EVALUATION OF PROFESSIONAL SUITABILITY OF TRAIN DRIVERS BY PHYSICAL INDICATORS

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Annotation In this article, in order to correctly evaluate the qualities of strength, speed, agility, flexibility and work ability, which are considered very necessary in the assessment of the professional suitability of train drivers, they must use special clothing, headgear and shoes with a certain weight. aimed at determining the circumstances. In addition, in the assessment of Professional Compliance by physical indicators, it is considered necessary that the husband be carried out by testing train builders who wear special clothes and work shoes in the conditions of the railway station, and not according to the tests carried out with people. It is recommended to use the following tests when assessing the professional suitability of train drivers in terms of the quality of physical activity: time to walk at a high pace using a special clothing head; time to walk in a special outfit carrying a set of "shoes"; tests consisting of the time of going up and down from the car ladders and other complex of actions related to work should be included.

Keywords train builders, professional suitability, special clothing head, station, special test.

ОЦЕНКА ПРОФЕССИОНАЛЬНОЙ ПРИГОДНОСТИ МАШИНИСТОВ ПО ФИЗИЧЕСКИМ ПОКАЗАТЕЛЯМ

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Аннотация В данной статье для правильной оценки качеств силы, скорости, ловкости, гибкости и работоспособности, которые считаются очень необходимыми при оценке профессиональной пригодности машинистов поездов, они должны использовать специальную одежду, головные уборы и обувь с определенный вес. направлены на установление обстоятельств. Кроме того, при оценке Профессионального Соответствия по физическим показателям считается необходимым, чтобы муж проводился по испытаниям поездостроителей, носящих специальную одежду и спецобувь в условиях железнодорожного вокзала, а не по проведенным испытаниям. с людьми. При оценке профессиональной пригодности машинистов поездов по качеству двигательной активности рекомендуется использовать следующие тесты: время ходьбы в высоком темпе с использованием специальной одежды на голове; время ходить в специальном наряде с комплектом «обуви»; Должны быть включены испытания, состоящие из времени подъема и спуска с трапов вагона и других комплексов действий, связанных с работой.

Ключевые слова поездостроители, профпригодность, руководитель спецодежды, станция, специспытание.

Enter. The work of train builders mainly consists of physical work, which is carried out by performing the following physical actions in the course of work:

- walking at a high pace using special clothes;
- walking in special clothes carrying a set of "bashmaks";
- going up and down from wagon ladders;

- moving while standing on the thresholds of wagons (on the platform);
- moving on stairs;
- standing on freight wagons and shunting locomotive drums;
- crossing railway lines [1].

Conducting the research: The above-mentioned types of movement are carried out under the influence of dust, harmful substances, noise, vibrations, and indicators of climatic conditions in the station territory, which are emitted from stationary equipment installed in another station, wagons, shunting locomotives, trains passing by the station, shunting locomotives, loaded with various types of cargo or loaded with various types of cargo. Therefore, when developing a method of assessing the professional suitability of train operators, it is necessary to take into account the qualities of movement, such as strength, speed, agility, flexibility and work ability, which are important for the safety of their physical activity, as well as sanitary-hygienic indicators of their working conditions.

It is known that when a person performs various physical actions, the work performed by his basic movement apparatus is the sum of the work derived from external and internal energies.

Through special tests "Alpomish" and "Barchinoy" [2], which determine the level of physical fitness and health of the population, the physical fitness of people aged 18-59, that is, those who work as train builders at railway stations, is evaluated. However, when assessing the physical fitness of men of this age (18-59 years old), the qualities of movement that are required to be in the head of special clothing of train builders during work are not determined. Due to this, it does not provide an opportunity to correctly assess the qualities of strength, speed, agility, flexibility and work ability, which are considered very necessary in the assessment of the professional suitability of train builders. Because the train builders work in special clothes, headgear and shoes of a certain weight, which must be used (Table 1). In addition, it is appropriate to determine them not in the conditions of physical fitness assessment, that is, in the conditions of the location of sports facilities, but in the conditions of the railway station. Most of the activities of train builders during their work activities are related to walking.

Table 1

Special clothing head and shoe weights that train drivers must use

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

It is known that the energy consumption of the train builder during walking depends on the sole of the shoes, the weight of the head of special clothing, and the physical and mechanical properties of the surface of the moving area. A study was conducted on the theoretical analysis of this relationship.

The frictional force between the foot and the support should prevent the foot from slipping. Slippery surfaces and ill-fitting footwear pose a risk of falls and injuries. According to medical statistics, more than 60% of injuries occur due to falls [3]. The risk of falling increases with age: 54% of people over the age of 65 have fatal fall-related injuries [4]. It is interesting to note that according to official statistics, more people in Sweden die from falls (43% of all deaths) than from traffic accidents (31%) [5].

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

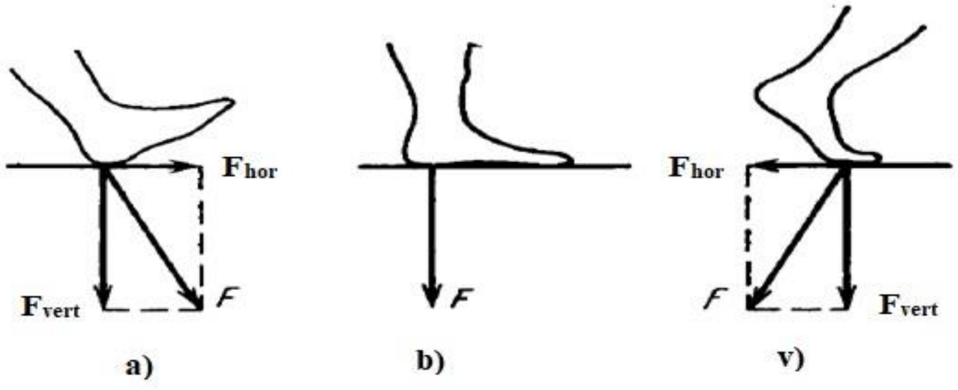

Figure 1. Interaction forces between the foot and the support

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

$$A = (F_{hor}/F_{vert}) - f\,, \quad (1)$$

Here, f - coefficient of friction between the floor and shoes.

If F_{hor}/F_{vert} f greater than , there is a greater risk of slipping. If F_{hor}/F_{vert} f is less than , this risk is minimal.

Neither when walking nor running f, neither F_{hor}/F_{vert} ratio cannot be constant values. Friction coefficient f can vary depending on the shape of the foot, say, by more or less "touch" of the toes on the sole of the shoe or on the ground. F_{hor}/F_{vert} the ratio depends on the nature of walking (its maximum values decrease when walking with small steps; this is how people try to walk on a smooth surface) and individual characteristics of people [6].

The coefficient of friction between the shoe and the support f it should not be less than 0.3 [7] in normal walking, and 0.4 in fast walking. This is especially true for the friction between the heel and the sole of the shoe. f <0,3 ... 0,4 there is a risk of slipping. Selected data on the coefficients of friction of a tile floor with a rubber base are presented in Table 2.

Table 2

Information on friction coefficients of tile floor with rubber underlay in different situations [6]

Condition of the tile floor	Angle	Friction coefficient	Evaluation
Dry	33,8	0,65	No risk of slipping
Wetted with a layer of water	21,6	0,50	There is no risk of slipping here either
Lubricated	9,0	0,16	The risk of slipping is high
Chopped horseradish is covered with fat	7,0	0,12	There is also a great risk of slipping here

In some cases, increased demands are placed on the frictional quality of shoes. This mainly applies to some enterprises, where there are always particles of oil on the ceramic floor, which destroys the connection of the sole with the support (the friction force decreases), as a result of which the shoes slip. The coefficient of friction should be increased in case of highly lubricated soles of shoes used in such conditions. This can be achieved with the help of a reasonable selection of materials and their structure for shoe soles, special absorbent soles, soles and heel corrugations [8]. The friction characteristics of the feet depend on the shoes and their corrugation, in particular, the direction of the ridges. For walking on a dry surface, it is advisable to use soles with the direction of the reef perpendicular to the single axis; for movement on an oily surface (for example, in the conditions of a meat processing plant), it is necessary to use shoes with a reef pattern at an angle of 60° to the axis of the sole. This form of corrugation ensures better compression of oil into the corrugation cavity, as a result of which the coefficient of friction increases.

Until about 1982, all work on the biomechanics of falls was based on the assumption that the horizontal velocity of the heel is zero when the foot lands on the ground; the coefficient of static friction between the shoe and the pavement should be used when assessing the risk of slipping.

Research by Swedish authors showed that neither one nor the other is true [9, 10, 11, 12].

Before the foot lands on the ground, the foot moves back (relative to the body). If there was no such motion and the leg simply descended, it would have horizontal velocity, resulting in a continuous change in velocity and impact. In an ideal position, the speed of the backward movement of the leg should be equal to the forward speed of the body. Only in this case, the landing speed of the leg will be zero. A person cannot always coordinate these two movements of the body (forward and backward) with ideal precision. Therefore, the rate of foot placement is usually different from zero. Most often it is negative (that is, it is directed in the direction opposite to the direction of walking).

Authors [9] registered foot landing with high accuracy, they found a negative foot landing speed in 80 trials (only trials with an absolute value of foot landing speed greater than 0.05 m/s were included). A positive sway on the dynamogram map was detected in 82 cases. The tetrachoric correlation coefficient between the frequencies of these events was very high. It can be seen that the initial conditions for placing the foot on the ground are not static.

Some of the authors of the experiment [9] asked the volunteers to walk on a slippery surface during the experiments (using a corridor made of corrosion-resistant steel, this corridor was covered with soapy water without informing the volunteers). During the experiment, 124 attempts were registered. Slips were observed in 39 cases, including 16 attempts without a fall and 23 attempts resulting in a fall. In all cases where slips were recorded (including falls), heel slips occurred after an average of 50 ms, when the vertical support force was approximately 60% of body weight. At the same time, the ground adhesion strength was very low (Table 3).

Table 3

Biomechanical characteristics of the interaction of the foot with the support during sliding during walking [6]

Indicators	Slip x ±σ	
	Without falling (n=16)	**With a fall (n=39)**
The time of the beginning of sliding when the foot is in contact with the support, ms	51±22	48±21
The time when the maximum speed in sliding is returned, ms	47±22	The registration is terminated until the maximum speed in the glide is returned
Maximum speed in sliding, ms	440±280	Above walking speed (1-2ms)
Sliding distance, mm	48±45	Registration is closed before the slide begins
Relation of horizontal force to vertical force: at the onset of sliding After 50 ms After 100 ms	 0,09±0,07 0,13±0,05 0,13±0,05	 0,09±0,06 0,09±0,06 0,09±0,06

Based on the presented data, it is concluded that not static, but more complex methods of modern tribology should be used to assess the risk of sliding, that is, the kinetic coefficient of friction, which depends on the sliding speed, the applied force and the time it is applied, the shape and area of the contact surface.

The authors [12] compared 27 different methods of determining the friction properties of shoes (out of more than 70 methods presented in the literature). Correlation coefficients obtained in various ways were found to be close to zero in most cases. Therefore, it was proposed to measure the friction coefficient directly during walking. For this purpose, volunteers were asked to walk along a maximum slippery track in the shape of a triangle with a perimeter of 12 m. The coefficient of friction is determined by the following formula:

$$Friction\ coefficient = K/T^2, \quad (2)$$

where T is time and K is an empirical coefficient, depending on the road geometry. The coefficient of friction determined in this way is highly correlated with the coefficient of friction calculated based on the analysis of the dynamics of interaction with the support during walking (*r* = 0,99). For the final decision, it should be taken as the highest ratio of the horizontal component to the vertical support (the vertical component is more than 20% of the body weight).

Research results: Currently, there are no generally accepted methods for determining the friction characteristics of shoes. These include only methods that are modeled as accurately as possible under natural walking conditions.

Currently, due to the increase in the number of man-made synthetic coatings in industrial buildings, attention is paid to the fact that their high friction properties are usually achieved by surface corrugation, rather than the inherent properties of the material itself.

Summary: Based on the analysis of the theoretical studies conducted by the authors, it was found that the evaluation of the professional suitability of train drivers according to physical indicators was returned above [2] not according to the tests conducted with men aged 18-59 years, but by conducting test tests of train drivers wearing special clothes and work shoes in the conditions of the railway station. implementation is necessary. It is recommended to use the following tests when assessing the professional suitability of train drivers in terms of the quality of physical activity:

time to walk at a high pace using a special clothing head;

time to walk in a special outfit carrying a set of "shoes";

tests consisting of the time of going up and down from the car ladders and other complex of actions related to work should be included.

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