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**НАУЧНО-ТЕХНИЧЕСКИЙ ЖУРНАЛ  
НАМАНГАНСКОГО ИНЖЕНЕРНО-  
ТЕХНОЛОГИЧЕСКОГО  
ИНСТИТУТА**



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Table 4.

**Monthly wage supplement (%) for employment with unfavourable working conditions**

Factors	Working conditions classes						
	1st class is acceptable	Class 2 is permitted	Class 3 is dangerous				Class 4 is dangerous
			3.1 1 <sup>st</sup> degree	3.2 2 <sup>nd</sup> degree	3.3 3 <sup>rd</sup> degree	3.4 4 <sup>th</sup> degree	
Additional payment to the monthly salary	0	0	5%	10%	15%	20%	25%

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**DEVELOPMENT OF A METHODOLOGY FOR THE ASSESSMENT OF THE PROFESSIONAL COMPETENCE OF RAILWAY PERSONNEL**

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**Abstract:**

**Objective.** *This article has a specific weight for the correct assessment of such qualities as strength, speed, agility, elasticity and working capacity, which are considered extremely necessary in assessing the professional compatibility of train builders, in which it is mandatory to use special clothing head and shoes, in order to assess the physical readiness of the attributes of their movement, is aimed at determining*

**Keywords:** train builders, professional compliance, custom clothing head, station, custom testing.

The work of train-makers consists mainly of manual labour, which is carried out in the course of work by performing the following physical actions:

- walking at a high pace in special clothing;
- walks in a special suit with a set of « башмаклар »;
- ascents and descents of carriages;
- moving standing on the thresholds of trains (trays);
- Moving of the stairs;
- standing on freight wagons and on shunting locomotives;
- crossing railway lines [1].

The types of traffic listed above are carried out under the influence of dust, harmful substances, noise, vibrations, climatic conditions of the station area, emitted from stationary equipment installed at another station. Therefore, in developing a method of assessing the professional suitability of train builders, it is necessary to take into account the qualities of movement, such as strength, speed, agility, flexibility and ability to work, as well as sanitary and hygienic indicators of their working conditions.

It is known that when a person performs various physical movements, the work performed by his basic locomotive system is the product of work generated by external and internal energy.

The special tests «Almomish» and «Barcinoy» [2], which determine the level of physical preparedness and health of the population [2], assess the physical preparedness of people aged 18-59, i.e. those who work in the railway profession. at the train station. However, in assessing the physical fitness of men of this age (18-59 years), the quality of the movements requiring them in the head of the special clothing of train designers at work is not defined. As a result, it is not possible to accurately assess the qualities of train designers, such as strength, speed, manoeuvrability, flexibility and operability, which are considered important in assessing their professional suitability. This is due to the fact that train builders work in special clothing, headgear and footwear with certain weight and mandatory use (Table 1). In addition, it is expedient to determine their movement qualities in the conditions of the railway station, not in the conditions of assessment of physical fitness, ie in the conditions of location of sports facilities. Most of the actions that train builders make during their work are related to walking.

Table 1.

**Special clothing for heads and shoes, which train builders should use**

Seasonal classification of special clothing headgear and footwear	Weight (kg)
Special clothes for spring and summer months	1,330
Weight of shoes with special head for spring-summer months	2,245
Special clothes for autumn-winter months	2,945
Weight of shoes with special head for autumn-winter months	3,860
Shoe weight	0,915

It is known that the energy consumption of the train designer when walking depends on the sole of the shoe, the weight of the head of special clothing, and the physical and mechanical properties of the surface of the moving section. A study has been carried out on the theoretical analysis of this relationship.

The friction between the foot and the base shall prevent the foot from sliding. Smooth surfaces and inappropriate shoes pose a risk of falling and injury. According to medical statistics, more than 60% of injuries are caused by falls [3]. The risk of falling increases with age: in 54% of people over 65 years of age, injuries associated with falling result in death [4]. Interestingly, according to official statistics, more people die in Sweden than in road accidents (31 per cent) (43 per cent of all deaths) [5].

When a person moves, the foot acts on the support surface with a certain force (fig. 1). This force can be divided into vertical  $F_{vert}$  and horizontal  $F_{hor}$  constituents [6].

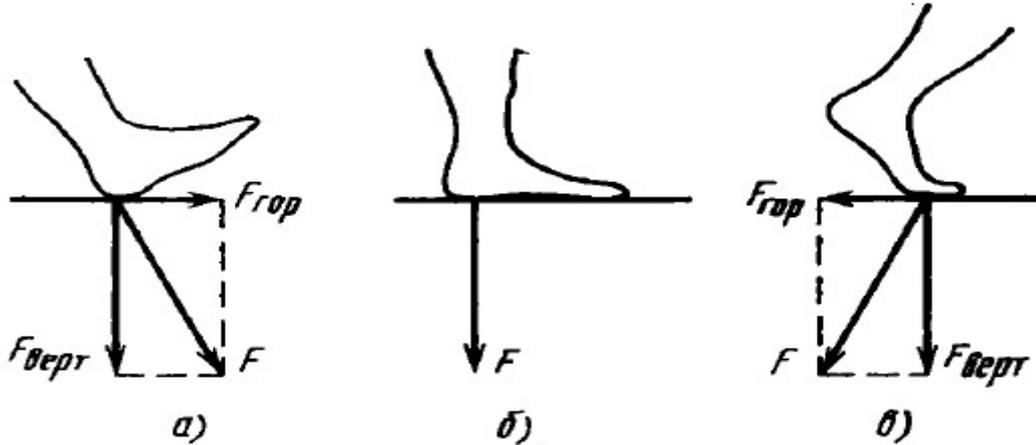


Figure 1. Interaction forces between foot and base

The level of safety (in terms of the possibility of slipping) can be assessed by the following expression:

$$A = (F_{hor}/F_{ver}) - f,$$

Here,  $f$  - coefficient of friction between the floor and the shoe;

If  $F_{hor}/F_{ver} > f$  major than, the risk of slipping is high. If  $F_{hor}/F_{ver} < f$  minor than, this risk is minimal.

Neither  $f$  nor  $F_{hor}/F_{ver}$  relation can be constant values during walking and running. The friction coefficient  $f$  can vary depending on the shape of the foot, for example, more or less «touching» the toes of the sole of the shoe or the ground. The ratio of  $F_{hor}/F_{ver}$  depends on the nature of the walk (its maximum values decrease when walking in small steps; people tend to walk on a smooth surface) and on the individual characteristics of people [6].

Пояфзал ва таянч орасидаги ишқаланиш коэффициенти  $f$  оддий юришда 0,3 [7] дан, тез юришда эса 0,4 дан кам бўлиши керак эмас. Бу айниқса, товон ва пояфзал таглиги орасидаги ишқаланиш учун тўғри келади.  $f < 0,3 \dots 0,4$  да сирпаниш хавфи пайдо бўлади. Каучук таглик билан кафел полининг ишқаланиш коэффициентлари бўйича танланган маълумотлар 1-жадвалда келтирилган.

The coefficient of friction  $f$  between the shoe and the base shall not be less than 0.3 [7] in normal walking and 0.4 in quick walking. Especially the friction between the heel and the sole of the shoe.

At  $f < 0,3 \dots 0,4$  there is a risk of slipping. The selected data on the coefficients of pulmonary floor friction on the rubber base.

As shown in table 2.

Table 1

**Information on the coefficients of pulverized floor friction with a rubber base under different conditions [6]**

The condition of the tile floor	Corner	Friction coefficient	Rating
Dry	33,8	0,65	There is no risk of slipping
Moistened with a layer of water	21,6	0,50	There is no risk of slipping here either
Grease is applied	9,0	0,16	The risk of slipping is high
The chopped horse is coated with oil	7,0	0,12	Here, too, the risk of slipping is great

In some cases, the quality of shoe friction is increased. This is mainly the case in some enterprises where there are always oil particles in the ceramic floor that disrupt the connection of the sole to the base (reducing the friction force), which causes the shoe to slide. The friction factor should be increased if the sole of the shoe used in such conditions is heavily greased. This can be achieved by a reasonable choice of materials for the soles of shoes, special soles with sutures, soles and corrugations of heels, as well as their structure [8]. Foot friction depends on the footwear and its wavy state, in particular on the direction of the reefs. It is recommended to use reef-oriented trays perpendicular to a single axle for walking on dry surfaces; to move on an oil surface (e.g., in a meat processing plant) You must use a footwear with a rhyme pattern at an angle of 60 ° to the sole axle. This form of corrugation ensures better oil compression in the corrugation groove, which in turn increases the friction coefficient.

Until about 1982, in work on all fall biomechanics, the frictional properties of shoes and insoles were based on the assumption that the horizontal velocity of the heel was zero when the foot was placed on the ground; the coefficient of static friction between the shoe and the lining should be used in assessing the risk of slipping.

Studies by Swedish authors have shown that neither one nor the other is true [9, 10, 11, 12].

Before placing the foot on the ground, the foot (relative to the body) moves backwards. If there were no such movement and the leg simply fell, it would have a horizontal speed, which would result in a constant change in speed and impact. Ideally, the speed of the foot moving backwards should be equal to the speed of the body moving forwards. Only in this case the speed of the foot is zero. These two body movements (forward and backward) may not always be perfectly coordinated by a human. Therefore, the speed at which the foot is placed is usually different from zero. It is often negative (E. It is directed in the opposite direction from the walk).

The authors [9] recorded the placing of the foot on the support with high precision, they found a negative speed of the foot in 80 attempts (this included only attempts in which the absolute value of the foot setting speed exceeded 0.05 m / s). Positive oscillations on the map of the dynamogram were detected in 82 cases. The coefficient of tetrachoric correlation between the frequency of these events was very high. You can see that the initial conditions for putting feet on the ground are not static.

Some authors of the experiments [9] suggested that volunteers should walk on slippery surfaces during experiments (using a corrosion-resistant steel corridor, which was covered with soap water unnoticed by volunteers). During the experiment 124 attempts were recorded. In 39 cases, there was a slip, including 16 attempts without a fall and 23 attempts ending in a fall. In

all cases where slip (including falls) was recorded, slippage of the heel was observed at an average of 50 ms with a vertical support force of approximately 60% body weight. However, the ground force was very low (Table 3).

Table 3

**Biomechanical properties of the interaction of the foot with the base in sliding during walking [6]**

Indicators	Sliding $\bar{x} \pm \sigma$	
	Without falling (n=16)	With the fall (n=39)
Time of onset of slip when the foot interacts with the base, ms	51±22	48±21
Maximum slip speed return time, ms	47±22	The recording is completed until the maximum speed in the slide is returned
Maximum sliding speed, ms	440±280	Higher than walking speed (1-2 ms)
Sliding spacing, mm	48±45	Registration is complete before the slide starts
Relation of horizontal force to vertical force: at the beginning of the slip	0,09±0,07	0,09±0,06
After 50 ms	0,13±0,05	0,09±0,06
After 100 ms	0,13±0,05	0,09±0,06

Based on the data provided, it is concluded that the use of more complex methods of modern tribology rather than static methods to assess the risk of slipping, i.e., the kinetic coefficient of friction depending on the displacement rate, force applied and time, The shape and area of the contact surface.

The authors [12] compared 27 different methods for determining the friction properties of shoes (out of more than 70 methods cited in the literature). According to the results obtained in different ways, the correlation coefficients were close to zero in most cases. It was therefore proposed to measure the coefficient of friction during direct walking. To do this, volunteers were invited to walk along a maximum slippery road in the shape of a triangle with a perimeter of 12 m. The coefficient of friction is determined by the following formula:

$$\text{Friction coefficient} = K/T^2,$$

depending on the road geometry here T - time and K - empirical coefficient. The coefficient of friction thus determined is highly correlated with the coefficient of friction calculated on the basis of the analysis of the dynamics of interaction with the base during walking ( $r = 0.99$ ). For the final decision, the horizontal component should be taken as the maximum ratio to the vertical support (the vertical component is greater than 20% of body weight).

Currently, there are no common methods for determining the frictional properties of shoes. These are only methods that are modeled as accurately as possible in a natural walking environment.

At present, due to the spread of artificial synthetic coatings in industrial buildings, attention is paid to their high friction properties, which are usually achieved by corrugating the surface rather than by specific properties of the material.

On the basis of analysis of theoretical studies carried out by the authors, it was found that the evaluation of the professional fitness of train-makers by physical indicators is repeated [2], implementation is necessary. The following tests are recommended to assess the professional fitness of train-makers:

time to walk at a high pace with special clothing over the head;

Time to walk in a special dress with a set of “башмаклар”;

Tests consisting of the time at which wagons are lifted and lowered on the stairs and a range of other activities related to work shall be included.

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