

■ Introduction – Andrzej Massel 1

News

■ The development of a prototype of an innovative system preventing icing and frosting of overhead contact lines with the use of an automatic weather station 2

■ The first 2021 session of the Railway Research Institute's Scientific Council 2

■ Publications of the Railway Research Institute 2

■ Materials and Structure Laboratory of the Railway Research Institute 7, 8

Articles

■ Selected Sources of Financing Research and Development and Investment Projects in the 2017–2021 Financial Framework on the Example of the Railway Research Institute's Activity – Renata Barcikowska 3

■ IK Participation in Horizon 2020 Projects in Multiannual Financial Framework 2014–2020 – Eliza Wawrzyn 4

■ New Test Stand at Signalling and Telecommunications Laboratory – Kamil Bialek, Patryk Wetoszka 5

■ Scope of obligations under the Delegated Regulation 2017/1926 – Iwona Wróbel 6

Editor's

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Dear Readers,

it has been one year since the global Covid-19 pandemic reached Poland in March. The past year will probably be remembered by all of us for a long time, essentially due to the effects of this pandemic, which can be noticed in virtually all areas of human life, including transport. According to figures from the Office of Rail Transport (Urząd Transportu Kolejowego), the

year 2020 ended for railways in Poland with a result of just over 209 million passengers carried, while the year before there had been over 335 million. It can already be predicted that the pandemic will have a long-term effect on transport behaviour of the society, mostly because of the spread of remote working and the fear of being in large groups of people, at stations and stops including, as well as the means of transport themselves. Reorganising transport operations so as to ensure the safety of travellers and staff is a major challenge for transport organisers and operators. It is also a highly important research topic.

The outbreak of the pandemic was also a considerable challenge for the Railway Research Institute. Particularly in the first few months, we had to operate under conditions of danger and great uncertainty. All our actions were fundamentally motivated by the concern for our workplace. We did not know what the scale of the economic crisis would be and how long it would last, nor did we know what the economic situation in rail transport would be like, but we did try to maintain the continuity of the Institute's work and carry out all our work and research projects.

Now, from the perspective of the past year, much more can be seen. Thanks to the joint commitment and sense of responsibility of all employees, the Railway Research Institute's standing is very good. We are doing our best to perform all the tasks that IK has to carry out. Much credit goes to the employees who, despite the pandemic, fulfil their daily duties, both in our departments and laboratories and on the test track as well. We are looking to the future with confidence.

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The development of a prototype of an innovative system preventing icing and frosting of overhead contact lines with the use of an automatic weather station

Since November 2020, the Railway Research Institute together with scientific-industrial consortium partners PKP Energetyka S.A. (consortium leader) and ELESTER-PKP sp. z o.o. have been implementing a project called "The development of a prototype of an innovative system preventing icing and frosting of railway track line with the use of an automatic weather station" (Project no.: POIR.01.01.01-00-0052/20). The project is co-financed by the National Centre for Research and Development (NCBR) under the Smart Growth Operational Program 2014-2020.

The goal of the project is to develop a novel product – an energy efficient power system of catenary elements preventing the catenary against frosting and icing. The application of the product in the PKP PLK infrastructure might decrease the risk of delays related to unfavourable weather conditions. The compilation of adverse weather conditions, such as below-

zero temperature and high humidity, lead to the formation of a layer of ice and rime on the traction network elements, which leads to its degradation and prevents the supply of electricity to the traction vehicle. The solution to the problem is to create an innovative system that will act as a current generator with appropriate parameters in order to increase the temperature of the contact wires, which consequently will prevent the formation of icing and frosting for specific external conditions.

An important element of the system will be the prediction team - the first such advanced module that analyzes weather conditions and predicts the risk of icing. As a result, the system will be the first automatic preventive solution, which will further increase operational efficiency and reduce the risk of failure due to icing.



The first 2021 session of the Railway Research Institute's Scientific Council

The first 2021 session of the Railway Research Institute's Scientific Council was held on 3 February. The discussions mostly referred to two essential documents for the Institute, i.e. "IK financial plan for 2021" and "Plan of IK activity in 2021". The plans are of a framework nature and take into consideration various types of activities carried out at the Institute. Research and development projects, European and national research projects, activities conducted on the basis of accreditations and notifications (including certification), activities for the

dissemination of knowledge about rail transport, international cooperation and the development of the Institute's research base were distinguished.

The year 2021 is a special year in the Railway Institute's activities due to the two anniversaries: the 70th anniversary of the establishment of the Railway Scientific and Research Institute (30 May, 1951), now known as the Railway Research Institute, and the 25th anniversary of the Żmigród test track facility.

Publications of the Railway Research Institute

Despite a difficult pandemic situation in Poland, which also affects the sector of science (lack of organized conferences, symposia or seminars), the Railway Research Institute's workers published numerous articles in scientific journals (the Ministry of Science and Higher Education reference base includ-

ing) and two monographs published by IK Publishing House. Publications indexed in Web of Science or/and Scopus databases: 22

Publications published in scientific journals from the ministerial lists: 5



Selected Sources of Financing Research and Development and Investment Projects in the 2017-2021 Financial Framework on the Example of the Railway Research Institute's Activity

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From the moment of Poland's accession to the European Union and even earlier, in the pre-accession period, new opportunities were opened up for the Polish research and development sector thanks to European funds. The level and quality of funding for research and development activities in a given country depends on the government's scientific and innovation policy and results from the country's long-term development strategies.

The economic conditions for the development of this sector are defined by subsequent national development plans: National Cohesion Strategy 2007-2013, National Development Strategy 2007-2015, Strategy for Responsible Development up to 2020.

Research institutes play a crucially important role in building modern, positive relations between science and business. They are the closest to the economy because of the tasks they perform, i.e. conducting development and implementation-oriented industrial research.

The Railway Research Institute operates pursuant to the Act of 30 April 2010 on research institutes and is registered in the National Court Register. For many years the Railway Institute, as one of the research and development entities, has been trying to influence the development of innovation policy in Poland in the field of rail transport and to actively participate in it. As an entity directly subordinated to the Ministry of Infrastructure and cooperating with the Office of Rail Transport, it has the opportunity, at least indirectly, to influence and impact government activities in order to create modern, safe and passenger-friendly rail transport.

The priority tasks of the Railway Research Institute include: substantive support for entities, decision-makers, transport organizers, operators, investment projects, the Community law process, improvement of the competences of human resources in the broadly understood transport sector and improvement of transport safety. For many years, the Institute has been playing a leading role in the field of research and development of rail transport, conducting research and development and certification work in the field of railway and urban rail transport.

Scientific and research activity carried out by the IK is an important element in the development of innovative attitudes and their impact on shaping the innovation policy. Every year the number of projects, both international and national, in which the Institute is involved increases.

In 2017-2021 the Multiannual Financial Framework (MFF) 2014-2020, funds from participation in EU and national projects became quite a strong support for the Railway Research

Institute. Thanks to such projects, in recent years it was possible, among others, to purchase research infrastructure and equip laboratories with modern, unique apparatuses.

The Railway Research Institute obtained funding for R&D activities and investment projects in the Multiannual Financial Framework 2014-2020, from the following sources:

- from the annual statutory subsidy for the implementation of statutory tasks, for infrastructure and research equipment including. The Ministry of Science and Education is the administrator of budgetary funds in the case of research institutes,
- funds acquired from the participation in competitions for national projects financed by the NCBR,



- from European funds granted through the Smart Growth Operational Programme,
- from participation in the Shift2Rail initiative under the EU Horizon 2020 framework programme,



- from funds obtained under the Operational Programme Infrastructure and Environment,
- from funds obtained under the Regional Operational Programme of the Mazowieckie Voivodeship.

The mission of the Railway Research Institute is to carry out scientific and research tasks that will lead to an increase in the effectiveness of rail transport, allow to systematically define the goals and vision of the sector's development, ensure its modernization and improve the competitiveness of rail transport. In order to achieve this goal, it is necessary to obtain financial support from, among others, the active participation of the Institute in R&D and investment projects.

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IK Participation in Horizon 2020 Projects in Multiannual Financial Framework 2014-2020

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The eighth framework program, Horizon 2020, is coming to an end. This is the largest EU research and innovation (R&I) funding program to date. The budget of the entire programme amounts EUR 80 billion, of which EUR 2.8 billion has been allocated to research and innovation. In Horizon 2020, R&I funding for the rail industry is handled by the Shift2Rail Joint Undertaking. Shift2Rail is a public-private partnership established under Council Regulation (EU) No.

642/2014 of 16 June 2014 for the period until 31 December 2024. The overarching goal of Shift2Rail is to integrate research and innovation results in reference to passenger rolling stock, freight, traffic and infrastructure management systems from their concept to the market implementation. Due to the public-private nature of the project, Shift2Rail is subsidized by European Union funds as well as funds from the private sector. As part of Shift2Rail, the following Innovation Programmes are distinguished:

- IP1 Passenger trains,
- IP2 Traffic management,
- IP3 Optimised infrastructure,
- IP4 Digital services,
- IP5 Rail freight,
- CCA Cross-cutting activities,
- IPX – System Architecture and Disruptive Technologies.

The Railway Research Institute is carrying out 3 projects under the Shift2Rail framework.

1) "IN2STEMPO: Innovative Solutions in Future Stations, Energy Metering and Power Supply" addresses the call S2R-CFMIP3-01-2017 Smart System Energy Management Solutions and Future Station Solutions within the Shift2Rail Joint Undertaking. The project started on 1 September 2017 and will run over 60 months under the coordination of Network Rail. There are nineteen participants including eight Linked Third Parties (LTP). The total budget of the project yields of 13.6 M€ with max. EU contribution of nearly 6 M€.

IK as LTP of PKP S.A. contributes to the Station sub-project in the three work packages (WP): WP6, WP7 and WP8. Activities are

aimed at improving the customer experience and safety at stations, resulting in a better passenger experience for customers using the railway. Research is focused on improving crowd management in high capacity stations, station design and components, accessibility to trains and new ticketing technologies.



2) „HYPERNEX: Ignition of the European Hyperloop ecosystem" won the open call of the Shift2Rail Joint Undertaking S2R-OC-IPX-01-2020: Innovation in guided transport. HYPERNEX will run for 1 year (since 01.12.2020) with the budget of EURO 250,000.

HYPERNEX

The consortium consists of thirteen entities: both enterprises and research centres, the level of project co-financing is 100%. The project focuses on: Hyperloop concept, existing infrastructures integration and competitiveness factors, hazard identification and safety case analysis, as well as technical components of Hyperloop architecture. HYPERNEX addresses the need for a catalyst to accelerate the development of the fifth means of transport, Hyperloop, in Europe.

The Railway Research Institute is a direct consortium member and the leader of WP4 Transferability and roadmap beyond HYPERNEX. WP4 is responsible for mapping the existing synergies between Hyperloop and existing transport modes. This WP will also describe the needs in terms of standardization and regulation that Hyperloop systems may be required to meet trying to take advantage of the existing programmes. Here, the synergies and opportunities within Shift2Rail programmes and other joint undertakings such as SESAR or CleanSky JU's will be also identified.

3) "ExtenSive: Extending the attractiveness of transport for end user and extending IP4 to SaaS solutions" addresses the call S2R-CFM-IP4-01-2020 IP4 Enhanced end user centric travel ecosystem. The project has started on 1 December, 2020 and will run over 31 months under the coordination of CS SYSTEMES D'INFORMATION. There are eight participants with their LTP. The total budget of the project yields of 11.4 M€ with max. EU contribution of around 5 M€.

IK as LTP of PKP S.A. contributes to the WP7 IP4-IP2 Collaboration specification & WP8 IP4-IP2 Collaboration implementation, WP9 IP4-IP3 Infrastructure on stations and their surrounding specification & WP10 IP4-IP3 Infrastructure on stations and their surrounding implementation and WP11 Technical Coordination and large-scale implementation as well as WP12 Dissemination and Communication.



The aim of the activities is to improve the user's experience, improve the existing components and functionalities so as to ensure compliance with the Mobility as a Service (MaaS) approach, ensure the cooperation of IP4 projects with IP2 projects related to railway infrastructure, better management of stations by improving the interaction between the traveller and the station manager in buildings.

In addition, IK has submitted a project application to the European Research Council (ERC) - Consolidator Grants to provide long-term funding for ground-breaking research to significantly reduce the number of train-to-train collisions. Moreover, IK submitted an application under the COST - (European Cooperation in Science and Technology) programme in the subject "Interaction of Wheel and Rail" under the Open Call Collection OC-2020-1.

The participation in European research programmes offers a unique opportunity to develop, validate and implement innovative solutions, which are often pioneering, risky and full of challenges. Not only does it allow to carry out complex and costly projects, but also to build positive relations between various research centres in the country and abroad.

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New Test Stand at Signalling and Telecommunications Laboratory

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Signalling and Telecommunications Laboratory,
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Signalling and Telecommunications Laboratory in the Railway Research Institute in Warsaw was established in September 2000. It operates basing on the management system specified in compliance with the ISO/IEC 17025 standard and holds Accreditation Certificate No. AB 310 granted by the Polish Centre for Accreditation (PCA), associated in International Laboratory Accreditation Cooperation (ILAC).

Last year, a wide range of accredited tests offered by the Laboratory was extended with a new EMC test stand for carrying out immunity tests to electromagnetic interference in a wide voltage range.

An IMU-MGS generator was purchased along with an automatic three-phase network of CDN-A-6-32 type, enabling the performance of device immunity tests with a maximum rated voltage of 690 V AC at 32 A per phase and 500 V DC / 32A - (Fig. 1).



Fig. 1. IMU-MGS generator with an automatic CDN-A-6-32 three-phase network

The device that generates interference allows performing immunity tests on the main AC power supply (single- and three-phase devices) or DC, auxiliary, battery ports, as well as on signal, control and communication ports.

The IMU-MGS generator enables testing of electronic devices installed on the rolling stock, e.g. passenger information system, recorders, cameras, buffer power supplies, etc.

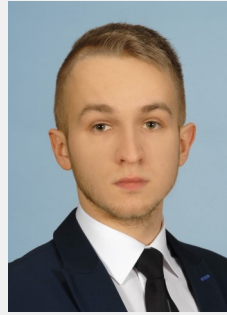
It is possible to conduct immunity tests of command control and signalling equipment (e.g. axle counters, electronic indicators, level crossing signalling systems), telecommunications (e.g. radiotelephones, CCTV systems) as well as power equipment. The built-in coupling decoupling internal network (CDN) enables performing BURST tests on the following lines L, N, PE, L+N, L+PE, N+PE, L+N+PE, direct out as well as SURGE tests on lines L-N (2Ω), direct out, L-PE and N-PE (12Ω) - Fig. 2.

The measurement system allows carrying out tests for direct and alternating voltages (single and three-phase):

- Electrical fast transient/burst tests in compliance with PN-EN 61000-4-4 standard, maximum impulse voltage 5.1 kV, frequency 1 MHz,

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Signalling and Telecommunications Laboratory,
Railway Research Institute



- Surge tests in compliance with PN-EN 61000-4-5 standard, voltage of $1.2/50 \mu\text{s}$ (max. 5.1 kV) and current of $8/20 \mu\text{s}$ (max. 2.55 kA),

- Voltage dips tests in compliance with PN-EN 61000-4-29.

The system can be expanded by purchasing further components that will allow extending the scope of the tests performed on the test stand:

- Electrostatic discharge immunity tests in compliance with PN-EN 61000-4-2 standard,
- Power frequency magnetic field immunity tests in compliance with PN-EN 61000-4-8 standard,
- Impulse magnetic field immunity tests in compliance with PN-EN 61000-4-9 standard,
- Voltage dips, short interruptions and voltage variations immunity tests in compliance with PN-EN 61000-4-11 and PN-EN 61000-4-34 standards,
- Ring wave immunity tests in compliance with PN-EN 61000-4-12 standard,
- Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz in compliance with PN-EN 61000-4-16 standard,
- Test for immunity to conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz in compliance with PN-EN 61000-4-19 standard.

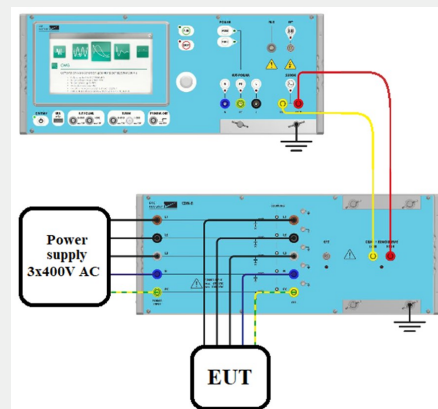


Fig. 2. Test setup example Surge

Controlling the generator is possible from the level of dedicated software on the measurement computer and LCD touch display panel. The left side of the front panel is called the control panel. The right side consists of the generator and high voltage switches, impulse generating network, coupling decoupling network as well as safety stop button - this part is called the operation panel. The purchase of the new equipment for the immunity tests stand allows conducting research and development work in a wider voltage band at Signalling and Telecommunications Laboratory in the Railway Research Institute in Warsaw.

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SCOPE OF OBLIGATIONS UNDER THE DELEGATED REGULATION 2017/1926

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Commission Delegated Regulation (EU) 2017/1926 of 31 May 2017 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide multimodal travel information services is one of the four regulations defining requirements in reference to priority areas and activities concerning the deployment of Intelligent Transport Systems (ITS) in the field of road transport and interfaces with other modes of transport.

ITS services using advanced applications aim to provide innovative multi-mode and traffic management services, better inform different users and ensure safer, more coordinated and 'more intelligent' use of transport networks. The use of information and communication technologies in the road transport sector and its interfaces with other modes of transport is expected to contribute significantly to the improvement of the environmental impact, efficiency, energy efficiency including, road transport safety and security, i.e. the transport of dangerous goods, public safety and passenger and goods mobility, while ensuring the functioning of the internal market as well as increased levels of competitiveness and employment.

Delegated Regulation (EU) 2017/1926 outlines specifications necessary to guarantee ITS users the provision of Union-wide multimodal travel information services. Thus it applies to all transport modes in the Union, such as schedule based transport (air, rail including high speed rail, conventional rail and light rail, long-distance coach, maritime including ferry, metro, tram, bus, trolley-bus, cableways), transport on demand (shuttle bus, shuttle ferry, taxi, ride-share, car-share, car-pool, car-hire, bike-share, bike-hire, dial-a-ride) and personal transport (car, motorcycle, bicycle, walking).

Under the provisions of this regulation, Member States are required to:

- establish a national access point that enables the provision of at least the static travel and traffic data as well as historic traffic data of the different transport modes, upgrading including,
- assess the compliance of activities of transport authorities, transport operators, transport on demand service providers, infrastructure managers and travel information service providers with the requirements for the availability, exchange, re-use and updating of multimodal travel data,
- regular reports on the national access point and its operation, as well as the results of monitoring the implementation of the regulation.

Transport authorities, transport operators, infrastructure managers or transport on demand service providers are obliged to provide the static travel and traffic data. This involves the use of unified catalogue of interoperable information exchange formats and protocols basing on existing technical solutions and standards relating to different transport modes. These entities timely transfer relevant information through the national access point. The annex to the regulation defines the categories of static and dynamic data divided into 3 service levels.

The Railway Research Institute participated in the preparation of a conformity assessment model, taking into consideration the role of national access points in the assessment process,

including a proposal for a declaration form and criteria for conformity assessment resulting from Delegated Regulation 2017/1926. As part of the cooperation of the Polish Network of Transport Research Institutes POLTRIN established by transport research institutes (Road and Bridge Research Institute, Railway Research Institute, Motor Transport Institute), the reasons for legislative changes in the scope of national legal acts, resulting from the provisions of Directive 2010/40/EU and delegated regulations that Poland, as a Member State, should implement in its domestic legislation or apply directly. Changes in the statutes of institutes were also proposed.

Union-wide multimodal travel information services, based on DELEGATED REGULATION 2017/1926

DATA CATEGORIES

The types of the static travel data	
<i>Level of service 1</i>	<ul style="list-style-type: none"> – Location search (origin/destination), – Trip plans, – Location search (access nodes), – Trip plan computation – scheduled modes transport, – Trip plan computation – road, transport (for personal modes).
<i>Level of service 2</i>	<ul style="list-style-type: none"> – Location search (demand-responsive modes) – Information service – Trip plans, auxiliary information, availability check
<i>Level of service 3</i>	<ul style="list-style-type: none"> – Detailed common standard and special fare query (all scheduled modes) – Information service (all modes) – Trip plans – Trip plan computation
Types of the dynamic travel and traffic data	
<i>Level of service 1</i>	<ul style="list-style-type: none"> – Passing times, trip plans and auxiliary information
<i>Level of service 2</i>	<ul style="list-style-type: none"> – Passing times, trip plans and auxiliary information (all modes) – Information service – Availability check
<i>Level of service 3</i>	<ul style="list-style-type: none"> – Trip plans: future predicted road link travel times



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Materials and Structure Laboratory of the Railway Research Institute

Materials and Structure Laboratory of the Railway Research Institute is constantly extending its research and development capabilities through investing in specialist test stands regarding fire, mechanical and corrosion tests. The purchase of new equipment is carried out within the framework of RPMA.01.01.00-14-9845/17-00 and from the Institute's internal resources. Photos 1–15 show new apparatuses bought starting from 2018 up to February 2021.

The purchases enabled the Laboratory to extend its competence as well as implement new research methods, including accreditation to changing EU's requirements, and adapt standards of the tests to the world level.

Non-Metallic Material Section:



photo: IK archive

Photo 1. Tube furnace for toxicity measurements – purchase under RPMA.01.01.00-14-9845/17-00 Project in 2019

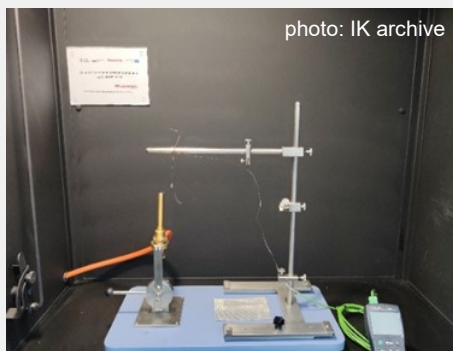


photo: IK archive

Photo 2. Test stand for small flame tests – purchase under RPMA.01.01.00-14-9845/17-00 Project in 2019

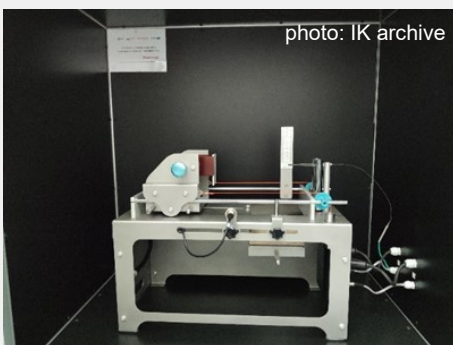


photo: IK archive

Photo 3. Test stand for temperature measurement in glowing/hot-wire based tests – purchase under RPMA. 01.01.00-14-9845/17-00 Project in 2019



photo: IK archive

Photo 4. Climatic chamber for air-conditioning of large-scale facilities – construction under RPMA.01.01.00-14-9845/17-00 Project in 2019



photo: IK archive

Photo 5. Cone calorimeter for determining the smoke formation and heat release rate for materials exposed to a source of radiant heat (ISO 5660-2:2015) – purchase from IK own resources in 2020



photo: IK archive

Photo 6. Modernisation of a smoke chamber and apparatus for measuring toxicity based on Fourier Transform Infrared (FTIR) technology together with control and recording systems (according to PN-EN 17084:2019-02 standard) – purchase from IK own resources in 2021

Metallic Material Section:

Photo 7. Strain gauge indicator using NI LabView software – purchase under RPMA.01.01.00-14-9845/17-00 Project in 2020

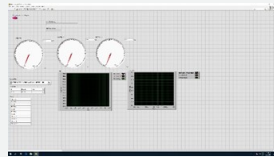


Photo 12. Instrument for magnetic field measurement – purchase from IK own resources in 2018



Photo 8. A system of hydropulse actuators from 20 kN to 160 kN for fatigue tests (6 pcs) – purchase under RPMA.01.01.00-14-9845/17-00 Project in 2020

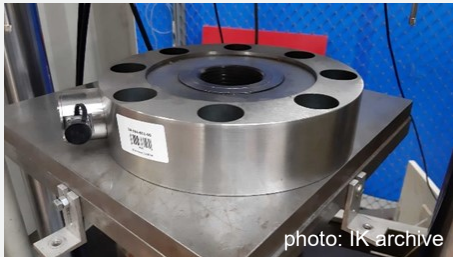


Photo 9. Load cells (7 pcs) – purchase under RPMA.01.01.00-14-9845/17-00 Project in 2020

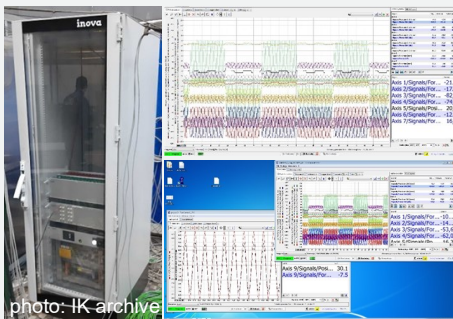


Photo 10. Control system for fatigue test stands – purchase under RPMA.01.01.00-14-9845/17-00 Project and from IK own resources in 2020 – 2021

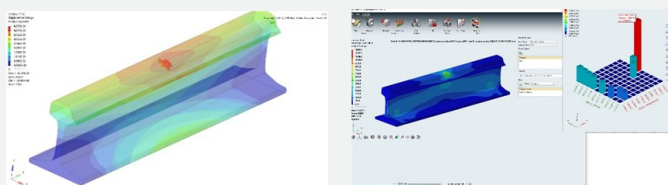


Photo 11. FEM Ansys Mechanical software – purchase under RPMA.01.01.00-14-9845/17-00 Project in 2020 (photo: IK archive)

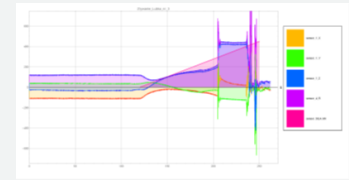
**Chemistry and Anticorrosion Section:**

Photo 13. Konica Minolta CM2600D Spectrophotometer and Rhopoint IQ-S Gloss-Meter – purchase from IK own resources in 2018



Photo 14. XENOTEST 440 weathering instrument for assessing the resistance to sunlight in the full spectrum of light (UV + VIS + IR) – purchase from IK own resources in 2018



Photo 15. The TQC Sheen TI SP 0500 Pendulum Hardness Tester using the Koning & Persoz pendulum - purchase from IK own resources in 2019

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