

KEY OCCUPATIONAL HAZARDS ASSOCIATED WITH THE WATER FILLING OF PASSENGER RAIL CARS

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Outfitter is one of the most important specializations among the many professions in the railway industry. Among other duties, outfitters fill the water supply systems of passenger cars, a process associated with exposure to the combined effects of a complex of hazardous industrial factors, such as heavy physical labor, an adverse microclimate, high noise levels, low lighting, and bacterial contamination of the skin of the hands and overalls. This study aimed to investigate the specifics of the working conditions of outfitters and the morbidity with temporary disability among them in order to develop preventive measures. We used the "snapshot of the working day" method, measured harmful physical factors and bacterial load. By the severity of labor, the work of the outfitters was established to belong to class 3.2 (R 2.2.2006-05). During nighttime hours, the intensity of artificial lighting in outdoor areas and on station tracks ranged from 6 to 8 lux, whereas the normative value was ≥ 10 lux; this corresponded to class 3.1. The equivalent sound level at the outfitters' workplaces was 88 dBA, which is 8 dBA higher than the maximum permissible level, which corresponded to class 3.2. By the biological factor, the working conditions belonged to class 3.2, and by the hygienic indicators — to class 3.3. Analysis of three-year average morbidity with temporary disability data indicates that specific occupational hazards increase morbidity: disability rates among outfitters were significantly higher than in the railway transport industry overall (by 27.8% in cases and 29.0% in disability days). The study enabled the development of a number of preventive measures.

Keywords: outfitters filling water tanks in passenger cars, working conditions, microclimate, noise, lighting conditions, bacterial contamination, morbidity with temporary disability, preventive recommendations

Author contribution: Kaptsov VA — study conceptualization, methodology, approval of the final version of the article; Ovechkina ZhV — data collection and processing, article authoring; Korolik W — literature review, selection and analysis of studies, analysis of the regulatory and procedural guidelines; Kozyreva FU — data analysis, article editing; Tikhonova YuL — statistical data processing, text editing; all authors — approval of the final version of the article, responsibility for the integrity of all sections of the article.

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Received: 22.03.2026 **Accepted:** 06.08.2026 **Published online:** 06.09.2026

DOI: 10.24075/rbh.2026.170

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ВЕДУЩИЕ ПРОИЗВОДСТВЕННЫЕ ФАКТОРЫ ПРИ ЗАПРАВКЕ ПАССАЖИРСКИХ ВАГОНОВ ВОДОЙ

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Среди многочисленных профессий железнодорожной отрасли важное место занимают экипировщики, заправляющие водой систему водоснабжения пассажирских вагонов, которые подвергаются сочетанному воздействию комплекса вредных производственных факторов, таких как тяжелый физический труд, неблагоприятный микроклимат, высокий уровень шума, низкая освещенность, бактериальная обсемененность кожных покровов рук и спецодежды. Целью исследования было изучить специфику условий труда экипировщиков и заболеваемость с временной утратой трудоспособности (ЗВУТ) для разработки профилактических мероприятий. В ходе исследования использовали метод «фотография рабочего дня», измерение вредных физических факторов, бактериологические методы. Установлено, что условия труда экипировщиков по показателю «тяжесть трудового процесса» относились к классу 3.2 (Р 2.2.2006-05). На открытых территориях и станционных путях в темное время суток уровень искусственной освещенности находился в пределах 6–8 лк при норме не менее 10 лк, что соответствовало классу 3.1. Эквивалентный уровень звука на рабочих местах экипировщиков составлял 88 дБА, что на 8 дБА выше предельно-допустимого уровня, и относился к классу 3.2. Оценка условий труда по биологическому фактору соответствовала классу 3.2, а общая оценка условий труда — классу 3.3. Воздействие вредных факторов труда может приводить к росту заболеваемости, что подтверждают результаты анализа среднегодовых показателей ЗВУТ экипировщиков за трехлетний период, которые значительно превышают общеотраслевые показатели для работающих на железнодорожном транспорте (по случаям на 27,8%, по дням нетрудоспособности на 29,0%). Выполненные исследования позволили разработать ряд профилактических мероприятий.

Ключевые слова: экипировщики по заправке пассажирских вагонов водой, условия труда, микроклимат, шум, освещенность, бактериальная обсемененность, заболеваемость с временной утратой трудоспособности, ЗВУТ, профилактические рекомендации

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Статья получена: 22.03.2026 **Статья принята к печати:** 06.08.2026 **Опубликована онлайн:** 06.09.2026

DOI: 10.24075/rbh.2026.170

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There is no doubt that railroad transport is one of the key drivers of the industrial and economic development of the Russian Federation. This mode of transportation connects regions of the country and promotes trade, production, and tourism. One of the key advantages of railroad transport is its capability to carry large volumes of cargo over long distances. Train tracks and cars are extremely durable, which makes railroads ideal for transportation of heavy and bulky items, including coal, ore, oil, and construction materials. Railroads interconnect industrial facilities located in different regions of the country. The extensive network of tracks allows bringing cargo to the farthest corners of the nation. It underpins the development of industrial clusters and enables creation of jobs, which, in turn, stimulates economic growth and improves the quality of life of the population. Railroads also play an important role in the tourist industry, comfortably and conveniently moving people between cities and sights. Trains allow tourists to quickly and easily reach popular resorts and cultural landmarks, which eventually translates into profits for the state. In addition, railroad transport is a more environmentally friendly mode of cargo moving than motorways: locomotive engines run on electricity, and hence emit no harmful substances into the atmosphere, thus contributing to the improvement of the environmental conditions and health of the population [1–4].

Labor conditions on the railroad are specific and heavy: there is a considerable number of occupational hazards the workers are exposed to [5–14], including round-the-clock operation, moving trains, insufficiency of mechanical aides and automated routines, poor lighting in the working areas, loud noise, shock hazard, psychoemotional stress.

The aforementioned factors underpin the urgency of investigation of the conditions of labor of outfitters who fill long-distance cars with drinking water, as the ceaseless movement of trains, passenger safety and comfort largely depend on their work.

Drinking water plays a key role in human life; in the context of traveling by railroad, it is used for both subsistence and sanitary purposes [15–17]. In the passenger car replenishment systems installed at stations, violations of the rules of storage and use of filling hoses and contamination of tanks and piping can result in the pollution of the supplied water. The problem becomes especially urgent in summer, when high temperatures promote growth of the colonies of microorganisms.

Outfitters work outdoors in adverse conditions: poor lighting at night, high noise levels, and a heavy bacterial load. Their work is physically demanding, involving the manual handling of filling hoses and many other strength-intensive tasks.

Among the numerous jobs in the railroad industry, that of outfitters filling passenger cars with water remains largely unstudied by scholars. A comprehensive analysis of the specifics of work of the considered professional category and its overall operational importance necessitated field studies aimed at investigation of occupational hazards and factors.

This study aimed to investigate the specifics of the working conditions of outfitters and the incidence of temporary disability among them in order to develop preventive measures.

METHODS

We studied the working conditions of outfitters filling passenger cars with water (hereinafter referred to as outfitters) from 2021 to 2025 at several service stations: Moscow-3, Belorusskaya, and Studencheskaya (all belong to the Moscow Railway).

The work included a systematic analysis of scientific literature, compilation of a hygienic report, registration of labor hours, and measurement of physical factors. To record the levels of noise and assess its effect on the hearing of outfitters, we used an Octava-111 noise meter (Oktava–ElectronDesign; Russia). The equivalent sound level was calculated according to GOST ISO 9612–2016 [18]. The intensity of artificial illumination was measured using a Testo-540 luxmeter (Testo SE & Co KGaA; Germany) according to GOST 24940–2016 "Buildings and structures. Methods of measuring illumination" [19]. To assess bacterial contamination of palmar skin and work clothing, we collected palm prints and swabbed overalls according to the methodological guidelines [20]. Morbidity with temporary disability was assessed at the individual level, using ICD-10 for classification. For each outfitter, we completed an individual data card. Workers included in the study were required to have at least one year of employment with the company. Morbidity with temporary disability was assessed at the Moscow railway node. Ultimately, we processed the morbidity with temporary disability data of 229 outfitters filling passenger cars with water, who had at least one year of employment, for three years.

Statistical processing of the collected information was performed using the SPSS Statistics 27 package (IBM; USA). We calculated M , the arithmetic mean, m , the standard error of the mean, and P , the confidence interval.

RESULTS

For outfitters filling passenger cars with water, a day is divided into two 12-hour shifts. Their duties include supplying water to cars from water standpipes at service and intermediary stations where the consists are compiled and processed.

As a rule, passengers cars are filled with water when being formed into a consist or otherwise processed on servicing tracks, which feature cold and hot water piping outlets. At intermediary stations, water is generally refilled on general purpose tracks equipped with standpipes.

The outfitter's job involves supplying water from a standpipe to the car's water tank via a hose.

The outfitter plugs one end of the hose into a special inlet in the car, connects the other end to the pump, and opens the valve of the pump to allow water to enter the tank of the car. When the tank is full, the outfitter closes the pump valve and disconnects the hose from the pump and the car.

At some stations, each standpipe has its own hose, which allows the outfitter to skip connecting the hose to the source of water. The opposite end of the hose (the one for the car) is fixed in a special clamp on top of the standpipe. This is a proper arrangement from the hygienic point of view, as it prevents the penetration of various pollutants into the water. In most cases, however, the number of connecting hoses is insufficient, and outfitters have to drag them over considerable distances between standpipes. Dragged across the surface, the hose gets contaminated. The average weight of the hose is about 20 kg; dirt and ice can make it 30–40 kg. Therefore, carrying or dragging a hose is a physically demanding task.

Chronometry (cold weather period) yielded the following results: filling cars with water is the main activity of outfitters that takes up 48.4% of their working time on average; they spend 6.4–8.2% of the working time (mean 7.2%) on hose movement; and 26.7% of the working time they stand by.

The average time spent on a lunch break is 35 minutes. There is no designated period of the shift for this break, the outfitters make it when standing by.

Table 1. Occupational factors outfitters are exposed to when filling passenger cars with water

Occupational factor	Standard MPC, MAL	Actual value	Working conditions class (Guidelines R 2.2.2006-05 [21])
Noise (equivalent sound level), dBA	80	88 ± 0.8	3.2
Lighting (outdoor work at night), lx	10	7 ± 0.1	3.1
Microclimate (outdoor work): – cold season – warm season	Depend on the climatic zone		2–3.4 2–3.1
Physical intensity of labor			
– physical dynamic load per shift, kgm when moving cargo over a distance of more than 5 m (for males)	up to 46 000	48 000 ± 3.87	3.1
– static load, kgf (the amount of static load per shift when holding the load, applying effort), involving muscles of the body and legs (for males)	up to 100 000	115 000 ± 4.35	3.1
– working position (uncomfortable), % of shift time	up to 25	26 ± 0.4	3.1
– body tilts, number per shift	up to 100	120 ± 0.84	3.1
– horizontal movement (per shift), km	up to 8	10 ± 0.08	3.1
Overall assessment of the "physical intensity of labor" indicator			3.2
Biological factor	lacking	present	3.2

During the filling of passenger cars with water, outfitters are exposed to adverse occupational factors, including significant physical exertion, an unfavorable outdoor microclimate, increased noise from train traffic, and insufficient artificial lighting at night.

Since outfitters risk bacterial contamination when filling cars with water, we took prints and swabs of their palmar skin and overalls seeking to detect *E. coli* group bacteria.

Table 1 presents the occupational factors the outfitters are exposed to when filling passenger cars with water.

With all the occupational hazards factored in, the working conditions of outfitters filling passenger cars with water belongs to class 3.3 (R 2.2.2006-05) [21].

Adverse working conditions for outfitters filling passenger cars with water may contribute to the development of various diseases. The analysis of their health status is based on the frequency of cases of temporary disability.

Age-wise, this professional group has an even composition (workers under 25 years old — 18.2%, 26–30 years old — 20.3%, 31–40 years old — 20.3%, 41–50 years old — 27.3%, over 50 years old — 13.9%), except for the subgroup of 41–50 year-olds, which was slightly more numerous and made up about one third compared to other age groups.

As for the length of service, the distribution was as follows: from 1 to 5 years — 32.8%, from 6 to 10 years — 20.7%, from 11 to 20 years — 33.6%, from 20 to 30 years — 12.1%, over 30 years — 0.8%. Thus, most of the outfitters filling passenger cars with water have been doing this job for 1–5 years or 11–20 years.

Tables 2 and 3 show the mean annual morbidity with temporary disability among the outfitters filling passenger cars with water for three years.

As shown in Table 2, respiratory tract diseases account for the largest proportion of all cases (49.5%). Skin and subcutaneous tissue diseases rank second (14.9%), followed by injuries and poisoning — the third most common cause of temporary disability (10.8%) — and diseases of the circulatory system (9.8%).

Diseases of the respiratory system account for the largest share of disability days (34.2% of the total), followed by injuries and poisoning (24.7%). Diseases of the skin and subcutaneous tissue rank third (14.9%), followed by the diseases of the circulatory system (10.4%).

The analysis of the data from Table 3, which shows mean annual morbidity with temporary disability figures per 100 outfitters, revealed a direct relation to the distribution of the causing diseases shown in Table 2, with the diseases of the respiratory system (62.0) ranking first, followed by injuries and poisoning (13.5), diseases of the circulatory system (12.2), mental disorders (3.9), diseases of the nervous system (3.5), and diseases of the digestive system (3.1).

By the number of disability days caused, the first place belongs to the diseases of the respiratory tract (482.1 days), second — to injuries and poisonings (348.0 days), third — to the diseases of the musculoskeletal system (210.9 days), and fourth — to the circulatory system diseases (146.7 days). The longest temporary disability leaves were registered for the diseases of the following classes: injuries and poisonings — 25.7 days, diseases of the urogenital system — 19.0 days, diseases of the digestive system — 16.0 days.

A three-year analysis of the causes of morbidity with temporary disability among workers who fill passenger cars with water showed that, in this group, rates were higher than in the industry overall: the number of cases was 27.8% higher (125.2 vs. 90.4 per 100 employees), and the number of disability days was 29.0% higher (1409.4 vs. 1000.6 per 100 employees).

DISCUSSION

Railroad car outfitters are an important professional group within the railway industry that ensures the comfort and safety of passengers.

Their labor is considered intense, belonging to class 3.2 (R 2.2.2006-05).

High physical loads are combined with an adverse microclimate, poor lighting, and high noise levels. Researchers

Table 2. Fraction of mean annual values in the structure of morbidity with temporary disability among outfitters filling passenger cars with water (3-year period)

Classes of diseases	Cases of disability		Disability days	
	in %	Rank	in %	Rank
Diseases of the endocrine system	1.0	IX	1.3	IX
Mental disorders	3.1	VI	2.7	VIII
Nervous system diseases	2.8	VII	2.9	VII
Diseases of the circulatory system	9.8	IV	10.4	IV
Respiratory diseases	49.5	I	34.2	I
Diseases of the digestive system	2.4	VIII	3.5	VI
Diseases of the genitourinary system	0.8	X	1.2	X
Diseases of the skin and subcutaneous tissue	14.9	II	14.9	III
Diseases of the musculoskeletal system and connective tissue	4.9	V	4.2	V
Injury, poisoning and certain other consequences of external causes	10.8	III	24.7	II
Total	100.0	–	100.0	–

have previously established that these factors indeed affect the work of core categories of the railway industry workforce [22, 23].

Exposure to biological hazards in the working environment of outfitters may impair immune function and, under certain conditions, increase the risk of intestinal infections [24, 25].

These hazards allow attributing the working conditions of outfitters filling wagons with water to class 3.2 (R 2.2.2006-05), since there is a risk of infection by contact with *E. coli*-infested car equipment and soil surface.

With all the occupational hazards factored in, the working conditions of outfitters belong to class 3.3 (R 2.2.2006-05).

Harmful working conditions can induce changes in the cardiovascular and nervous systems and in the musculoskeletal system, and may lead to serious diseases, including occupational disorders, as confirmed by numerous authors [26–34]. Our own findings support this: the average annual rates of temporary disability among outfitters filling railway cars with water are significantly higher than the industry-wide rates for railway transport employees (by 27.8% in terms of cases and by 29.0% in terms of disability days), mainly due to respiratory diseases, which account for the largest proportion of all cases (49.5%), followed by diseases of the skin

and subcutaneous tissue (14.9%), injuries (10.8%), diseases of the circulatory system (9.8%), and diseases of the musculoskeletal system and connective tissue (4.9%).

CONCLUSIONS

This study is the first to comprehensively evaluate the work of the outfitters filling passenger cars with water. We found that most occupational hazards in this line of work are difficult to eliminate with current technical means and changes of the organization of labor. The work itself was found to be associated with physical exertion, unfavorable microclimate, poor lighting conditions, loud noise, and bacterial contamination of the palmar skin and overalls.

A comprehensive evaluation of working conditions for outfitters filling cars with water, which considered all harmful occupational factors, resulted in classifying this occupation as heavy work with an environmental hazard level corresponding to class 3.3 (R 2.2.2006-05).

We observed markedly elevated morbidity leading to temporary disability among railway transport workers, exceeding industry-wide rates by 27.8% in number of cases and by 29.0% in disability days.

Table 3. Mean annual morbidity with temporary disability among outfitters filling passenger cars with water for three years (per 100 individuals)

Classes of diseases	Cases of disability	Disability days	Single case duration, days
Diseases of the endocrine system	1.3	17.0	13.0
Mental disorders	3.9	37.9	9.6
Nervous system diseases	3.5	41.5	11.8
Diseases of the circulatory system	12.2	146.7	12.0
Respiratory diseases	62.0	482.1	7.7
Diseases of the digestive system	3.1	48.9	16.0
Diseases of the genitourinary system	0.8	16.6	19.0
Diseases of the skin and subcutaneous tissue	6.1	59.8	9.7
Diseases of the musculoskeletal system and connective tissue	18.8	210.9	11.2
Injury, poisoning and certain other consequences of external causes	13.5	348.0	25.7
Total	125.2	1409.4	13.6
industry-wide indicators on railway transport (three years)	90.4	1000.6	11.1

Based on a study of railway carriage outfitters' work, preventive measures were developed to improve working conditions, protect health, prevent diseases and injuries, support

professional longevity, and enhance medical and preventive care through organizational, technical, and sanitary-hygienic interventions.

References

- Shchipacheva ES, Baranov DN. Perspektivy razvitiya zheleznodorozhnogo transporta. *Matritsa nauchnykh znaniy*. 2021; (10): 39 (in Rus.).
- Ksenofontova TYu, Mardas AN, Gulyaeva OA. Povyshenie gruzo- i passazhirooborota zheleznodorozhnogo transporta, v tom chisle posredstvom subsidirovaniya proektov kompleksnogo razvitiya territorij. *Byulleten' rezul'tatov nauchnykh issledovaniy*. 2020; (1): 85–94 (in Rus.). DOI: 10.20295/2223-9987-2020-1-85-94.
- Kutsevol NA, Sokolova VS. Zheleznodorozhnyy transport s tochki zreniya ekologii v sravnenii s drugimi vidami transporta. *E-Scio*. 2020; 9 (48) (in Rus.). Available from: <https://cyberleninka.ru/article/n/zheleznodorozhnyy-transport-s-tochki-zreniya-ekologii-v-sravnenii-s-drugimi-vidami-transporta>.
- Petrovskij AI. Faktory vliyaniya zheleznodorozhnogo transporta na razvitie regional'noj ekonomiki, vkluchaya tochnost' otsenki stoimosti stroitel'stva zheleznodorozhnoj infrastruktury. *Otkhody i resursy*. 2023; 10 (2) (in Rus.). DOI: 10.15862/09FAOR223. Available from: <https://resources.today/PDF/09FAOR223.pdf>.
- Spirin VF, Eliseeva YuV, Pichugina NN. Trud na zheleznodorozhnom transporte: riski dlya vzroslykh rabotnikov i podrostkov. *Medsina truda i ekologiya cheloveka*. 2022; (1): 133–43 (in Rus.). DOI: 10.24411/2411-3794-2022-10109.
- Samarskaya NA. Issledovanie osobennostej uslovij truda rabotnikov na zheleznodorozhnom transporte s tsel'yu razrabotki rekomendatsij po obespecheniyu bezopasnosti tekhnologicheskikh protsessov pri osushchestvlenii gruzopassazhirskikh perevozok. *Okhrana i ekonomika truda*. 2018; 3 (32): 48–57 (in Rus.).
- Kuzmin SV, Samodurova NYu. Gigienicheskaya otsenka uslovij i rezhima truda rabotnikov zheleznodorozhnogo transporta. *Gigiena i sanitariya*. 2024; 103 (6): 541–7 (in Rus.).
- Shevchenko DA, Ilyaskina KS. Vrednye faktory na proizvodstve OAO RZHD. *Nauchnyy Lider*. 2024; 44 (194) (in Rus.). Available from: <https://scilead.ru/article/7259-vrednie-faktori-na-proizvodstve-oao-rzhd>.
- Pichkaleva SYu. Usloviya truda i obespechenie bezopasnosti rabotnikov zheleznodorozhnogo transporta. *Nauchnoe obrazovanie*. 2022; (2): 126–7 (in Rus.).
- Loginova VA, Kaskov YuN, Zhidkova EA, Gurevich KG, Smertina YuL, Pletnikova OA. Regulirovanie professional'no-assotsiirovannykh proizvodstvennykh vozdeystvij na rabotnikov zheleznodorozhnogo transporta: opyt Rossii i drugikh stran. *Analiz riska zdorov'yu*. 2021; (1): 173–85 (in Rus.). DOI: 10.21668/health.risk/2021.1.18.
- Holzinger B, Mayer L, Klösch G. Night today, day tomorrow: how irregular work shifts interfere with our psychological health. *Chronobiol Int*. 2021; 38 (11): 1611–7. DOI: 10.1080/07420528.2021.1937199.
- Ivashchenko GI, Gumbatov VG. Prichiny vozniknoveniya khronicheskikh zabolevanij u rabotnikov zheleznodorozhnogo transporta. *Innovatsii. Nauka. Obrazovanie*. 2021; (48): 1560–6 (in Rus.).
- Karpova OA, Filimonov SN, Kolyado VB, Semenikhin VA, Balandovich BA. Zabolevaniya kozhi i podkozhnoj kletchatki u rabotnikov zheleznodorozhnogo transporta: gigienicheskie aspekty. *Medsina truda i promyshlennaya ekologiya*. 2020; (6): 387–91 (in Rus.). DOI: 10.31089/1026-9428-2020-60-6-387-391.
- Landsbergis P, Johanning E, Stillo M, Jain R, Davis M. Occupational risk factors for musculoskeletal disorders among railroad maintenance-of-way workers. *Am J Ind Med*. 2020; 63 (5): 402–16. DOI: 10.1002/ajim.23099.
- Osetrina DA, Saveleva YuK, Volskij VV. Znachenie vody v zhizni cheloveka. *Molodoy ucheniy*. 2019; 16 (254): 51–3 (in Rus.).
- Kutimskaya MA, Buzunova MYu. Rol' vody v osnovnykh strukturakh zhivogo organizma. *Uspekhi sovremennogo estestvoznaniya*. 2010; (10): 43–5 (in Rus.).
- Shishelova TI, Tolstoj MYu. Sovremennoe sostoyanie nauki o vode. *Problemy i perspektivy. Nauchnoe obozrenie. Referativnyy zhurnal*. 2016; (4): 61–80 (in Rus.).
- GOST ISO 9612–2016 "Akustika. Izmereniya shuma dlya otsenki ego vozdeystviya na cheloveka. Metod izmerenij na rabochikh mestakh".
- GOST 24940–2016 "Zdaniya i sooruzheniya. Metody izmereniya osveshchennosti".
- MUK 4.2.2942-11 "Metody sanitarno-bakteriologicheskikh issledovaniy ob"ektov okruzhayushchej sredy, vozdukh i kontrolya steril'nosti v lechebnykh organizatsiyakh".
- R 2.2.2006–05 "Rukovodstvo po gigienicheskoy otsenke faktorov rabochej sredy i trudovogo protsessa. Kriterii i klassifikatsiya uslovij truda". Utv. Glavnym gosudarstvennym sanitarnym vrachom Rossijskoj Federatsii 29.07.2005.
- Sudejkina NA. Gigienicheskaya otsenka uslovij truda i sostoyanie zdorov'ya rabotnikov vagonoremontnogo proizvodstva [dissertatsiya]. Irkutsk, 2018 (in Rus.).
- Kosyakin VS. Sovershenstvovanie sistemy obespecheniya bezopasnykh uslovij truda rabotnikov vagonnogo khozyajstva [dissertatsiya]. M., 2020 (in Rus.).
- Khamanov IG, Shchetinin AN. Problemy otsenki riska vozdeystviya "biologicheskogo faktora" na rabotnikov OAO "RZHD". V sbornike: *Tekhnicheskije nauki — ot teorii k ppaktike: materialy XXX mezhdunarodnoj nauchno-prakticheskoy konferentsii*. Novosibirsk: SibAK, 2014; 142–150 (in Rus.).
- Prokopenko LV, Lagutina AV. Otsenka biologicheskogo faktora na rabochikh mestakh: voprosy i predlozheniya. *Medsina truda i promyshlennaya ekologiya*. 2018; (12): 29–34 (in Rus.). DOI: 10.31089/1026-9428-2018-12-29-34.
- Ivanov SA, Nevzorova EV, Gulina AV. Kolichestvennaya otsenka funktsional'nykh vozmozhnostej serdechno-sosudistoj sistemy. *Vestnik Tambovskogo universiteta. Seriya: Estestvennye i tekhnicheskie nauki*. 2017; 22 (6-2): 1535–40 (in Rus.). DOI: 10.20310/1810-0198-2017-22-6-1535-1540.
- Gutor EM, Zhidkova EA, Gurevich KG. Faktory riska razvitiya zabolevanij u rabotnikov lokomotivnykh brigad. *Medsina truda i promyshlennaya ekologiya*. 2022; 61 (1): 43–52 (in Rus.). DOI: 10.31089/1026-9428-2022-62-1-43-52.
- Pavlov IM, Sarsenov AE, Utarova ZA. Analiz vliyaniya vrednykh i opasnykh proizvodstvennykh faktorov na zdorov'e rabotnikov zheleznodorozhnogo transporta. *Nauka i obrazovanie*. 2022; (2-2): 214–22 (in Rus.). DOI: 10.56339/2305-9397-2022-2-2-214-222.
- Klepikov OV, Borejko AN, Kurenkova GV. Otsenka professional'nogo riska zdorov'yu rabotayushchikh na predpriyatii po remontu zheleznodorozhnykh vagonov. *Sanitarnyy vrach*. 2020; (3): 1–3 (in Rus.). DOI: 10.33920/med-08-2003-01.
- Kuzmin SV, Samodurova NYu. Otsenka zabolevaemosti s vremennoj utratoy trudospособnosti i ee veroyatnykh prichin u rabotnikov zheleznodorozhnogo transporta. *Zdorov'e naseleniya i sreda obitaniya — ZNiSO*. 2026; 34 (3): 30–9 (in Rus.). DOI: 10.35627/10.35627/2219-5238/2026-34-3-30-39.
- Abdulaev MA, Kim IA, Zadornaya OL. Otsenka dinamiki zabolevaemosti s vremennoj utratoy trudospособnosti (ZVUT) u rabotnikov Rossijskoj zheleznoj dorogi za 2015–2018 gg. *Golovnaya bol' i sheya. Rossijskoe izdanie*. 2020; 8 (S2): 97–8 (in Rus.).
- Vilk MF, Kaskov YuN, Kaptsov VA, Pankova VB. Dinamika proizvodstvennogo riska i pokazatelej professional'noj

- zabolevaemosti rabotnikov zheleznodorozhnogo transporta. Meditsina truda i ekologiya cheloveka. 2020; 1 (21): 49–59 (in Rus.).
33. Vilk MF, Tulushev VN, Kaptsov VA, Pankova VB, Latynin EO. Fiziologo-gigienicheskie osobennosti proizvodstvennoj nagruzki rabotnikov zheleznodorozhnogo transporta pri sovremennykh formakh vozhdneniya. Gigiena i sanitariya. 2024; 103 (7): 657–62 (in Rus.). DOI: 10.47470/0016-9900-2024-103-7-657-662.
34. Loginova VA, Kaskov YuN, Onishchenko GG, Klimova AA. Prioritnyye nozologii pervichnoj zabolevaemosti rabotnikov zheleznodorozhnogo transporta i chlenov ikh semej. Gigiena i sanitariya. 2022; 101 (3): 303–10 (in Rus.). DOI: 10.47470/0016-9900-2022-101-3-303-310.

Литература

- Щипачева Е. С., Баранов Д. Н. Перспективы развития железнодорожного транспорта. Матрица научных знаний. 2021; (10): 39.
- Ксенофонтова Т. Ю., Мардас А. Н., Гуляева О. А. Повышение грузо- и пассажирооборота железнодорожного транспорта, в том числе посредством субсидирования проектов комплексного развития территорий. Бюллетень результатов научных исследований. 2020; (1): 85–94. DOI:10.20295/2223-9987-2020-1-85-94.
- Куцевол Н. А., Соколова В. С. Железнодорожный транспорт с точки зрения экологии в сравнении с другими видами транспорта. E-Scio. 2020; 9 (48). URL: <https://cyberleninka.ru/article/n/zheleznodorozhnyy-transport-s-tochki-zreniya-ekologii-v-sravnenii-s-drugimi-vidami-transporta>.
- Петровский А. И. Факторы влияния железнодорожного транспорта на развитие региональной экономики, включая точность оценки стоимости строительства железнодорожной инфраструктуры. Отходы и ресурсы. 2023; 10 (2). DOI: 10.15862/09FAOR223. URL: <https://resources.today/PDF/09FAOR223.pdf>.
- Спирин В. Ф., Елисеева Ю. В., Пичугина Н. Н. Труд на железнодорожном транспорте: риски для взрослых работников и подростков. Медицина труда и экология человека. 2022; (1): 133–43. DOI: 10.24411/2411-3794-2022-10109.
- Самарская Н. А. Исследование особенностей условий труда работников на железнодорожном транспорте с целью разработки рекомендаций по обеспечению безопасности технологических процессов при осуществлении грузопассажирских перевозок. Охрана и экономика труда. 2018; 3 (32): 48–57.
- Кузьмин С. В., Самодурова Н. Ю. Гигиеническая оценка условий и режима труда работников железнодорожного транспорта. Гигиена и санитария. 2024; 103 (6): 541–7.
- Шевченко Д. А., Иляскина К. С. Вредные факторы на производстве ОАО РЖД. Научный Лидер. 2024; 44 (194). URL: <https://scilead.ru/article/7259-vrednie-faktori-na-proizvodstve-oao-rzhd>.
- Пичкалева С. Ю. Условия труда и обеспечение безопасности работников железнодорожного транспорта. Научное образование. 2022; (2): 126–7.
- Логинова В. А., Каськов Ю. Н., Жидкова Е. А., Гуревич К. Г., Смертина Ю. Л., Плетникова О. А. Регулирование профессионально-ассоциированных производственных воздействий на работников железнодорожного транспорта: опыт России и других стран. Анализ риска здоровью. 2021; (1): 173–85. DOI: 10.21668/health.risk/2021.1.18.
- Holzinger B, Mayer L, Klösch G. Night today, day tomorrow: how irregular work shifts interfere with our psychological health. Chronobiol Int. 2021; 38 (11): 1611–7. DOI: 10.1080/07420528.2021.1937199.
- Иващенко Г. И., Гумбатов В. Г. Причины возникновения хронических заболеваний у работников железнодорожного транспорта. Инновации. Наука. Образование. 2021; (48): 1560–6.
- Карпова О. А., Филимонов С. Н., Колядо В. Б., Семенихин В. А., Баландович Б. А. Заболевания кожи и подкожной клетчатки у работников железнодорожного транспорта: гигиенические аспекты. Медицина труда и промышленная экология. 2020; (6): 387–91. DOI: 10.31089/1026-9428-2020-60-6-387-391.
- Landsbergis P, Johanning E, Stillo M, Jain R, Davis M. Occupational risk factors for musculoskeletal disorders among railroad maintenance-of-way workers. Am J Ind Med. 2020; 63 (5): 402–16. DOI: 10.1002/ajim.23099.
- Осетрина Д. А., Савельева Ю. К., Вольский В. В. Значение воды в жизни человека. Молодой ученый. 2019; 16 (254): 51–3.
- Кутимская М. А., Бузунова М. Ю. Роль воды в основных структурах живого организма. Успехи современного естествознания. 2010; (10): 43–5.
- Шишелова Т. И., Толстой М. Ю. Современное состояние науки о воде. Проблемы и перспективы. Научное обозрение. Реферативный журнал. 2016; (4): 61–80.
- ГОСТ ISO 9612–2016 «Акустика. Измерения шума для оценки его воздействия на человека. Метод измерений на рабочих местах».
- ГОСТ 24940–2016 «Здания и сооружения. Методы измерения освещенности».
- МУК 4.2.2942–11 «Методы санитарно-бактериологических исследований объектов окружающей среды, воздуха и контроля стерильности в лечебных организациях».
- Р 2.2.2006–05 «Руководство по гигиенической оценке факторов рабочей среды и трудового процесса. Критерии и классификация условий труда». Утв. Главным государственным санитарным врачом Российской Федерации 29.07.2005.
- Судейкина Н. А. Гигиеническая оценка условий труда и состояние здоровья работников вагоноремонтного производства [диссертация]. Иркутск, 2018.
- Косякин В. С. Совершенствование системы обеспечения безопасных условий труда работников вагонного хозяйства [диссертация]. М., 2020.
- Хаманов И. Г., Щетинин А. Н. Проблемы оценки риска воздействия «биологического фактора» на работников ОАО «РЖД». В сборнике: Технические науки — от теории к практике: материалы XXX международной научно-практической конференции. Новосибирск: СибАК, 2014; 142–150.
- Прокопенко Л. В., Лагутина А. В. Оценка биологического фактора на рабочих местах: вопросы и предложения. Медицина труда и промышленная экология. 2018; (12): 29–34. DOI: 10.31089/1026-9428-2018-12-29-34.
- Иванов С. А., Невзорова Е. В., Гулин А. В. Количественная оценка функциональных возможностей сердечно-сосудистой системы. Вестник Тамбовского университета. Серия: Естественные и технические науки. 2017; 22 (6-2): 1535–40. DOI: 10.20310/1810-0198-2017-22-6-1535-1540.
- Гутор Е. М., Жидкова Е. А., Гуревич К. Г. Факторы риска развития заболеваний у работников локомотивных бригад. Медицина труда и промышленная экология. 2022; 61 (1): 43–52. DOI: 10.31089/1026-9428-2022-62-1-43-52.
- Павлов И. М., Сарсенов А. Е., Утарова З. А. Анализ влияния вредных и опасных производственных факторов на здоровье работников железнодорожного транспорта. Наука и образование. 2022; (2-2): 214–22. DOI: 10.56339/2305-9397-2022-2-2-214-222.
- Клепиков О. В., Борейко А. Н., Куренкова Г. В. Оценка профессионального риска здоровью работающих на предприятии по ремонту железнодорожных вагонов. Санитарный врач. 2020; (3): 1–3. DOI: 10.33920/med-08-2003-01.
- Кузьмин С. В., Самодурова Н. Ю. Оценка заболеваемости с временной утратой трудоспособности и ее вероятных причин у работников железнодорожного транспорта. Здоровье

- населения и среда обитания — ЗНиСО. 2026; 34 (3): 30–9. DOI: 10.35627/10.35627/2219-5238/2026-34-3-30-39.
31. Абдулаев М. А., Ким И. А., Задворная О. Л. Оценка динамики заболеваемости с временной утратой трудоспособности (ЗВУТ) у работников Российской железной дороги за 2015–2018 гг. Головная боль и шея. Российское издание. 2020; 8 (S2): 97–8.
 32. Вильк М. Ф., Каськов Ю. Н., Капцов В. А., Панкова В. Б. Динамика производственного риска и показателей профессиональной заболеваемости работников железнодорожного транспорта. Медицина труда и экология человека. 2020; 1 (21): 49–59.
 33. Вильк М. Ф., Тулушев В. Н., Капцов В. А., Панкова В. Б., Латынин Е. О. Физиолого-гигиенические особенности производственной нагрузки работников железнодорожного транспорта при современных формах вождения. Гигиена и санитария. 2024; 103 (7): 657–62. DOI: 10.47470/0016-9900-2024-103-7-657-662.
 34. Логинова В. А., Каськов Ю. Н., Онищенко Г. Г., Климова А. А. Приоритетные нозологии первичной заболеваемости работников железнодорожного транспорта и членов их семей. Гигиена и санитария. 2022; 101 (3): 303–10. DOI: 10.47470/0016-9900-2022-101-3-303-310.