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**Railway Engineering in Hungary
Companies in the spotlight offering
their products, services and skill**

Latest Rail Diagnostic Inspections

FMK-008 Rail diagnostic train

See FMK-008 on Innotrans 2016 at stand 0/642 on Outdoor Display!



See more on page 4-9.

Colophon

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DEAR READER,



It is a key strategic priority of the Hungarian Government to raise the quality of community transport, and within that, the upgrade of the railway track network is of special importance.

Railway can be one of the largest beneficiaries of the present financial cycle of the European Union. In the upcoming years a total of approximately 3 billion Euro will serve the development of railway infrastructure, from Hungarian and Union sources. Until 2020, developments will be focused on the upgrade of the TEN-T railway network, the elimination of structural congestions and the continuation of the implementation of communication and safety systems on the tracks and in the vehicles in order to improve interoperability. In addition to the upgrade of international and suburban sections, the comprehensive reconstruction of the South Balaton railway line continues unabated. As a result of the investment, the entire South Balaton railway line will be renewed by summer 2018.

The primary aim of the capital investments underlying the timetable developments is to provide higher quality service to the passengers.

In addition to the restructuring of the providers of community transport, the renewal of the obsolete vehicle fleet is also an urgent task. With the new multiple units received till date, MÁV-Start Co., the national passenger railway company is already the operator of the largest FLIRT fleet in the world. They are also planning to purchase 600 passenger double decker trains for suburban transport. The gist of the strategy is that brand new vehicles run in the entire service segment by 2020.

After its IC Plus passenger cars, MÁV-Start will once again be introduced in InnoTrans as a vehicle manufacturer with its newly developed FMK-008 rail diagnostic train.

The Hungarian railway is looking forward to a promising period, however, in order to realize the anticipated boom it is essential that we cooperate with our foreign partners, owing to the limits of domestic capacities. InnoTrans offers an excellent opportunity to establish and reinforce connections, therefore I kindly request all of you to visit the Hungarian stands!

I wish useful meetings to every participant!

Ágnes Balla

Managing Director, Editor

InnoRail Kiadó és Konferencia Kft.

(InnoRail Publishing and Conference Ltd.)



Dear Reader,

The Hungarian railways that has been operating since 1846 grew into one of the densest European rail networks in the past 170 years. Its continuously improving operation demands an adequate financial background. Competitive disadvantages of rail companies in Central and Eastern Europe are obvious when compared to their Western counterparts; we are working on closing this gap now, partly using EU funds to this end. But we have advantages too, mostly in case of Hungary, as the share of railways in passenger traffic is way above the EU average. Here Hungary ranks third; only Austria and Denmark can boast better figures.

2007-2013 programming cycle. Special mention should be made of the Szajol-Püspökladány, Szolnok-Szajol-Békéscsaba and Hegyeshalom-Csorna-Porpác lines and the border crossing into Slovenia that all meet TEN-T parameters. Hungary is also spectacularly progressing in the introduction of the ERTMS system, the GSM-R rail communication, the ETCS-2 train control system and the installation of the FOR rail traffic management system.

▶ Railway industry underwent a serious crisis in the 1980's when a veritable explosion of motorway construction occurred and the number of road vehicles also started to dynamically grow. The European Union countered this trend mostly by legal means: the first railway packages were passed. The final objective of the legal regulations, that were mandatory for the member states to transpose into their national legislation, was to provide for a uniform management of rail transport throughout the entire Union; that no competitive disadvantages emerge due to the specificities of the individual countries or regions. Modernization of the EU regulations is in progress now, in form of the Fourth Railway Package.

Rail corridors designated have to meet stringent technical parameters in order to retain and improve competitiveness. Tracks able to sustain 740 meters long trains, an axle load of 22.5 kN, installation of the GSM-R and ETCS-2 systems and electrification are important considerations of fast and safe rail transport too. Additional expectations are environmental protection, interoperable transport and crossing of borders without a need for changing engines. Many of the regulatory frameworks and many of the technical conditions for investments are thus present.



The guideline for railway development in Hungary – just like in other countries – is that we cannot modernize everything at the same time. We had to find the main directions along which to progress, and focus on these areas. The Hungarian sections of the EU corridors do also make part of the most important main lines in Hungary. Their rehabilitation is supported by the European Union and the work has been progressing for years.

Meaningful forward moves have been taken in Hungary since 2010 in all fields of railway development by the stalwarts working in and for the cause of railways. In terms of legal regulations, we followed those of the Union thus numerous sections could be rehabilitated in the

As to passenger traffic, the most tangible development is that MÁV Zrt., and GYSEV Zrt., purchased modern multiple units in the past few years, in order to rejuvenate their vehicle fleet. A positive trend is also discernible in suburban rail transport around Budapest and the other major cities. An improving public transport tariff policy, extension of integrated clock-face scheduling, construction of P+R car parks, improving on-board and station passenger information systems and the addition of bicycle carriages to trains are all positive developments. As a result of the improvement of services, more and more people opt for a comfortable and fast, environment friendly transport as against individual transport.

**Dr. László Mosóczy**

Deputy State Secretary
for Transport
Ministry of National
Development



There are more than thirty registered and licensed train operating companies in Hungary. Their performance has significantly dropped after the 2008 crisis, however, the trend has reversed since and the amount of goods hauled is on the rise, with exception of a minor drop last year. Transit goods volume is also significant – this is why a good condition infrastructure, fostering the forwarding of freight trains on schedule under all circumstances, is a fundamental expectation. A tariff policy focusing on network access fees is used to encourage hauliers to use the Hungarian rail network for their rail freight transit activities. A use-based e-toll system introduced for public roads in 2013 has also contributed to a decrease in the competitive disadvantages of rail freight transport. A ramp-up of rail transport between the Far East and Central Europe also offers great opportunities, therefore, Hungarian experts are working on the signing of agreements that may increase rail trans-

port towards the Hungarian section. Reliability and the acceleration of forwarding time is also important here, this is why preparations for the development of the Budapest-Belgrade line have also come to the fore in the past two years. The rail line could serve the Piraeus sea port leased by the Chinese; container traffic of the port grew 7.5 times since 2008.

Hungary will have to continue its corridor strategy in order to provide for a maximum amount of traffic on MÁV and GYSEV lines. EU financing policy for the period 2014-2020 will greatly help here as a result of which masses of new investments will be commenced in the near future. Among them, the Kelenföld-Pusztaszabolcs, the Budapest South rail connection bridge and



the Rákos-Hatvan projects, all financed from the EU Connecting Europe Facility (CEF), are worth of specific mention here. The Integrated Transport Development Operative Program (IKOP) will be instrumental, among others, in the realization of the Püspökladány-Debrecen section, the modernization of the Southern Balaton line or the electrification of the Szombathely-Zalaszentiván section. Renewal of the multiple unit fleet will proceed, serial production of Hungarian-made IC+ coaches is imminent. In the next period, the railway friendly government of Hungary will continue its work for making the Hungarian railways a 21st century provider to all passengers and hauliers, befitting the traditions of Hungarian railways.

A Newer Milestone of Hungarian Railway Vehicle Production

FMK-008



MÁV Central Rail and Track Inspection Ltd. (MÁV CRTI Ltd.) owns several decades of experiences in the field of operation of rail diagnostic measuring equipments and measuring vehicles.

▶ They operate also presently a measuring train which consists of two power cars type ABmot and one inserted coach. The technique which is more than 50 years old really served its time, the old power cars are less reliable, therefore getting permission for their foreign transport became harder and harder. Knowing these facts the firm decided to procure new vehicles. Resurgent vehicle production of MÁV (Hungarian State Railways) group gave the chance that the new measuring train could be prepared on the base of Hungarian plans and in domestic production. The customer has dreamed a two-part train keeping all the functions of the earlier three-part measuring train and completing it with some new ones. The total length of the train is relevant also in order that the train should not be split at going into its engine shed located in Rákos railway station. Nevertheless we had to keep

the low axle load thinking for the possibility of measurement of tracks in weaker state. The range of functions to be realised was properly in maturity on the base of experiences gained with the existing vehicles during decades. The measuring train itself as a construction proved up, the task was the transplantation of this base construction into a modern vehicle. It was an important aspect that in spite an individual vehicle is produced but its main parts or even its smaller parts should correspond with the parts applied in other vehicles in favour of easier maintainability.

Main parameters of the new vehicle

The meaning of FMK abbreviation is Superstructure Measuring Coach, although this is not a single coach but a power car and a measuring coach composing a united train. The power car can be driven

from the measuring coach with remote control. Since it is about only two vehicle units, the low piece number determined more characteristics of the new vehicles. Several equipments of great volume should have been installed in the vehicle, therefore longer chassis longitudinal beams were required than at passenger coaches and at IC+ coaches in order to reach the appropriate car-body strength. But none of the steel-industry figures produces this in small quantity therefore we chose Ganz produced mail-coaches with middle-number of 00-40 which were stopped several years ago. 008 vehicles were produced by modification of these coaches, the height of their chassis longitudinal beams is 240 mm, so they ensure appropriate strength to the new car-bodies. Furthermore the customer explicitly asked for a high-floor configuration in order that under the chassis the measuring equipments could be located. Thus it was also obvious that the original bogies can be kept, and to the driven vehicle the driven version of the bogie belonging GH 250 family used at

mail coaches should be applied. It was an advantage that MÁV FKG Ltd. some years earlier produced Lencse vehicles with crane, so produced driven bogie also for them, furthermore MTU manufactured diesel power pack applied for Lencse got under FMK-008 as well.

Auxiliary energy supply is ensured by hydrostatic generators driven by diesel engines, and by a separate aggregator. It was essential that in case of failure of one unit the train could be work further, so the individual consuming installations can be connected on any power source. To ensure the comfort, individual roof climates, water heating using the waste heat of diesel engines and subsidiary oil stove are also installed.

Measuring systems

The vehicle owns more measuring systems, the harmonised operation of them is ensured by a central controlling system, and the evaluation of the measured data is helped by an integrated evaluation system. The sensors of the measuring systems are carried by a measuring bogie, which in case of measurement is lowered on the rails, and during travel without measurement it can be pulled up by electric actuators with the help of cables to the chassis. Measuring bogie is mounted with an ultrasonic measuring system for the detection of inner defects of rails and with an Eddy-current measuring system for the detection of hair-crack faults (head-check). Corrugation is measured by the application of induction measuring principle. The coach is prepared for the possibility of mounting of laser clearance gauge measuring equipment, GSM-R measuring equipment, and catenary measuring equipment.

Inner equipments

In the vehicles almost all the functions can be found which can be imagined in a railway vehicle: they contain power packs,, drivers' cabins, and the inherent vehicle control, furthermore train control and deadman's control as well. The single pow-

er car is also able to move in both directions, for this purpose on its coupled end an ancillary driver's cabin is formed.

The most important room is the measuring room this is the working place of people doing the measurement and here can be found the computers of the measuring equipments. The whole train must carry measuring water for technology purpose, the tanks of this can be found partly in the passenger space and partly under the chassis. Thos measuring water ensures the coupler fluid for the ultrasonic measurement. In the vehicles one WC, shower, kitchen, and workshop and sleeping cabins are also located.

Vehicle control

One of the biggest development works in the vehicle was the elaboration of the vehicle control. This was executed by MÁV-Start Passenger Transportation CO. by his own team, the hardware and the development environment was bought from a Swiss firm. The same Swiss firm supplies the vehicle controls for Stadler Flirt, it is true that in them the former generation is used. The remote control bus between the measuring coach and driven-car corresponds with the one applied at Flirt. Of course the vehicle drivers' work is helped by a graphic operating panel, while the system is redundant, so in case of the failure of its any element the train can proceed even if with restrictions.

The team

Maybe a lot of people don't think of it but surely serious development work and well operating team stand behind such difficult vehicles. Design was executed by the experts of MÁV-Start Co. Technical Development Unit. They had planned IC+ coaches as well, so presently in Hungary they have the biggest knowledge concentrated in one place in the field of railway vehicle construction. At the beginning of IC+ planning, around 2011 when the team started to set up, the members generally had worked at

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the old railway vehicle-producer large-scale business firms. Many of them took on the planning of IC+ coaches beside pension as their last work. They were completed progressively in greater and greater number the young engineers as entrants or having some year experience. Now the young generation is already in majority, after the older colleagues handed over their experience. Major of them are railway enthusiasts as well: this work beside all of its pleasurable can be done much easier if one considers it as his profession. Producer in Szolnok (MÁV Start Co. Szolnok Railway Vehicle Repair Shop) had not an easy job either since the compilation of first specimens always requires more effort. Meanwhile in the course of years the appropriate cooperation formed between planning and production. At the different phases of production and at putting into operation the engineers are also commonly present in order that the work could continue unobstructedly and experiences arose here they could utilize in later projects.

Technical data

Allowed highest speed: 120 km/h

With lowered measuring bogie: 70 km/h

Inbuilt capacity: 2x390 kW

Train control: MIREL and Indusi, prepared for ETCS

Brake system: KE-P-A (D) Knorr brake, passenger train type, with spring-force storing parking brake, with 2 brake discs per axles
Haulable train length: max. 100 m, linked into air-brake

Fleet numbers

Railcar: H-KVF 99 55 9160 008-6

Measuring coach: H-KVF 99 55 9362 008-2

Latest Rail Diagnostic Inspections

One of the most important fields of railway track diagnostics is the regular inspection of the condition of the rails. At the development of the new measuring train MÁV Central Rail and Track Inspection Ltd's (MÁV CRTI Ltd.) basic requirement was the high-level service of rail diagnostic data by enhancing the examination speed through the development of a vehicle which can be operated economically.

Our experts' several decades of experience ensures the appropriate base for the updating and development of our services. In the field of measuring technical equipment and vehicle mechanical engineering and also of functionality the requirements were unambiguously drawn up, which are expected by MÁV CRTI Ltd., from a modern rail diagnostic measuring train.

Practical realization of the requirements has requested the application of individual solutions from the manufacturer of the vehicle (MÁV-START Co.) and from the suppliers of measuring devices.

Measuring equipment

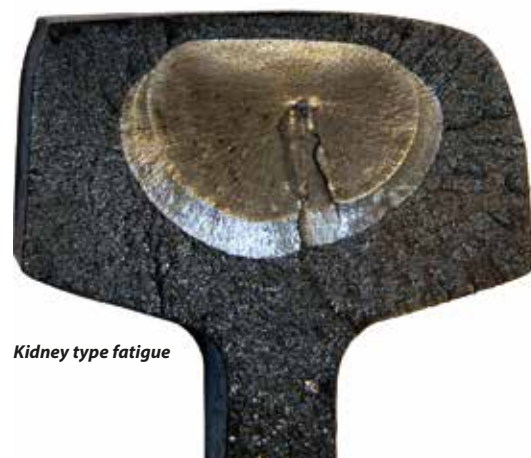
Currently the following measuring systems were installed on FMK-008 rail diagnostic train:

- Ultrasonic measuring system
- Eddy-current measuring system
- Rail corrugation measuring system

Inspecting probes of the measuring equipment were installed in the middle of the measuring coach on the measuring bogie being under the chassis. Structural form of the measuring bogie was developed by MÁV CRTI Ltd's experts. This subassembly has an emphasized role in holding the measuring technical equipment in the appropriate position during the measurement process; furthermore this enables the continuous passing on the turnouts without interrupting the examination. In the frame of the develop-

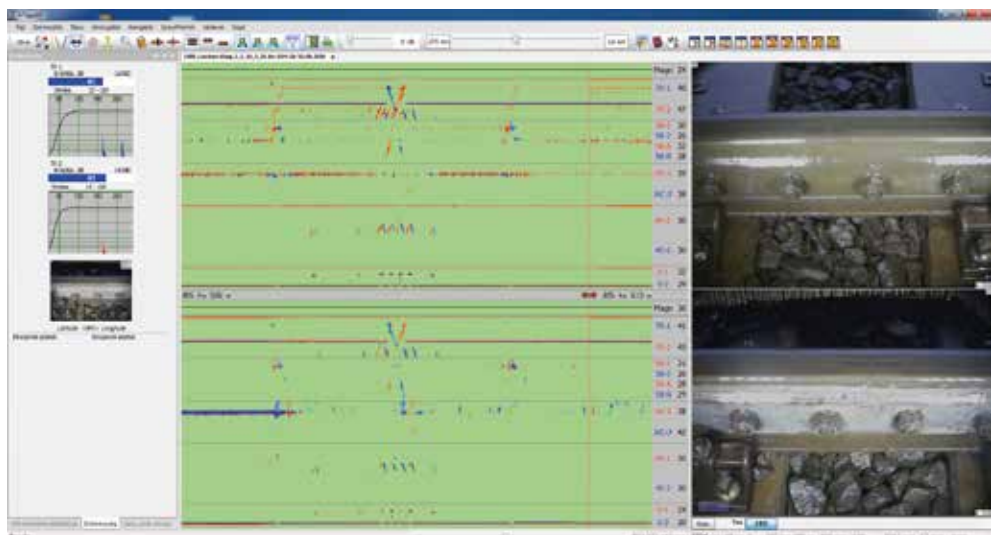
ment and updating the measuring bogie, which was well approved in the earlier applications, was redesigned and updated by MÁV VAGON Ltd.

Allowed speeds in the lowered state of the measuring bogie:



Kidney type fatigue

„B” image of ultrasonic inspection completed by video picture



Panoramic view of a turnout section from the video record



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- In case of $v \geq 160$ km/h allowed speed is 70 km/h,
- In case of $v < 160$ km/h allowed speed is 50 km/h, where v is the authorized speed for the track.
- In jointed track (by fish-plates): 40 km/h.
- Passing a turnout in straight direction: 50 km/h.
- Passing a turnout in diverging direction: on high-speed turnouts the allowed speed in diverging direction is $V_{\text{turnout}}/2$ while on turnouts passable by 40 km/h the allowed speed in diverging direction is 30 km/h.

Besides the above equipment procurement of a rail profile measuring system is under process which will also be installed on the measuring train covering the most important rail diagnostic examinations with this.

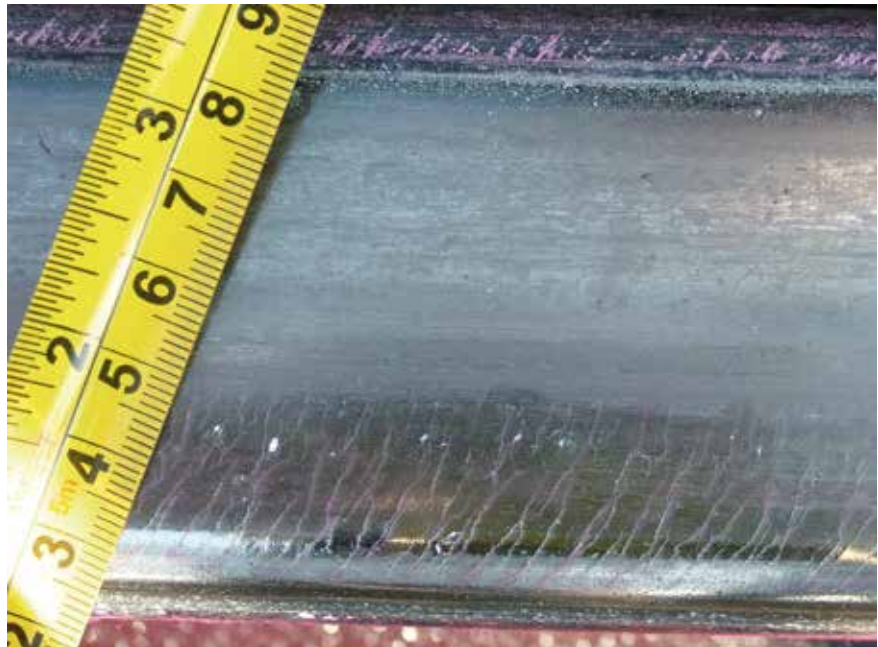
Ultrasonic measuring system

Exploration of inner material flaw of rails is executed with a 12 channel by rails ultrasonic rail inspection system produced by the Russian Radioavionika Corp., firm. Number of ultrasonic probes and their special arrangement enables the through radiation of almost the whole rail cross-section. Precise positioning of measuring probes and safe passing on turnouts is ensured by the measuring bogie and by the measuring beam guided between its axles. Maximum inspection speed on continuous welded track of good quality is 70 km/h. In the course of the examination signals of inspection heads are recorded and during the evaluation these recorded signals can be analysed by the help of the so called „A” and „B” images. Conformity of the measuring system to the requirements drawn up in the standard was certified by DB Systemtechnik GmbH.

Evaluator's work is greatly helped by video records of rails in good quality and the semi-automatic evaluating function. Video records about the given tested section can be saved into a separate video file together with positioning data.

Eddy-current measuring system

Eddy-current measuring system, installed on the measuring train and supplied by the German PrüftechnikLinke & Rüh-eGmbH. (PLR GmbH.), has 4-4 pieces of measuring probes for each rail for the detection of Head Checking faults resulting



Head Checking rail fault

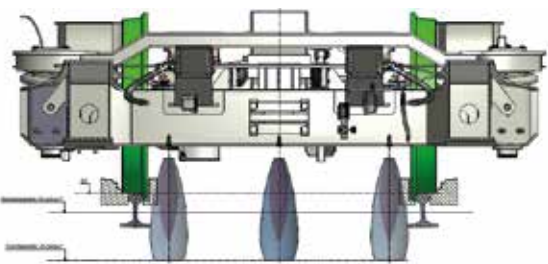


Eddy-current measuring graph

from rolling fatigue load. Inspection mechanics stretches in front of the wheels of the measuring bogie through a cantilever beam. Qualification of faults is executed on the base of damage depth, its maximum value by meters and the crack piece-number belonging to the given meter that is supplied by the measuring system for both rails even at inspection



Eddy-current inspecting mechanics



Level crossing detecting sensors

speed of 70 km/h. A measuring graph can be created from the results which represents the measured characteristics in the function of the covered distance in picturesque form. Eddy-current measuring system also owns the certification of DB Systemtechnik GmbH.

Presently an automatic turnout and level crossing detection system is under procurement for the eddy-current equipment. With this completion the number of missed sections from the examination can be reduced to minimum.

Corrugation measuring system

Corrugation measuring system was realised by MÁV CRTI Ltd's own development. Corrugation of the rail surface is measured on the base of induction principle then characteristic wave length and amplitude are determined with the help of a math-



Corrugated rail section

ematical model. Evaluation of the measuring results is executed in the range of short wavelength. In case of amplitudes RMS value according to the standard is also calculated on the base of which rail grinding works can be planned.

Rail profile measuring system

Technical specification of rail profile measuring system is finalized nowadays pursuant to which the applicants in the future should make a tender for their offered equipment. Besides the price essential aspects will be

the conformity to the drawn technical specification, fulfilment of accuracy criteria and flexibility in alignment with MÁV CRTI Ltd's special demands. Due to contact-free examination technology this equipment will be installed not on the measuring bogie but on the chassis of the measuring coach close to the running bogie.

Central controlling system, complex evaluation of the results

In favour of reaching the basic demands, described in the preamble, the expectations were drawn up to the suppliers of the already procured measuring systems, which are needed for the realization of the complex rail diagnostic system imagined by our firm. In the course of the new development the requirement of controlling

to hold parallel the control of 4 measuring systems in one hand. In front of the measurement leader a monitor wall was created on which beside the screens of the individual measuring systems the camera pictures substantial from examination point of view can be displayed.

The complexity of the system on the other hand rests in the evaluation. The evaluated results of the individual measuring systems can be matched in the system helping the evaluator's work in order to make the utmost information available about a given fault and about its surrounding for decision making.

Presented non-destructive rail examinations are the most important in rail diagnostics, and in the course of its development and application MÁV CRTI Ltd., holds



Measurement leader's panel with the monitor wall in the measuring coach

the individual measuring systems from a common interface received an enhanced emphasis. Handling and controlling of measuring equipment by the measurement leader can be executed through a central system which supplies all the systems with instructions concerning the measurement (measurement starting, cessation, finishing) and with synchronized positioning data (distance signal + GPS coordinate). So the „Central controlling system" realised in MÁV CRTI Ltd's own development enables the measurement leader

a strong market position in Central European area. Our experts execute preparedly the railway track diagnostic activity with high professional experience to which FMK-008 measurement train can open new challenges and perspectives. Approaching to the end of this great-volume investment we think that the technical background is ensured in order to remain faithful to our main principle also in the future which is supplying as high-quality service as possible, which serves our partners' satisfaction.

Special Bogie for FMK-008 Measuring Train



Árpád Krisztián

Managing Director

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In 1892 the Imperial and Royal Southern Railway Company established eight workshops in Hungary for repair of railway wagons one of them was the Repair Shop of Székesfehérvár. This more than 100 year history of railway mechanical engineering and continuous developments and investments grounded wagon repair, component and steel-structure manufacturing activity of today's MÁV VAGON Ltd. which has been owned by MÁV (Hungarian State Railways) since 1993.



Excellent expert team of our firm, continuous technological developments and manufacturing experiences of several decades resulted that for the ordering from MÁV CRTI Ltd. we produced a special bogie for FMK-008 measuring train which meet the special customer's demands and counts as a new milestone of railway vehicle production.



Presentation of the frame holding the measuring head

The measuring head holding frame is a special bogie which was planned and produced for FMK-008 measuring train. The bogie is suitable for carrying equipment executing the ultrasonic and eddy-current examination of rails. Electric signs of sensors get to the processing equipment located in the measuring train through cables.

Measuring bogie in basic position is suspended on the chassis of the measuring coach. For measurement the fixing of the bogie are unfixed by pneumatic cylinders, and actuators – mechanical structures driven by electric motors – lower the bogie on the railway track with the help of wire-rope cables.

The frame holding the measuring head consists of two frame-parts, both frame-parts consists of one longitudinal beam

and one cylindric crossbeam. Crossbeams can be matched as a telescope which enables the two longitudinal beams to draw away parallel from each and their approach, and the angular rotation of the two longitudinal beams according to each other. This construction enables that the bogie could trace the vertical and horizontal track faults.

Ultrasonic transmitting and receiving heads are mounted on the bottom of longitudinal beams between the wheels. Their moving up and down are executed by pneumatic cylinders through mechanisms. Inspection heads of eddy-current measuring equipment of which has an individual positioning system are mounted on consoles at the end of longitudinal beams.

Main sizes of measuring bogie

Length of the bogie: 2488 mm

Width of the bogie: 1970 mm

Height of bogie measured from the top

We serve different partners on three characteristic activity fields with high-level fulfilment of market demands.

- Our basic task is the repair and production of railway wagons and passenger coaches. Coming from our sizes first of all the realisation of smaller series and individual tasks are executed at our firm.
- In the field railway vehicle components – utilizing the possibilities of our forge shop – we can totally cover the demands.
- In the field of General steel-structure and mechanical engineering production we are the supplier for big companies of our region first of all for our partners who deliver for German linguistic area. In professional area the steel-structures made by our welders with European qualification and treatment of high accuracy pieces with considerably need for chipping raise our reputation.

of the rail, without drawbars: 823 mm

Height of the bogie frame upper cover plate measured from the top of the rail: 600 mm

Axle base of bogie: 1900 mm

Wheel diameter new: 460 mm

Track gauge: 1435 mm

Tracking of track gauge: between 1480-1420 mm

Width of suspension: 1500 mm

Length of suspension: 1900 mm



Electric bus

When You Need to Roll...

Our company provides an overall service for our Customers in the field of system design of electric vehicles such as trolley-buses, electric buses, diesel-electric and hybrid locomotives, electric boats and free-time e-cars.

Furthermore we offer solutions for low power applications of vehicle traction motors (wheel-hub motors) and the relating drivetrain equipment.



In case of either refurbishment or new vehicle design of road and rail vehicles dedicated for passenger or goods transportation we offer for our Customers the following activities:

- elaboration of main design conception (characteristics and running simulations, energy balance estimation, etc.) and providing its feasibility study in order to find the most economical solution for installing new and refurbished units or replacing ones,
- elaboration of main arrangement, detailed design of mounting the traction system components,
- preparation of complete system documentation (control and power current schemes, assembling documentation, cable layout diagrams and cable harness design),
- software development of vehicle control equipment and diagnostic facility,
- performing test runs and procedures to set vehicles into operation.

Modernized Tatra tramcar



System design

Our company's experts, thanks to their experience and knowledge, particularly work in the field of vehicle traction, system design and the relating information system topics.

During projects we deal with asynchronous and permanent magnet AC traction system design and also with chopper controlled and traditional resistor controlled DC traction system design. Furthermore we deal with drive system specification and, depending on contractual situation, with manufacturing or purchasing of them.

Regarding the different sources of energy we design vehicles powered by AC or DC overhead line, on-board traction battery group, diesel-generator set or the combination of these. However we also take part in unusual solution design with pleasure.

The processor based control system design and manufacturing are individual or traction system specific tasks which provides high level diagnostic functions as well besides the vehicle operation.

During vehicle design we prepare the concept of traction and control systems based

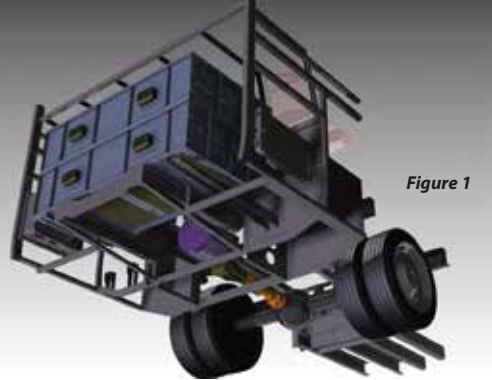


Figure 1

on technical agreement with our Customers. Based on calculations and simulations we define the parameters of power current systems then we elaborate the control system arrangement fitting it to the special task. We specify the operational software of chosen controller in detail. During software development we test the sub-modules of software in laboratory and if possible in operational circumstances.

In software programming we use our standard and many times approved software modules and solutions. Thus the work can be accelerated and what is more important the reliability can be increased. We make an effort to use modular arrangement when placing the power current and control components into the vehicle. The single units can be tested partly or totally immediately after assembling. After assembling the vehicle we carry out the tests that are required by standards and requested additionally by our Customers. These examinations concern insulation, endurance and running tests. Then we test the functionality of operational software totally and even the whole vehicle on a system level. Furthermore we undertake training of mechanical experts of our partner companies in a vehicle refurbishment or modernization project, giving technical management even in the framework of a technology transfer project.

Software development

Our software design activity covers the development of operational software on PLC or PC based controllers, remote controllers, data acquisition and display systems and human-machine interface units (operator panels, panel PCs). Furthermore,

involving our partner companies, we can provide embedded software based applications.

Our engineers perform their work relying on their decades of experience in the field of vehicle control and traction system design when they elaborate a specific operational structure and control concept. During the software development we strive to follow the modular architecture to achieve the aim of a clearer structure and later an easier possibility of modification on wish. We implement all software with up-to-date development environments like CoDeSys, SELECTRON Symphony, SELECTRON TOP 1131, SELECTRON CAP 1131, C++ Builder, etc. Communication protocols we use: RS 232, RS485, ETHERNET, CANOPEN, SAE J1939, WTB, MVB.

All software passes through a careful and detailed preliminary and site tests during setting it into operation. After the final software is approved the full version is given over to our Customers or given on trust at a lawyer or notary depending on the agreement in the contract. This solution enables later modification or failure investigation easier for our Customers in case of our company is obstructed because of any reasons.

Vehicle construction

Our engineers can prepare designs of mechanical parts of vehicles by the means of most modern, most widespread 3D CAD software. In most cases components of our system designs are integrated into the structure of vehicle by our mechanical engineers. The structure modifications for installation and the assembling documentation also can be provided by our engineers.



Figure 3

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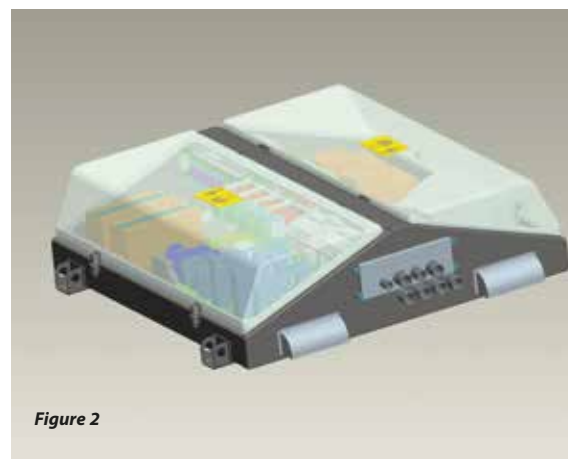


Figure 2

Besides the vehicle structure modification our mechanical engineering capability covers the newly designed traction containers and control boxes as well (Figure 1). The mechanical designs of course consist of the cable layouts and wire harnesses both in container level as well as complete vehicle level too (Figure 2).

Design of the traction battery group

Our team designs special traction battery box for NiMh and Li-ion battery cells with suitable ventilation or air-condition system.

We design:

- enclosed container,
- fully integrated system (main fuses, BMS, cooling, optional heating) consists of Lithium Iron Phosphate (LiFePO₄) maintenance-free battery cells,
- installation on the roof or in the rear or on the side of the vehicle,
- forced air cooling with internal cooling circuit,
- monitoring and balancing battery cells, with SEDPRO BMS (Figure 3).

Stadler is Making Its Mark at InnoTrans

Once again, Stadler will be presenting revolutionary rail vehicles at InnoTrans in Berlin. Stand 103 in hall 2.2 and our stands on the outside exhibition area will focus on presenting modern and individual vehicle concepts.

Figure 1


STADLER

▶ Their technical innovations, high performance and environmentally friendly aspects really set these vehicles apart. Stadler Service will be presenting its spectrum of services at stand 238 on the outdoor exhibition area: maintenance, provision of spare parts, repairs and modernisation of rail vehicles. Stadler will also be offering information about education, studying and internships at the career point in hall 7.1 c.

EC250, the world's first standard low-floor high-speed multiple unit, will be cruising through the newly opened Gotthard Base Tunnel from 2019 and this is a highlight amongst the new products on display. Further innovations that will be presented on the outdoor exhibition area from 20 to 23 September include FLIRT for The Netherlands, the diesel-electric EURODUAL locomotive for the UK, the VARIOBAHN for Aarhus/Denmark, the CITYLINK tram-train for Chemnitz/Germany and a sleeping coach for Azerbaijan. For the first time, a model of the new S-Bahn Berlin in a scale of 1:25 will be presented at the Stadler stand.

Stadler will be presenting the following six vehicles on the outside area at the InnoTrans:

EC250, a low-floor high-speed multiple unit for SBB, Switzerland

First up, our brand new product – Stadler's very first high-speed multiple unit – is the main highlight at this year's

Figure 2



Figure 3



Figure 4





InnoTrans. This high-speed train is being built for the Swiss Federal Railway (SBB) and is a symbol of the company's innovative capacity.

In October 2014, SBB ordered 29 eleven-part high-speed trains from Stadler, of the model EC250. Less than two years later, the first carriages are already being presented at InnoTrans! The electric multi-system train units reach speeds of up to 250 km/h and will be certified in accordance with TSI-Highspeed regulations. Step-free, low-floor access, air conditioned passenger compartments, multi-functional and bike compartments and modern WC systems – user friendly for families, seniors and people with limited mobility – ensure a comfortable travel experience. Each of the trains has 403 seats, of which 117 are first class and 286 are second class, with 17 seats in the dining compartment. The extensive comfort features and the transparent and open design contribute to the high-quality travel experience. Beginning in 2019, the trains will travel in record time from Zurich to Milan and later from Frankfurt to Milan. The trains are suitable for use on both conventional and high-speed tracks. Tried and tested technologies will be combined with the operational requirements of the new trans-Alpine base tunnel. Also, the trains – baptised “Giruno” by SBB – will be authorised for use in Germany, Austria and Italy (Figure 1).

FLIRT for NS Reizigers, The Netherlands

In April 2015, the Dutch railway company NS ordered 58 three and four-part low-floor multiple units of the model FLIRT. The trains will be operated by NS Reizigers, used on regional tracks and are intended to travel at speeds of up to 160 km/h. The new FLIRT generation fulfils technical specifications for interoperability TSI PRM, as well as the standards for crash regulations pursuant to DIN EN 15227. The trains' air suspension systems offer an outstanding level of comfort: Able to accommodate between 158 and 214 passengers (depending on the length of the train), the trains offer comfortable seating in an air conditioned, colourful interior. Space is also available for bikes, pushchairs and wheelchairs (Figure 2).

EURODUAL Locomotive, UK

Intended for use on secondary freight routes, locomotives also need to be able to travel without electricity, if necessary. This dual mode locomotive was developed with this in mind. It can be operated using either electricity or diesel. The hybrid locomotives offer the required operational flexibility and reduce transport costs because the same locomotive can be used on all tracks.

The EURODUAL is a versatile locomotive with an impressive electrical performance. With up to 7000 kW, even very heavy trains can be transported on busy sections of track at a reasonable speed. The powerful 6-axle locomotive has a driving power of 500 kN (Figure 3).

VARIOBAHN for Aarhus, Denmark

Stadler will supply the new light rail system in Aarhus with 12 TANGO light rail vehicles and 14 low-floor VARIOBAHN trams. The bidirectional vehicles can be accessed at platform level thanks to a floor height of just 385 mm (100% low-floor). Variobahn is a modern tram with a modular construction and a high level of flexibility in terms of its length, width,

gauge and the catenary supply voltage. The trams for Aarhus are equipped with air-conditioning and passenger information system. They also have modern LED lighting that adjusts automatically to suit the amount of daylight, as well as Wi-Fi for passengers and sockets in the seating areas (Figure 4).

CITYLINK for Chemnitz, Germany

Verkehrsverbund Mittelsachsen is planning to use 8 hybrid tram-trains. The vehicles are intended for use on the light rail system and on the mainline rail network. The tram-trains can reach maximum speeds of up to 100 km/h. For this reason, the bidirectional tram-trains have been designed pursuant to BOStrab and EBO and are even capable of operating under an additional voltage of 600V/750V DC or using diesel on the tram network. The vehicles are also suitable for use on platforms with different heights and are equipped with toilets and luggage racks. The modular, barrier-free and low-floor light rail system offers passengers a high level of security and comfort – not least due to the passenger information system and the quiet operation (Figure 5).



Figure 5

Sleeping Coaches for Azerbaijan

Stadler is building sleeping coaches for the state rail network in Azerbaijan (ADY). They are intended for international use on the route from Baku (Azerbaijan) via Tiflis (Georgia) to Kars (Turkey) and then on to Istanbul. The carriages have been

fitted with a pivot mounting with an adjustable gauge wheelset to ensure that they can be used on both the typical Russian broad gauge tracks used in Azerbaijan and Georgia as well as on normal gauge used in Turkey (and the rest of Central Europe). The operational speed is 160 km/h. Every carriage is equipped with an emergency power generator that allows the carriages to operate for 24 hours without using an auxiliary power supply line charged by the locomotive. The coaches are equipped with vacuum toilets and showers (in each first class compartment). The compartment for disabled passengers is fitted with wheelchair lifts and a cabin for the attendant. The carriages fulfil GOST and UIC specifications (Figure 6).

Presentations by Stadler:

20.09.2016 11 am-12 pm
Platform 9/40, position 1
FLIRT presentation
(for NS, The Netherlands)

20.09.2016 2 pm-3 pm
Platform 8/43, position 2
Presentation of the diesel-electric EURODUAL (for Beacon Rail Leasing Limited (BRLL), United Kingdom)

21.09.2016 11 am-12 pm
Platform 4/15, position 5
Presentation of the Variobahn (for Aarhus Letbanen I/S, Denmark)

21.09.2016 2 pm-3 pm
Platform 8/40, position 1
Presentation of the EC250/Giruno
(for the SBB, Switzerland)

22.09.2016 11 am-12 pm
Platform 4/29, position 16
Presentation of the tram-train CITYLINK Chemnitz (for Verkehrsverbund Mittelsachsen (VMS), Germany)

22.09.2016 2 pm-3 pm
Platform 9/42, position 2

About Stadler Rail Group

Stadler has been building trains for 75 years. Based in Bussnang, Eastern Switzerland, Stadler provides solutions for rail vehicle construction. Approximately 7000 employees work in productive collaboration in locations in Switzerland, Germany, Spain, Poland, Hungary, the Czech Republic, Italy, Austria, The Netherlands, Belarus, Algeria, Australia and the USA. Stadler offers a comprehensive product range in the field of standard gauge railways and local city transport including: high speed trains, intercity trains, regional trains and rapid transit systems, metros, tram-trains and trams. Furthermore, Stadler manufactures main-line locomotives, shunting locomotives and passenger carriages and also produces Europe's most powerful diesel-electric locomotive. Stadler remains the world leader in the production of rack-and-pinion rail vehicles. Stadler Service is responsible for maintaining 16 vehicle fleets comprising over 300 vehicles with an annual kilometre reading of 72 million kilometres.

In 2016 Stadler became part of a historical project: The world's longest railway tunnel, the Gotthard Base Tunnel, was officially opened in June. From 2019, the new "Giruno" Stadler Gotthard trains will transport passengers through the tunnel from Switzerland to Milan in record time, and later from Frankfurt to Milan.

Further Stadler statistics: Over 1300 instances of our bestseller FLIRT (Flinker Leichter Innovativer Regional Triebzug - Fast Light Innovative Regional Train) have already been sold in a total of 17 countries. Our KISS (Komfortabler Innovativer Spurtstarker S-Bahn-Zug - Comfortable Innovative Strong Spurt urban train) model is also in high demand: 216 instances have been sold in 7 countries. Europe's most powerful diesel-electric locomotive, the EURO 4000, has been sold 130 times in 7 countries.

Figure 6



Presentation of sleeper cars (for Azarbycan Damir Yollari (ADY), Azerbaijan)

Where to find Stadler at InnoTrans:
Hall 2.2/stand 103 – main stand
Outside exhibition area O/stand 238 – Stadler Service
Hal 7.1c/career point stand 201i
Open-air exhibition ground sites: T9/40, T8/40, T9/42, T4/15, T4/29, T8/43

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Railway certification activities of KTI Institute for Transport Sciences Non-profit Ltd.

KTI Railway Certification NoBo & DeBo

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KTI Institute for Transport Sciences Non-Profit Ltd. (KTI) founded in 1938 is one of the research bases of the Hungarian Ministry of National Development. The almost 80-year old institute has a remarkable prestige among Hungarian research organisations and European transport research institutes proved by the high number of its recent successful projects and the wide-ranging international connections of KTI.



▶ KTI Institute for Transport Sciences Non-Profit Ltd. has been awarded as a Notified Body (NoBo, NANDO:NB 2071) by the European Committee, and based on it – following the relevant European Union and national procedure – the Institute was appointed by the Hungarian National Transport Authority for certification (assessment) activities in the whole railway sector. KTI is entitled to execute all of the tests and inspections which can be used for the assessment of the conformity of any subsystem being a part of the railway system, namely railway infrastructure (INF, PRM), the rolling stock that using it (RS), energy system (ENE), control-command and signalling (CCS), as well as its constituents, components, subassemblies and main parts – so-called system elements – that they comply with the interoperability conditions. KTI – in addition to its NoBo activities – is recognized by the Hungarian National Transport Authority as Designated Body (DeBo), certifies the conformity of system elements and structural subsystems in accordance with the requirements of the Hungarian national regulation acknowledged by the European Commission. Its activities as NoBo and DeBo institution – in compliance with the official authorization procedure related on railway facilities, equipment and vehicles – go through the railway establishment phases starting with design via the whole manufacturing and construction period up to the acceptance of the subsystem before its putting into operation.

KTI Directorate for Certification performs certification procedures, and issues related certificates to the applicants using its own experts whose expertise is approved by the National Transport Authority, its own laboratories and – if the special nature of the task necessitates it – by the inclusion of external specialists.

The certificates issued by KTI as an independent body ("third party") based on the tests and inspections done following the requirements of transparency, traceability and reproducibility guarantee unanimously that the certified product – whether it is a whole subsystem (e.g. railway track or an engineering structure) or a system component – totally complies with the strict requirements of European Union and national specifications. Thereby the certificates can be considered as important reference documents for designers, manufacturers or building contractors since the documents are valid in each European Union member country according to the Directive 2008/57/EU.

As a part of the international activities of KTI, the leaders and the specialists of the Directorate for Certification actively participate in the work of European Railway Agency (ERA) and NB-Rail, the coordination group of notified bodies.

Please contact us with confidence! KTI Directorate for Certification is your devoted partner in the certification of the suitability of railway subsystems and system elements considering the European Union interoperability requirements and the related Hungarian national rules.

Precise and Reliable Delivery Pays Dividends

Just like two years ago, the Hungarian owned Jármű Zrt. will again showcase its products at the InnoTrans in Berlin. The company is an active participant in the European vehicle manufacturing industry as it is a supplier to all the four significant European programs.

▶ They participate as system suppliers in the ICx program of the German Railways, they produce subassemblies for the double-decker trains of Bombardier made for the German – DO 2010 Doppelstock – and the Swiss – SBB FV-Dosto – railway companies. In addition to ICx they received major orders from Siemens for the British suburban trains – Thameslink. The high quality parts also attract the attention of passengers aboard the RailJet trains with premium category, also in service on the railway lines in Hungary, in which certain fittings and assemblies are the products of the Hungarian manufacturer. These include the luggage shelves, the suitcase racks and the partitions. The Austrian Federal Railways (ÖBB) ordered seven additional RailJet trains over the past two years that have already been built, so this order has been delivered – said dr. József Forgács, CEO of Vehicle Components Plc. The case of the ICx-program is different, it is a further link

with Siemens, which provides orders for the company and the employees in the long run, up to 2032. The testing period of the ICx trains ordered by the German Railways (DB) has been completed, therefore, mass production may commence in September. Seven trains have been built so far, however if DB calls the total option, as many as 1800 railway cars may be produced supplying the luggage racks for them by the Hungarian company. At this time, it is Bombardier which gives the biggest order to the company. They are the supplier of windows, luggage racks and seat brackets for the 8-car InterCity multiple-unit motor trains of SBB. The passengers also encounter the Vehicle Components Plc., products aboard the Doppelstock trains and the suburban multiple-unit motor trains in England.

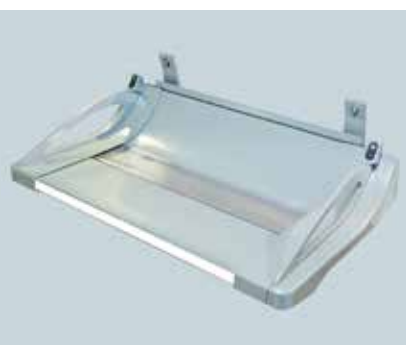
The offerings have also been diversified in the past two years: the plants of the Vehicle Components Plc. now also produce handrails, suitcase racks, internal as-



semblies and waste boxes for railway cars to meet the substantial demand for such items in the marketplace.

The most profound change in the Hungarian market may be brought by the InterCity (IC)+ program launched by MÁV-Start. If the envisaged mass production commence, the company may also be a key supplier for this program, although the manufacturer calls for tenders concerning all the subassemblies. Tables, windows, luggage shelves and internal covers, made by the company, were installed on the board of the two prototype carriages built so far, and the automatic front door is also the product of the company. As József Forgács highlighted, a lot has been done to restart rolling stock manufacture in Hungary thus they also rely on the IC+ program.





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training school. There are eight development engineers working at the entire company, and all machining centres are CAD-CAM controlled – this is how the quality demanded by the clients can be met. Future development is guaranteed by the introduction of integrated workplace management system with the completed implementation of the necessary modernisation and refurbishment projects.



At this time 99.5% of the firm's output is exported. The demand for railway rolling stock in Europe is also reflected by the performance of the company as the income increases by a significant rate. The annual revenue rose from 10.23 million EUR in 2014 to 11.86 million EUR in 2015. The company, celebrating its centennial this year, has always manufactured fittings for trains, coaches and buses. The company underwent a complete shakeup in the past ten years as a result of which they opened a new plant at Tiszavasvári (a town in eastern Hun-

gary) in October 2012, besides the Budapest one. Since that time the third production hall has already been opened in the town on the banks of the river Tisza, the local number of employees has grown to 75, bringing the total headcount of the company to 180. The long-term plan is to establish the Tiszavasvári branch as an autonomous business unit. As the CEO says, at this time there is no manpower shortage, adequate numbers of candidates apply for the vacancies advertised, and moreover, good relations are maintained with a local vocational

The renown of the company is well exemplified by the fact that they have also won tenders where their offer was not the cheapest one and Siemens voted them its best supplier in 2011. Precise and reliable work is appreciated not only by the market but also by the state decision-makers: after InnoTrans 2014 this company was awarded the Prize of the SME of the Month in recognition by the Ministry of National Economy.

Gábor Putsay

ARON-RCS – as flexible, client orientated, environmentally friendly, multimodal freight system

Rail Freight System in the 21th Century

The innovation of rail freight transport has slowed down during the last decades, so the out-of-date rail services cannot provide appropriate answer to the challenges of logistic sector. It is more and more urgent to develop such a flexible rail freight system which fits the present infrastructure and can be a competitive system in this market. We intend to find out the solution of this problem that is why we have developed ARON-RCS system.

▶ The multimodal transport looks back at about 50 years of history. During this time technologies have been developed continuously. This has brought the demand of transporting more and more by containers, semi-trailers and swap bodies, and thus the development of the related wagons too. Today the swap bodies, containers and semi-trailers transported on road have reached the biggest size that is authorized on the roads. There is just a little possibility to enhance them because road infrastructure does not allow it. The only way to develop the high distance road transport is to apply road trains with two or more trailers however it raises many other problems although

it is really effective. This is an often used solution in the sparse traffic areas of the northern states in Europe but on central Europe's crowded highways it is just being used on an experimental basis. Road transport causes huge environmental and social damage against to its economic utility so it is important to improve rail transport in perspective of energy, safety and environment too. Developing flexibility, accuracy and reliability are key issues because there is just this way to develop railway freight transport. Naturally we also mean break bulk shipping to the modern transport technology items where the cargo is delivered in containers and swap bodies as unac-

companied transport, and that has got the greatest development potential in technical and business sense too. However the currently used container trains, moving between two points/terminals, cannot satisfy economically all of the needs. That is why we have developed our brand new railway operation technology, the ARON-RCS freight system, which is patented.

As the solution to the problems mentioned above, Living Minimundus Environmental Foundation started a research with universities and technical organisations and they have developed a brand new rail freight transport system called ARON-RCS.

The ARONfreight DMU's/EMU's primary aim is to increase multimodal rail freight traffic's volume. One of our main tasks was to develop such mobile device which can load and unload standard containers, swap bodies and semitrailers. An important point of this invention is the container / swap body moving device placed on the trains. The primary objective of the lift-

ing system is supporting quickly and automatically the in- and off-loading of the motor vehicles of the train. It can operate fully automatically without the need of sidings, logistics bases and built loading infrastructure. The introduced train system can move independently anywhere, does not need shunting and marshalling. Its size suits for the freight task; it can be easily managed, fast and comfortable due to the modern information and communication system and cargo management system. Its own loading system allows the loading and unloading at different terrain and even on track. This increases the efficiency and the number of economically performed freights. Economic operational area of ARON system on Europe's network is 500-1500 km. Stepping over the border of Europe, it is 1500-3500km even if there is a break-of-gauge, because this system can vary gauge.

Possible train variations

The ARON system is a modularly built train that can be modified according to the needs every time. The base unit is a twin carriage. Twin carriage consists of an „A” type unit with driver's cab and one power unit (Diesel or electric).

The vehicle system is built from 4 base units.

- Types of wagons
 - „A” train unit with train driver's cab
 - „B” train unit with Diesel power supply
 - „C” train unit with electric power supply
 - „C1” AC electric power
 - „C2” DC electric power
 - „C3” Accumulator
 - „D” train unit without power supply

With the variation of these unit types and of the drive system in practice we can build almost infinite number of DMU/EMU combinations for the needs of the shipping and railway companies. Trainsets are composed by the client



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requirements. All compositions have a twin carriage at both end of the trainset. Between twin carriages the unit type „B”, „C” and „D” can be coupled. A great advantage that it keeps the flexibility of determining the number of the wagons in the train however it does it in a modern way. The ARON system can run in both directions (return freight) due to the flexible composition.

Shared drive system

ARON system has a shared drive system. It means that more axles are driven. The shared drive can eliminate the potential negative impact of conventional engine traction with limited acceleration and

dynamic braking abilities. But during the design we especially paid attention to that the axle load altering of each axle - primarily the driven axles - must stay under controlled limit. The drive system will be distributed between the wagons, bogies and axles thus the slack action between loaded and unloaded wagons will be limited enough as the driven and braked axles are positioned equidistantly. This can be a really big advantage in case of different course conditions and line conditions (like running upwards, on slope, in narrow arcs and the combinations of them). Shared drive system results higher acceleration and the train can proceed with constant velocity independently of the number of units and with higher reliability. So our technical upgrade contains lots of new parts thus it is a new approach to use shared drive DMU/EMU in freight traffic, unified unit design without locomotive on favourable cost of production and operation. The bogies of the vehicles have been prepared for the design phase to incorporate the variable gauge axles.



Brake system

The brake system of the train is the reliably operating modern railway air-brake with electronic control, but the main service brake is an electrodynamic brake differently from the freight trains practice so it can grant rapid deceleration due to the more driven axles.

The brake systems and the other systems will be built according to customer requests corresponding to the respective rail standards. The electric brake grants the energy-saving and quiet operation moreover it doesn't abrade the disc brake.

The technical configuration allows a speed of 160km/h in case of special configuration. Maximum speed of basic configuration is 140km/h.

Limits of axle load

The ARON unit can be classified to C and D axle load class, the design of the brake system, in both cases, allows the high-speed transport. The axle load effects on the adhesion ratio of the propulsion, but it levels off on the vehicle because this train has more driven axles. The modern drive system architecture grants the economic operation at any train composition. The user-friendly communication system, which is developed for the train, allows a really new quality of cargo handling in railway freight transport.

Summary

The applied technical solutions grant that this vehicle system can be a real rival of road freight transport considering the



time of transmission and the costs too. Its environmental and social advantages are numerous and similar to the international intentions. In our point of view it is an area that has a great development potential in economy and in technical solutions too. By installing this train system, road load would be less and utilization of railroads would be better. Thus there would be less environmental impact and environmental damages of accidents and congestions. Energy balance would be better mostly because of the railway traction that uses electricity. The on-board loading device offers a breakthrough; it doesn't require any special infrastructure and can load containers, swap bodies and semitrailers almost anywhere. The train has user-friendly control, telecommunication and cargo handling system that brings an entirely new quality of service. Freightage would be lower and environment friendly freight transport would be improved between countries.

Advantages of our new system are:

- Nonstop timetable

- No marshalling and shunting
- There is no special track requirement
- ARON system has an automatic variable gauge feature
- No dangerous emission
- Rapid on-board crane system
- Flexible train structure
- Client orientated
- Safe consignment
- Self-managed door-to-door service
- Short transport time

The ARON-RCS system is a Hungarian research and development of Living Minimundus Environmental Foundation. Nowadays we are working on the prototype with the domestic industry, and we are looking for investors.

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Maintenance of Rail Infrastructure in Hungary



The Hungarian rail infrastructure is managed by two infrastructure managers. The largest is MÁV Zrt., (Hungarian State Railways) with a network of approx. 7300 km's.

▶ Accession of Hungary to the EU in 2004 signified a milestone in rail infrastructure development that set or made possible a fundamentally new direction.

The decade when the political and economic system got changed and the subsequent c. 15 years were spent in monotonous underfinancing, coded in a gradual

missioning of TSI's between 2000-2004. EU funds slowly opening up facilitated a gradual turnaround of run-down processes and put them on a novel track of growth.

The years following 2004 and the next 15 years we have been living in since our EU accession have offered and do still offer a string of new investments that demand



slowdown of the system, coupled with organizational changes in MÁV Zrt. Our railway lines – and numerous sections of it more specifically – have gradually broken down, cannibalized their technological reserves and new kinds of issues (eg., head check) have emerged. Thus, a heterogeneous network cracked like a mosaic came into being, with major deviations in its characteristics.

Investments undertaken from PHARE and EBRD sources have partly stabilized the operation of the network; they were followed by approximation to the EU legal system, designation of corridors and com-

a rethinking of maintenance issues and work philosophy. Let us not forget that these few lines intend to put forth some thoughts about how to put track maintenance in a new context. A high number of new technologies, professional guidelines, structural developments and diagnostic tools have appeared during the course of our time travel, the legal and public procurement environment has also fundamentally changed thus the time had to arrive for the formulation of new strategies. And it was not by chance at all – it clearly followed from the internal logic of processes and events.

It became obvious that if we want line reconstructions to retain their expected quality and thus to improve the structure of the timetable, a new quality of thinking is needed, mostly in the field of maintenance.

Quality investments already effected have to be coupled with a novel track maintenance system that would be able to guarantee their long-term survival.

At present, adherence to the track parameters, licensed by the authorities, is either not possible or is only possible through the mobilization of major additional resources on a significant part of our network.

Certain lines and sections cannot be maintained by classical maintenance methods anymore. If we want to guarantee reliable and safe rail traffic, these lines and sections will need to be rebuilt in the foreseeable future, or, alternatively, licensed track parameters will need to be downgraded.

The coming into being of the current technical situation was thus greatly due to the underfinancing of maintenance and reconstruction activities, to a switch to predictive maintenance instead of the previously used scheduled preventive maintenance system and to the continuous changes in the organizational setup.

On basis of the experiences of the past period, we can state that the still existing shortage of resources and the switch to predictive maintenance lead to a rapid decline in the technical conditions of our rail lines.

The reason behind the phasing out of the scheduled preventive maintenance system was the need for decreasing high maintenance costs by undertaking maintenance only there and at the time where and when maintenance was needed.

Creation of a new and well-functioning infrastructure maintenance system requires the amalgamation of the phased out but partly „reutilized” scheduled maintenance system with its predictive counterpart. We cannot disregard the deterioration processes arising from the loads and stresses acting on rails (they create the basis for scheduled maintenance); their tracking and definition of the optimal place and time of intervention demands up-to-date diagnostic tools. The joint and harmonized use of the two systems of maintenance functioning on different bases offers an efficient and well planned utilization of available resources.

At present, introduction of the new maintenance system would only be possible in a phased manner as diagnostics-based maintenance of our technically run-down lines cannot be effected without their reconstruction.

Foundations of the new infrastructure maintenance system:

- Definition of the cycle time of line reconstruction, creation of „line maintenance categories” (rail system, sleeper spacing, axle load, speed, annual running load, all on basis of diagnostic-statistical data).
- Creation of a maintenance methodology, definition of cycle times for interventions.
- Use of an up-to-date track data registration system (PÁTER).
- Real harmonization of line inspections and measurements with rail diagnostic results (PÁTER).
- Analysis of cycle times of interventions also considering line inspection measurements and diagnostic results (statistics) – this would demand a special analysis unit like the one operating at ÖBB.
- Plannable and cost effective execution of track maintenance on basis of the analyses.

Conditions for the introduction of the new infrastructure maintenance system:

- In the first phase, the new system should only be rolled out on the lines newly re-

constructed with help of EU funding and MÁV's own resources.

- An analysis of all other lines and sections not involved in the above projects should be conducted to define which of them could be enrolled in the new maintenance system on basis of cycle times, line inspection and diagnostic measurements and analyses and the track parameters to be provided for and to be guaranteed as demanded by the timetable.
- In case of lines and sections where the new maintenance system cannot be implemented due to cycle times, line inspection and diagnostic measurements and tests, their reconstruction shall be planned and scheduled.

Advantages of the introduction of the new infrastructure maintenance system:

- Efficient use of line inspection and diagnostic measurements.
- The system makes the time planning of maintenance and reconstruction work possible, the notion of a three years rolling planning system becomes feasible.
- A cost efficient planning for maintenance and reconstruction work and investments is made possible.
- It fosters the meeting of the goals defined in MÁV's business plan.
- As the system yields itself to easy planning, large numbers of temporary and constant slow-orders can be avoided or can be phased out as per plan.
- As the system yields itself to easy planning, breakdowns and their sources can be phased out at the same time.
- As the system yields itself to easy planning, a decrease in the number of breakdown-and-disturbance kind of events is expected.
- Ordering track possessions becomes plannable and non-planned operational safety track possessions decrease in number.
- As the system yields itself to easy planning, adherence to technological discipline can be enforced.

Conditions for the formulation and reali-

István Virág

Head of Department

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Inspection and Technology

Department for Track Structures

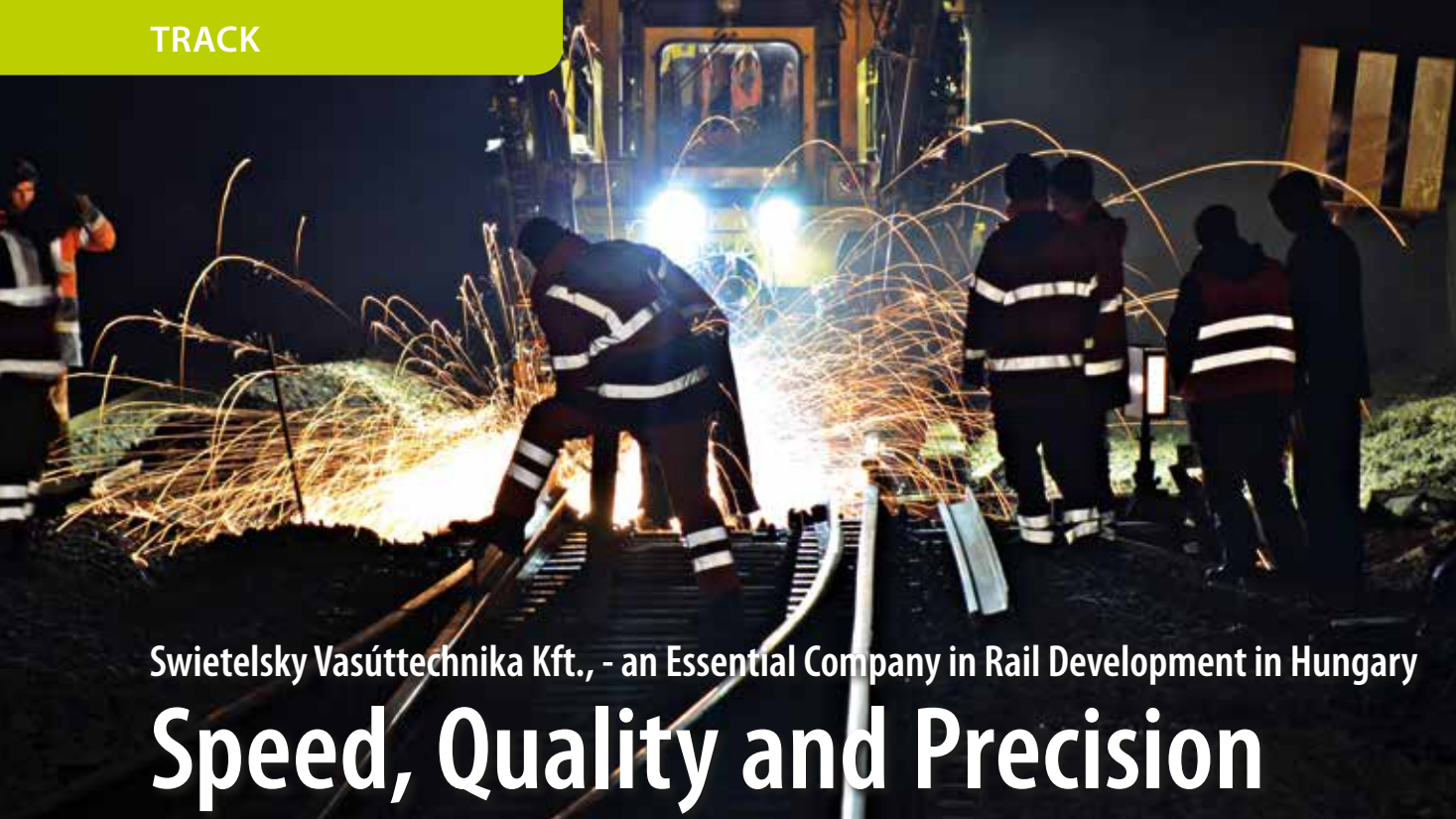
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zation of the new infrastructure maintenance system:

- Definition of and providing for the track parameters demanded by travel times planned by MÁV-START Zrt. (the passenger division of MÁV Zrt.).
- Modernization of the system of technical guidelines.
- Assessment of goods transport needs (definition and forecasting of present and future destinations and directions), definition of expected travel times and transport volumes and optimal track parameters.
- Optimization of the existing line and track network on basis of actual and forecast passenger and goods transport needs.
- Definition of reconstruction cycle times on basis of actual and forecast passenger and goods transport needs, also considering track diagnostic measurements.
- Conscious maintenance and overhaul programs need to be compiled in order to get rid of the lag in technical development apparent when compared to the parameters to be guaranteed on the network.
- Resources needed for the functioning of MÁV Zrt., for maintenance and scheduled reconstructions shall be made available on time, in the amounts needed.

The above system makes an organic part of the already approved „Track operation strategy of MÁV Zrt., until 2023, with an outlook to 2030” program, thus it will clearly support its realization from within. It is a vision that builds on past results, finetunes the present and this is how we will get to a future Europe free of (railway) borders.



Swietelsky Vasúttechnika Kft., - an Essential Company in Rail Development in Hungary

Speed, Quality and Precision

The Swietelsky group is a group of companies that has been in operation for 80 years and it is in the forefront of construction industry in Hungary and Europe alike. Swietelsky Vasúttechnika Kft., (Swietelsky Rail Technology Ltd.) was established in 2008 however it has several decades long history in rail development in Hungary through its legal predecessors.

▶ The company with its headquarters in Cell-dömölk is a market leader in Hungary due to its outstanding level of technology and well-trained professionals. The number of its engineers has been doubled since the establishment of the company and it has already more than 80 highly educated experts serving the successful realization of projects. The total number of its employees is also constantly increasing, it has risen to 322 from the original 137. Rail construction is the flagship of the company's portfolio, contributing c. 75% of all of its revenues. Besides, the company is also active in building, pillar and bridge construction and structural and machine engineering. As to railway development, Swietelsky Vasúttechnika Kft., is capable of participating in diverse work phases of projects as general or main contractor or subcontractor due to

its pool of experts and the most modern technology and tools applied.

The sweeping development of rail construction machinery and novel technical requirements urge actors of the industry to continuous development. In cooperation with its mother company, the Cell-dömölk company is capable of mobilizing



c. 150 pieces of machinery for its works. One of the most spectacular element of its machine pool is the almost 1 kilometer long, 1000 tons, 4000 kW track formation machine that is the top of

its kind in the profession. A special feature of the company is its ability to move its machines flexibly within Hungary and between different groups of construction sites due to its own logistic system.

Swietelsky Vasúttechnika Kft., has become an essential company in rail development in Hungary. It has participated



in 12 major rail investments in the 2007-13 EU programming period, including the Szajol-Püspökladány project with outstanding importance in rail development, the North-South „merging” tram line in Budapest and the rehabilitation of the Békéscsaba station. Swietelsky Vasúttechnika Kft., and its consortial partners have created the foundations for EU level rail transport on almost 400 km's of track, improving rail load capacity and increasing travel speed of rail carriages.

Speed, quality and precision - these words form the basis for the development of the company and yield it a chance to offer high quality construction services to its ever growing number of customers.

HIGH CAPACITY | PRECISION | RELIABILITY

Plasser & Theurer



Ballast cleaning in tracks and turnouts

Saving time and resources. Assuring high quality cleaning. And offering flexibility in operation too. That is Plasser & Theurer's philosophy for economical ballast cleaning. The most important foundation for sustainable track geometry is a faultless, straight formation. To produce this, the Plasser & Theurer ballast cleaning machines for tracks and switches are equipped with an excavating chain in a transverse cutter bar - adjustable precisely to the required excavating depth and formation crossfall.



Our Past Successes Are the Tokens of Our Future

A New Track Renewal Train



A-Híd Zrt., a fully Hungarian-owned company has concluded almost 150 contracts together with its consortial partners since 2008. The most important milestones of this period have been investments that are not only corporate successes but individual ones too, personal success stories of our colleagues.

Tímea Filó

A-Híd Zrt.

Chief Engineer for Rail

Engineering

filo.timea@hid.hu



▶ To highlight just the most important ones: construction of Ferenc Móra bridge over the Tisza river, reconstruction of Margaret bridge in Budapest, rebuilding a section of Motorway M0 as motorway between Motorway M6 and main road No. 51, and, in conjunction with it, the widening out of the Soroksár bridge over the Danube. Among track construction activities, the most important ones were the construction of the railway line between Óbuda (a part of Budapest) and Esztergom, reconstruction of tram lines 1 and 3 in Budapest, and, in the field of water engineering, construction of the Budapest Central Waste Water Treatment Plant and the Hany-Tiszasüly flood control reserve. Our past successes offer us a safe starting point for future ventures. This is why have we launched one of most important

investments in the history of the company that will open a new chapter in railway construction and rail maintenance. The new machines are developed and produced by Geismar SAS (France). The system will be unique in the region but has already been used at numerous places in the world for the construction, reconstruction and maintenance of track lines (tram, suburban rail, metro, railways), among others, for the continuous change of track sections of the TGV.

Our company is at service of our present and future clients with the following machines:

- PEM 807 telescopic track panel and turnout laying machine and
- LEM 460 R 1 self propelled transport trolley.

Combined with LEM 460, PEM 807 makes a complete track panel and turnout laying and transportation line. A system consisting of 2 units is capable of transporting and laying 24 meters long track panels, while the 10 unit system can transport and lay 120 meters long ones, and it can also be used for laying pre-assembled turnouts.

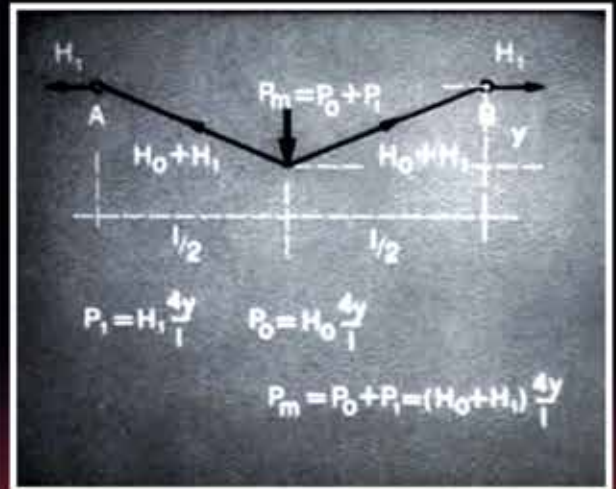
As these machines can be transported on road and rail alike, cost of their movement to the construction site is always defined on basis of the best conditions offered.

We have also purchased additional machinery required for rail construction in order to offer complete, turnkey projects. A wide range of rail construction and other auxiliary activities fostering, supporting and serving rail construction are also offered in a fast, cost efficient and highly professional manner.

The excellent developments are living on!

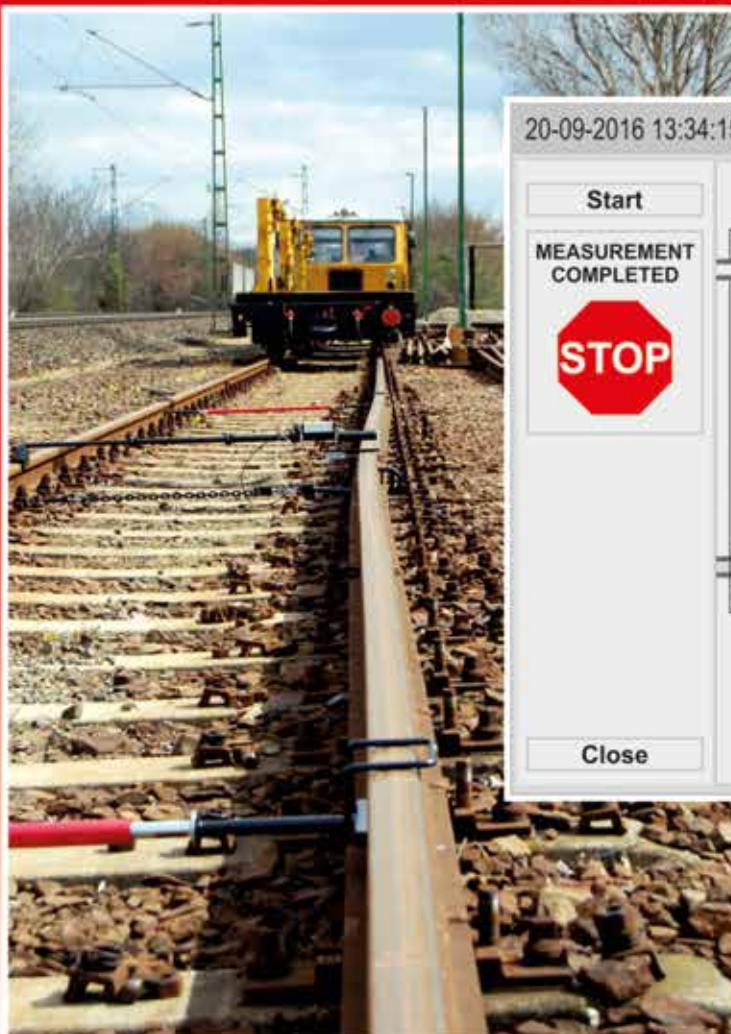


Respect for the Inventors!

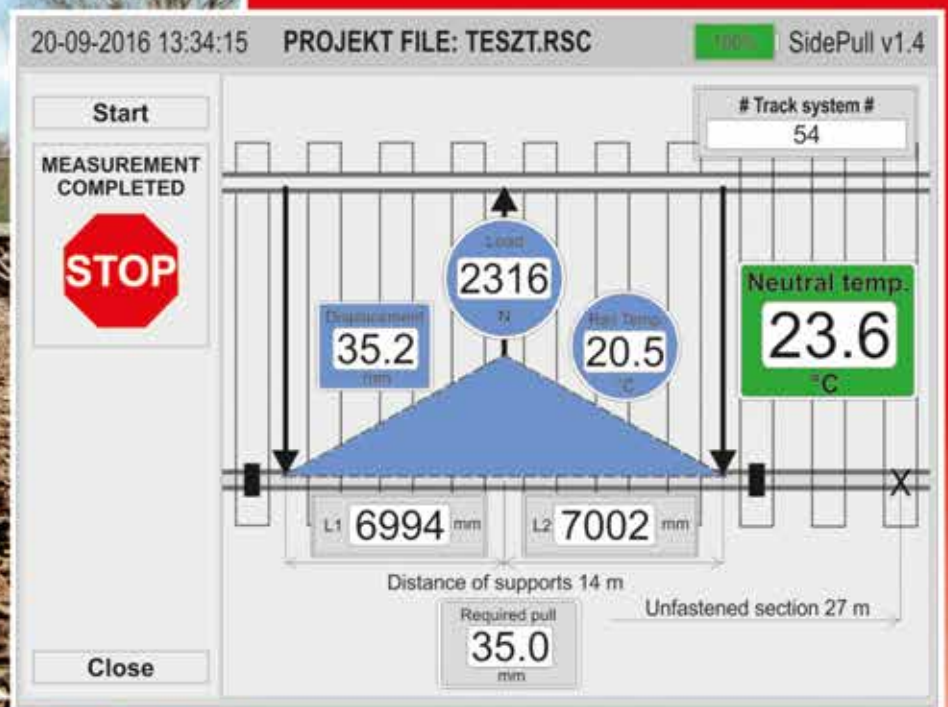


1981: MÁV Force Method

SFT measurement with 1°C accuracy - only 20 minutes in track closure!



2016: SidePull



The software controls all the processes from the recording of the parameters to the calculation of the SFT value and to the printing of the protocol!

Reconstruction of the Ústí nad Labem (Střekov) – Děčín East Railway Line (Section 503B)

Rail Construction Work in the Elbe Valley



Dávid Müller
A-HÍD Zrt.
engineer
muller.david@hid.hu



HÍD-Csehprojekt Kft., a daughter company of A-HÍD Zrt., won the tender invited for the reconstruction of the rail section between Ústí nad Labem and Děčín as a consortial partner of KLEMENT a.s., in August 2015. Work has progressed non stop since the signing of the contract.

after replenishment of the crushed stone, and alignment. At these places, finished track is temporarily removed in panels. Parallel to the construction of the engineering structures, new 55 cm high so-called Tischler passenger platforms are

▶ The complete section is 24 km's long, a double track, electrified line passing through numerous smaller bridges and one tunnel. The line runs along the river Elbe and though crosses through a varied topography, there is no major elevation in the section itself. The project consists of rebuilding the superstructure of the rail track at a length of 2x8 and 2x1 km's, changing one group of turnouts, and rebuilding 5 rail bridges, 3 pairs of out-track open platforms and 7 level crossings, all during 4 major track possessions. A further task is to renew the energy supply and electric as well as the signalling and IT system of the entire 24 km section. These latter ones are performed partly independently of the works requiring track possession.

The existing superstructure is not uniform but is mostly comprised of R65 and 49E1 rails fastened to SB5 concrete sleepers with GEO and T-type fastenings - the latter one is not used in Hungary. The new technical solution applied is based on the 60E2 rail system, with minor subsections retaining 49E1. In both cases, fastening is by Vossloh W14, on B91S/1 and B91S/2 sleepers.

A significant organizational challenge is posed by the fact that a section of 7 km's needs to be reconstructed during 60 days of track possession with significant traffic running on the adjacent track in a



way that the superstructure of the engineering structures need to be changed at the same time too. According to the master schedule, work commences with a partial change of the track formation at a length of 350 meters. After temporary restoration of the track, a SUM 1000 CS track renewal train starts working. The train is served by 3x7 sleeper transport wagons. These are unloaded at the station located at the end of the section and loaded in the factory c. 350 km's away. Having changed the rails and the sleepers, crushed stone ballast is cleaned by an SC600 ballast cleaner. As the spoil can only be unloaded at two locations, continuity of the work is guaranteed by MFS conveyor and hopper units. Reconstruction of bridge structures can be commenced

built. This prefab system consists of two parallel struts and one cantilevered cover plate that offers fine adjustment even after construction of the track.

Once the concrete sets, track panels are placed back to the bridge then partial crushed stone replacement and alignment follows, complete with welded rail construction. Intermediary welds are made by a PRSM 3.1 rail mobile resistance welding machine. Stress conditions on neutral temperature are produced by hydraulic rail tensors as per the specifications of the operator. It is an interesting observation that, as opposed to Hungarian practice, SŽDC's lines do not offer the use of SoW-5 Thermite welding technology yet, thus, final welds are produced by the SkV method.



VAMAV Railway Systems LLC

Hungarian market leader
manufacturer of the railway
superstructure

Turnouts have been manufactured in Gyöngyös since December 1951. At the end of 1991 a joint venture was established named VAMAV LLC. 50% owned by MÁV Co. and the other 50% belonged to voestalpine VAE GmbH. Today VAMAV LLC is an experienced manufacturer of railway and other steel products.

Main products

- turnouts
- crossovers
- expansion joints
- buffer stops
- transitional rails
- insulated joints
- fastening materials

Main services

- first and regular service of the turnouts
- delivery of pre-assembled turnouts
- installation of different diagnostic system
- rail grinding and milling

HUNGARY 3200 GYÖNGYÖS, Gyártelep út 1.

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Fax: +36 37/316-179, +36 37/316-226

E-Mail: info@vamav.hu

www.vamav.hu

Innovation and precision in the chemical railway weed control

Money and Chemical Saving

G&G Ltd., is an environmentally conscious company and the founders have been doing their best in order to emit the least amount of chemicals during the company's activities.



▶ We are very proud to say that today in Europe, and in global perspective, the company has the most advanced railway weed control technology and method.

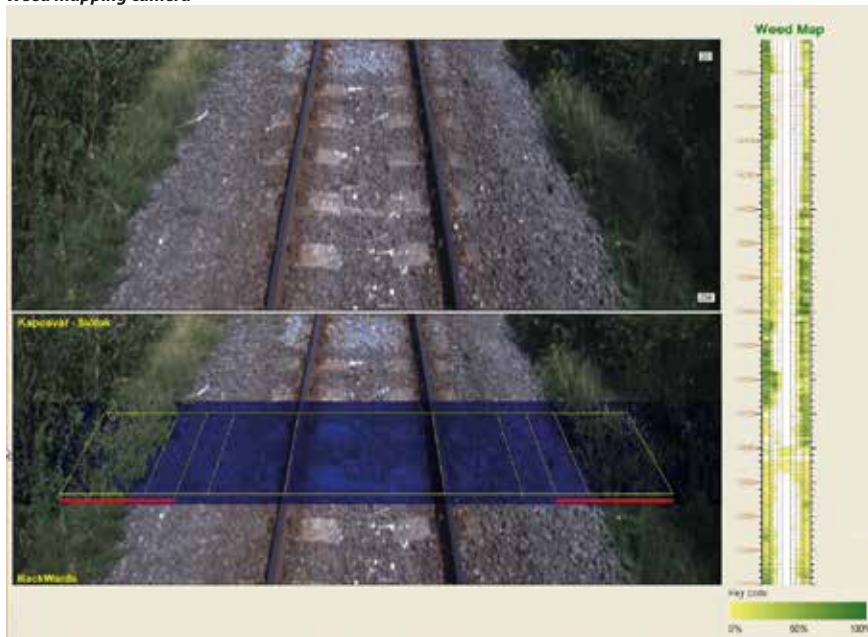
Nowadays the presence of the evincible chemical residues in food plays an increasing role. As an answer to this matter, the total or partial ban of the most com-

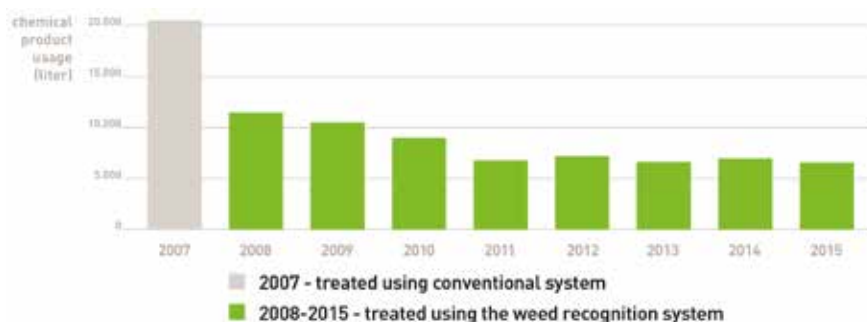
monly sold chemicals - such as the ones containing glyphosate - is being considered in more countries. Instead of drastic measures, it would be expedient to improve the control of the use of chemicals and reduce the dispensed amounts. The G&G technology offers a solution to this on railways, which is expected to expand in the agriculture as well.

Thanks to the continuous developments, the G&G technology with its weed recognition system only applies chemicals to the detected weed spots with high accuracy. The treatment is automated; the operator only supervises and may manually intervene in the process of spraying. At protected areas, e.g. bridges, surface waters, the spraying can be automatically stopped based on previously provided GPS coordinates and section numbers or it can be done manually if this information is not available and if necessary, the process can be automatized in the next spraying period. Using this method, depending on the weed coverage of the railways, up to 50-80% water and chemical saving can be achieved. The spraying is retrospectively traceable, the process is recorded by cameras, and a printable report can be prepared from the collected data according to the requirements of the client. Among other information, this report contains the meteorological data, the amount of sprayed chemicals and water in a given order; moreover, it records the protocols of the manual spraying interventions as well. The aim of further developments on the system is to



Weed mapping camera





András Gaál

Managing Director

G&G Plant Protection and Trade Ltd.

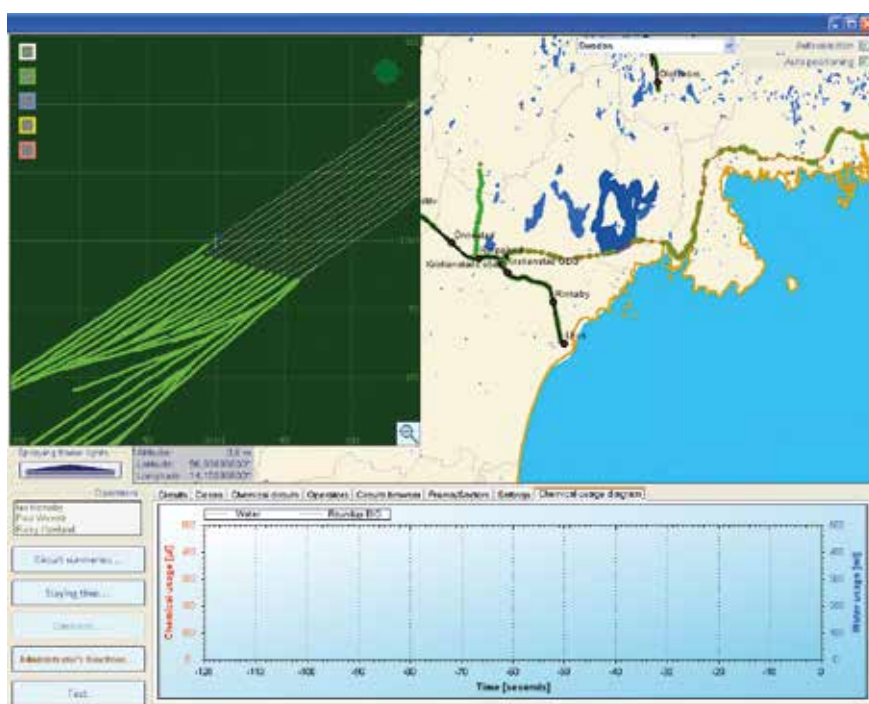
Phone: +36 62 405 215

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Web: www.gesgkft.hu



G&G containerized spray-train



Geospatial data in the spraying operator software

modernize the traceability in line with the needs of the clients and the tightening environmental regulations.

Nowadays most railway companies have geospatial database about their infrastructure and they expect their service providers to be able to integrate these data into their system. This integration makes the dataflow to and from the clients possible, which has the following double practical gain.

On the one hand, clients have the opportunity to mark fix points, lines, areas in

their own railway infrastructure database, based on that, the parameters of the service can be modified upon reaching or getting near to these, in an automatic or semi-automatic way. Such an intervention can be the total or partial suspension of spraying, or using only eco-friendly chemicals at given places. In such case, the client provides extra information to the service provider with the geospatial database used as the common language. On the other hand, the information flows from the service provider to the client

regarding the works that have been carried out. The flexible reporting possibilities based on area and location play an important role in the highly controlled chemical application.

With this high level monitoring and frugality, our equipment can maximally fulfil the needs of the clients from the leading countries in environmental protection, even of those which have already closed themselves off from chemical weed control.

As the G&G chemical railway weed control system is capable of working 24 hours a day, the operator staff can use a social coach with living premises, bathrooms and a community space to provide complete comfort.

Based on the experiences of building our own social coaches, a couple of years ago the company began to offer complete reconstruction service of unique and luxury coaches as well. The careful selection of the materials and facilities is essential in order to meet the requirements of customers in all fields. The used materials meet up to the strict railway standards of UIC. We provide detailed documentation about all works and materials in case it is needed for official authorisation processes. The result of precise planning, proper choice of materials and high standard construction, is a reliable, long-life and visually appealing product, which serves safely even under permanent extreme weather conditions.

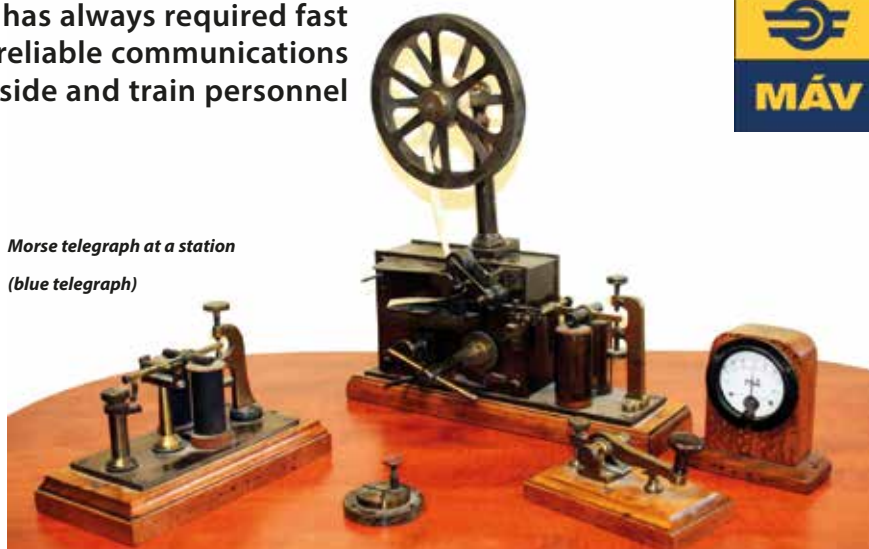
Telecommunication in Service of Hungarian Railways

The safety of railway transport has always required fast and – at least as importantly – reliable communications between the operational, trackside and train personnel in charge of the train services.



▶ Railway always used the most modern telecommunication equipment of the current era to support the flow of railway traffic from the very beginning. For that purpose, setting aside the various optical and acoustic signal systems used in historic times, the electric telegraph was introduced - and first used on the Hungarian railways on September 26, 1847 in Bratislava at the telegraph station commissioned at the railway terminal of the Hungarian Central Railways - that served the national railways for about 160 years. In addition to the telegraph lines installed along a significant proportion of the main and secondary lines the telephone was also gradually introduced around the turn of the century. The first long-distance telephone circuit was established in 1910 along the Budapest – Érsekújvár – Pozsony line, and gradually followed by the LB key or cord switch exchanges established at the endpoints of the main directions as well as the direct telephone links serving administration purposes, which were terminated in LB exchange cabinets. However, the first mechanically switched telephone exchange with 20 lines was also set up in the same year at Budapest-East railway terminal, serving even the commercial telephone lines besides the traffic control purposes. The appropriate information for passengers has got also a great importance in addition to the safe operation of trains and the commercial telecommunication systems. The growing traffic and the huge

*Morse telegraph at a station
(blue telegraph)*



physical dimensions of railway terminals of major cities demanded a kind of 'public address' voice communication system with amplified voice to support the work of railway personnel. One of the technological innovations of the era, the electric clock network and the visual passenger information system was introduced first in Budapest-East railway terminal in 1914, which displayed the departure time and destination of three trains assigned to the specific

tracks, constituting almost a complex system of audio-visual passenger information with centralised control.

Our current telecommunication services and system

Serving the demands of the railway, the dedicated railway telecommunication network of MÁV Zrt. (Hungarian State Railways) evolved in the course of the 20th century through continuous net-



*The EP512 switchboard operating at Dombóvár
between 1990 and 2014*

work extension and development including general and railway specific telecommunication services, which for example, are not available through public service providers. These are:

- General railway CB telephone and video services

- Data transmission services

Terminal point data transmission services provided through the package switched data network of MÁV operating under the IP-MPLS protocol (e.g., package switched data transmission service under IP protocol, MPLS-VPN services, Internet-based VPN access, Internet-based Proxy-VPN access, Internet services for proxy server).

- Leased line services

Physical or audio frequency basic circuits and/or accessories through the copper or fibre optic telecommunication network of MÁV and access services in the optical wavelength range.

- Managed leased line services

Access services of diverse data transmission speed and interfaces operating on the digital transmission network of MÁV connected to the central management system.

- Making available the info-communication equipment, devices, areas and place of installation.

Rental of area, telecommunication substructure (or parts thereof), or installation place (e.g., for wall-mounted equipment, antenna mounted on antenna mast) for the fitting of terminal or network equipment operating on the MÁV network or third party equipment in the telecommunication technological premises.

- Audio telecommunication services

The audio telecommunication services allow the support of passenger information systems and passenger service technologies (e.g., public address system, intercom systems of ticket windows).

- Railway standard time service

Accurate time display services for public information purposes

- Technological telecommunication services

Analogue and digital operational wired telephone services of centralised and decentralised (radial or combined line) topology.

- Analogue wireless telecommunication services

Telephone and/or low-speed data transmission services of fixed or mobile (on-board) and/or handheld (portable) UHF-WHF radio stations and setting up operation in the frequency ranges permitted by the telecommunication authority.

- Operation of telecommunication and IT systems for visual passenger information and digital contents supply

The visual passenger information provided for the travellers primarily ensures the vis-



ual display of data related to train services (times of arrival or departure, delay data, track number, type of train, etc.), as well as technological possibilities for displaying digital contents for marketing purposes, preferably on displays physically isolated from passenger information.

- Other telecommunication services

The category of other telecommunication services includes special services and system operating tasks provided by the telecommunication service provider, which cover the video and audio recording equipment in order to monitor incidents, the security and access control systems for technological purposes as well as the video monitoring systems of the railway technology concerning the technical operation of course.

Gábor Pete

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Railways Co.)
Telecommunication
Department
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Railway telecommunication infrastructure development projects

The technical wear and tear of the telecommunication systems and the demand for the introduction of new services require the continuous modernisation

of our systems. The most important projects of the past period of time are noted below:

- The replacement of analogue and electro-mechanical switchboards of the switched telephone network has been completed, a video conference system has been installed (Cisco TelePresence Video Communication Server), which can handle simultaneous HD quality video conference of 10 locations.

- The MÁV Contact Centre service was introduced in 2011 interfacing with the legacy Cisco VoIP infrastructure of MÁV. It is possible to set up several call centres in the Contact Center, e.g., the MÁVDIREKT Customer Service, the telecommunication customer service and the MÁV Service Centre HelpDesk.

- By means of the new generation PC-based or 'black box'-based security voice recorders, it is possible to record the communications over the analogue and digital telephone lines, the audio frequency channels of the radio districts, the VoIP signal streams, etc. All these recordings can be replayed even from remote locations according to the selected levels of authorisation.
- In the field of the public address systems, the first central audio control systems with technologies also used in concert halls was introduced in Budapest-East railway terminal in 2014. So called 'smart speakers' with directed characteristics were applied through which the sound energy is reduced by linear rate therefore the public address messages to passengers could be communicated with high levels of clarity and intelligibility and almost perfectly free of echo. A further novelty is the voice server TTS (Text to Speech) in which the text of limited subject matter is read by the machine with a close to human voice quality substituting also thereby the earlier regular recordings made in studios.
- The development of visual passenger information can be primarily traced on the displays applied. The dot matrix LCD and the most advanced TFT LCD and the dot matrix RGB LED technologies allow the graphic display of arbitrary texts and figures.

Use of TFT LCD displays:

- summary information board of departure and arrival data
- alarm display
- information board at the end of the track or platform
- interactive info post

Development projects promoting railway interoperability, GSM-R

The requirements of the 21st century and accession of Hungary to the European Union on May 1, 2004 presented new challenges for our railway company. While the borders have almost been completely eliminated in the public road transport in the area of the EU, in railway traffic the



End of track platform board TFT LCD at Budapest-East railway terminal

state border in general means the end of the road. Europe is still not yet unified with respect to railway transport. Every country has built its own railway network over the past 150 years with the captive power supply, safety and signalling systems and a specific communication system - typically different from the other systems. Admittedly, multi-system electric locomotives can handle a few different systems, however, the special own signalling and communication system of any given country represents a major hindrance for the international cross-border rail traffic. This has been recognised by UIC (International Union of Railways) in time and started the introduction of technical regulations already in the 90s. Today, UIC and the European Commission makes efforts at the uniform introduction of interoperable telecommunication and train control systems, GSM-R and ETCS L2 systems along all the main European railway lines, contributing thereby significantly to the simplification of international rail traffic. With the introduction of the GSM-R communication technology the train radios of various operating modes become unnecessary, therefore, this obstacle will also be removed from the way of the single European rail service.

Following intense preparations and lengthy public procurement procedures, on September 9, 2013 NISZ (National Information Services Co.), based upon the selection of the overall most favourable proposal, announced the tender submitted by joint tenderers Kapsch

CarrierCom Ltd., and MVM Ovit Co., worth 44,312,403 EUR as the winning offer, therefore, the installation of the European interoperable railway radio network has come close to reality along the railway lines of MÁV and GYSEV.

Let us see what does it mean for us? Naturally in phase I of the project, the GSM-R radio system will be installed along a length of 935 km. The establishment of the entire background infrastructure, that is necessary for serving the radio system, should not truly be considered secondary as it involves almost the full renewal of our railway telecommunications networks. In addition to the significant extension of our modern fibre optic telecommunication network, the new IP-MPLS telecommunication system also brings about an increase of capacity by orders of magnitude for the users - this can be noticed both by our associates and our passengers almost in every single specialised area of the railway.

As it is seen, the challenge is truly huge however we also have the possibility this time to support the competitive efficiency of MÁV and thereby also that of the European railways through the introduction of efficient telecommunication systems based on our skills, competence and the rapidly evolving new technologies. And we should not forget the ultimate common objective: we all support the safe and efficient implementation of railway transport even if our activities are not always directly visible to the users, the passengers and the railway companies.

INTEGRATED SMART PASSENGER INFORMATION DISPLAYS

More than **500** installed displays at field!!!



Low OPEX costs, long term solution
Extra durability
Managable, integrated IoT sensors
Outdoor/indoor versions
LED/LCD/TFT products

INFOPIX
PASSENGER INFORMATION SYSTEM



INNORAIL

magazin

INNORAIL magazine is a specialized rail quarterly in Hungarian language that was founded with the intention of positively fostering the present and future of railways in Hungary. Our objective is to convey up-to-date knowledge to Hungarian experts by presenting design, construction, maintenance and operational experiences and results of scientific research as well by sharing even scientific articles of analyses related to the individual topics from Hungary and abroad.

According to our intentions, INNORAIL will also strengthen the objectives of the INNORAIL series of conferences organized every second year by offering a forum for an exchange of views between various areas of expertise on railway infrastructure, for a discussion of practical issues and for presenting innovative developments, tools and methods.

Between the INNORAIL conferences the periodical can provide an efficient tool for representatives of the profession from Hungary and abroad to present opportunities for development and self-training.

Our permanent columns are as follows:

Transport policy • Infrastructure construction and management • Rails in cities • Structures • Telecommunications, signalling, traffic control, energy supply, catenaries and lighting technology • Rolling stock development, operation and maintenance

Be present on the Hungarian rail market, write professional articles or advertise in INNORAIL magazine!

Contact: Innorail Kiadó és Konferencia Kft. (Innorail Publishing and Conference Ltd.)

Ágnes Balla Managing Director E-mail: balla.agnes@innorail.hu



APIDM = Automatic Passenger Information Database Management

Your Success is Our Passion

Schauer-Hungária Kft. has recently developed a fully automated system called APIDM. We have asked Mr Zsolt Rück, one of the managing directors of the company, to talk about this application.

► Where does the name APIDM come from?

Our company names its self-developed products and applications in English. In our day-to-day practice we use abbreviated names. This is not different in the case of APIDM either: the abbreviation stands for Automated Passenger Information Database Management.

How did you come up with the idea of developing APIDM?

Our company has been engaged in the amendment of train schedule databases for more than 12 years. The spread of automated passenger information equipment has required increasing emphasis on database maintenance as this activity ties up more capacity on the customer and service provider side, and it is gradually becoming more expensive as well. Over the years we have realised that the management of this incredibly complex process is not effective enough. This recognition prompted us with my expert colleagues to analyse the current process and to identify the steps that can either be automated or eliminated. The result is a short and transparent process that can be best implemented by introducing APIDM.

Could you please explain the core principle of APIDM's operation?

Every public transport company has a timetable editing application that manages a database necessary for passenger information. After APIDM is connected to this database, passenger information appears on the display without the



need for human intervention, and it is announced over the loudspeakers at the right station with the right content and at the right time.

It is inconceivable to me how electronic data are turned into spoken announcements. Would you reveal the secret?

This is a reasonable remark. APIDM has 3 core functions. The first one is a logistics function that transmits the appropriate data to the right station at the right time. The second function is an automatically generated script book - that is APIDM independently edits the text of announcements. The third and probably the most interesting function of APIDM is the transformation of written text to human voice. We use TTS (Text To Speech), a speech synthesizer for this transformation ensuring a fully automated process.

A speech synthesizer is not capable of producing a perfect human voice. Does this not mean a loss of passenger information quality?

The developers were aware right from the beginning that no hi-tech TTS



could generate perfect speech. It is a fact though, that TTS can be trained, meaning that once it is trained how to pronounce a word, it will always reproduce that word perfectly in the future. Any possible pronunciation shortcomings can be eliminated and announcements can be improved to a quality matching live human speech by an operator with no particular preliminary training necessary.

How do you see the future of APIDM?

The future success of APIDM is a not a question to me. The reason is that no other system can manage passenger information in a more cost efficient way and at a practically zero error rate. As far as I know, no competitive system comparable to APIDM is available even on an international scale. So our only task is to familiarize domestic and international markets with the unique benefits APIDM can offer.

Thank your for uncovering the secrets of APIDM and I wish you best of luck with the distribution of the system.

An Independent Conformity Assessment Body and Competence Center



Certuniv Ltd., has established especially to act as independent and competent organization for railway interlocking and signalling.

▶ The company works with four chief experts: Geza TARNAI, CSc (tarnai.geza@certuniv.hu), Balazs SAGHI, PhD, (saghi.balazs@certuniv.hu), Gabor RACZ, dr. univ (racz.gabor@certuniv.hu) and Geza SZABO, PhD. (szabo.geza@certuniv.hu) and a supporting team including young CCS experts. The chief experts' experience covers all older types of interlocking installed in Hungary as well as railway interoperability issues. Beside this, they have strong academic background based on their university professor and associ-

ate professor positions and have many researches concerning safety management, risk analysis and so on.

Certuniv Ltd., is a Notified Body (NB2493) for railway interoperability according to 2008/57/EC, track side and on-board CCS (both for subsystem and for constituents) and a Designated Body (UVH/

Géza Szabó, PhD.

managing director and

chief CCS expert

Certuniv Ltd.

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www.certuniv.hu



contribute not only as NoBo and/or DeBo, but as independent safety assessor too; and we can provide our service not only in Hungary but anywhere in the world.



VF/847/4/2013) for nationwide railway interlockings as well as interlockings and signalling of guided public transportation (tram, underground, suburban railway, cog-wheel railway etc.). We have conformity assessment cases concerning ETCS Level 1 and Level 2 projects (from planning phase) and many conformity assessment cases concerning national track side interlocking functionality (both relay based interlockings and state-of-the-art electronic interlocking) and on-board Hungarian cab signalling (EVM) functionality. We can follow and support the whole development process from the concept phase till the integration/installation/trial operation and can

As Certuniv Ltd., and the chief experts are interested in research as well, we are happy to see any research opportunity in the interlocking field. Our recent research activities cover the integration of the analysis of human errors and technical failures; the quantification of safety management actions; the interconnection issues of safety management systems and classification of errors and segmentation of work in centralized railway traffic control.

As we are working many years in the CCS industry, we can provide information about the Hungarian CCS market, regulations, specialties, conferences, opportunities and about numerous other fields.



Major Challenges in Rail Network Management

Managing a large scale of rail network can be a complex operation. Being able to monitor and manage devices is essential to ensure that the network runs smoothly.

▶ However, while administrators are away from the control centre for other tasks, it can be very difficult for them to stay informed or quickly respond to emergencies that have occurred due to network failure. This frequently results in delays to railway operations, and even increased operation costs.

When performing regular maintenance or troubleshooting at waysides, stations, or on trains where multiple network devices are deployed, engineers often face with the daunting task of identifying specific devices among a multitude of identical devices. Even with proper labelling and hardware placement it can still take time to obtain the status information of a specific device. Frequently, faulty devices cannot be replaced quickly enough to ensure that operations continue to run smoothly. With the development of mobile networking tools, engineers can now improve operational efficiency and maximize network availability.

How Mobile Networking Increases the Efficiency of Network Operators

A mobile network monitoring app should support the following three features to ensure that monitoring a network from a mobile device is advantageous.

1. Sending Real-time Alerts

With a mobile network monitoring app, administrators can receive real-time push notifications to their mobile devices. Real-time notifications allow administrators to take action immediately in response to

critical events, even when they are out of the control room. For example, they can contact maintenance engineers to perform onsite troubleshooting and consequently reduce system downtime as soon as an alert is received.

2. Allowing Instant Network Checks

A mobile network app allows users to check the status of a network in real time. After you log in to the app, it will inform you whether or not the network is operating normally. The app will also display detailed information of a specific network device, keeping network administrators in the know while they are on the move or out of the control room. Information, such as a device's IP address, MAC address, location, and firmware version can be viewed from the app. For example, if an engineer receives an alert for a link-down event, the engineer can readily access the information needed to determine which port is faulty.

3. Finding Field Devices Quickly

In certain scenarios, it takes a long time to manually search for a specific device from racks and racks of similar devices. Moreover, if automation engineers need to access the parameters or settings of a specific device for onsite troubleshooting, they would need to physically connect the device to a laptop using a web console or CLI (command line interface), or read the MAC address or serial number printed on the device, and then check the information on

the laptop. Typically, engineers will spend more time than is necessary compared to checking the same information with a mobile device.

To make the task easier and more efficient, mobile network monitoring apps now usually come with a function that allows users to quickly find a particular device and even view detailed information about the device. For example, each network device could be encoded with a unique QR code based on its MAC address. If the mobile phone supports a built-in QR code scanner, engineers can scan the device's QR code onsite to pull up information about that device without needing to boot up a laptop or enter a device ID manually.

Moxa's mobile app MXview ToGo has taken the above three features into consideration and has developed an easy and convenient management app for our railway partners.

Conclusion

Using the MXview ToGo app, administrators can view device and network status and receive real-time alerts on their mobile devices. In addition to mobile monitoring, the MXview ToGo app supports a smart device search and identification function. When in the field, automation engineers can read detailed device information, and can find a specific device quicker than it was previously possible. Administrators can also use the locator feature to quickly locate devices, allowing them to improve efficiency and minimize system downtime.

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Embedded Control System with Shared Logic for Railroad Transport

In this year T-Systems Hungary and Obuda University are going to start a new R&D project: Embedded Control System for Railroad Transport, which ensures the real-time monitoring and management of safety of the railroad transport with minimized human resource needs and moderate costs.

▶ The control system can help avoid accidents and the data generated by operation are locally checked, even in the locomotive. The system has modular structure, shared logic and shared intelligence and it implements highly secure and autonomous operation.

Embedded system with shared intelligence

The main principle of design method of the Control System is that: the devices communicate with each other using a unique encrypted protocol via optical hard-wired network without any centralized control. The operation of the network is guaranteed on the required security level outdoors, even if any of the system elements are destroyed. The remaining system elements can still operate on the network. The primary objective of this system is to promote the integration of various subsystems in order to be able to cooperate with each other. The different types and different functions of these subsystems can help each other, which affects the operation of the entire infrastructure. [1]

Ambient system

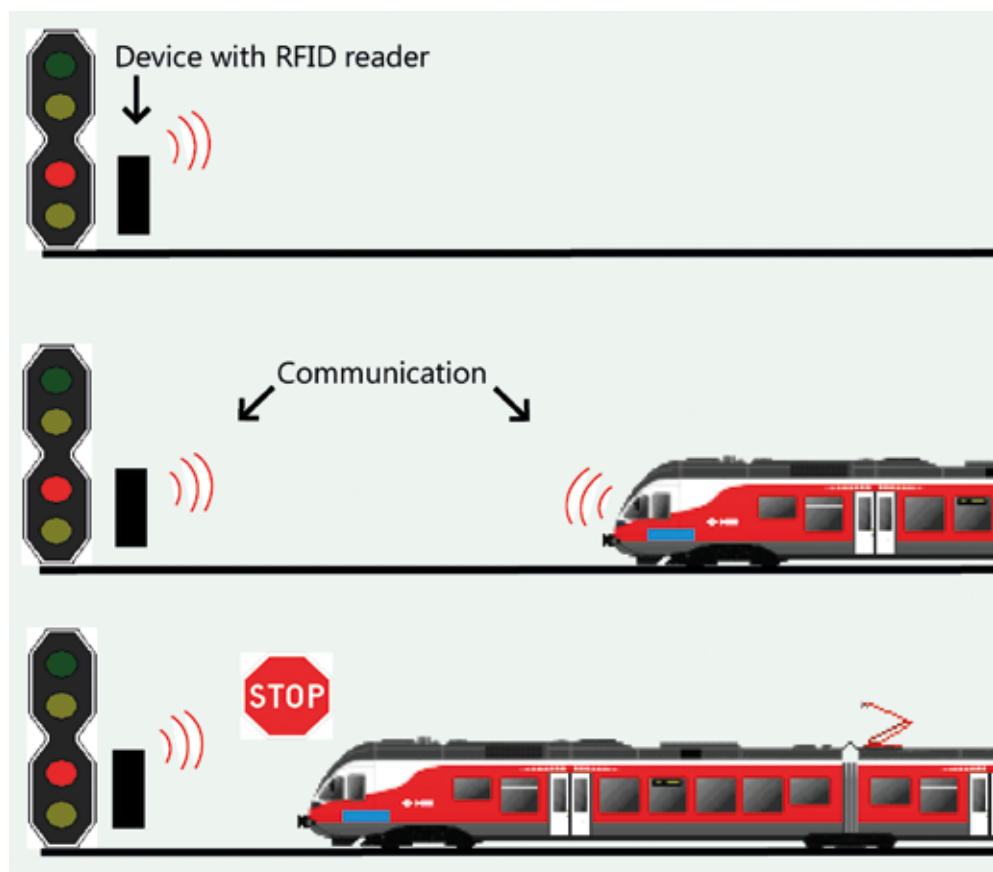
According to the principle of subsidiarity, problems must be solved where they emerge. That means the higher-level intervention is only necessary if the problem cannot be solved on its own level and

it would interfere with the operation of the entire network. With the application of this principle it is possible to create an ICT-based transportation system with ambient intelligence. In the architecture, that this technology allows, the devices continually monitor their own systems and the systems surrounding them with the help of sensors and measurements at a local level – where it is needed. Certain authorized elements may also intervene

into operating mechanisms. At the same time they are also able to inform the elements in higher „evolutionary” positions, and if necessary, send them warnings or alerts. Each element of the system operates autonomously but they work in a dynamic cooperation. [1]

The concept is based on small (1-6m) and medium (10-150m) range radio frequency identification (RFID). With the help of RFID we will get a global overview of monitoring and controlling options on the given section of the whole railroad system by integrating collected local information.

The implementation of integrated subsystems would provide high security, comfortable and cost-effective opera-



What is RFID?

Radio Frequency IDentification, or RFID, is a generic term for technologies that use radio waves to automatically identify objects. There are several methods of identification, but the most common is to store a serial number that identifies an object, and perhaps other information, on a microchip that is attached to an antenna (the chip and the antenna together are called an RFID transponder or an RFID tag). The antenna enables the chip to transmit the identification information to a reader. Transmitting in the kilohertz, megahertz and gigahertz ranges, tags may be battery-powered or derive their power from the RF waves coming from the reader. The reader converts the radio waves reflected back from the RFID tag into digital information that can be passed then to computers that can make use of it.

Jozsef Papp

Assistant Professor
Obuda University

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tion and prestige for the users. Integration means that the processes of each subsystem mutually interact with one another. In many cases, the subsystems have a complementary relationship. The integrated structure enables the development of a more complex rail system, which can ensure safe operation in a cheaper and more efficient way. [1]

How does the system work?

The train is identified by the system's devices via RFID reader. The identifica-

tion data is sent to the central database and to other devices via optical hard-wired network. The aspect of network configuration is that a single hard-wire cut-off can not cause damage of communication therefore it is necessary to implement a loop structure of network. If double hard-wire cut-off occurs, devices have secondary communication channels, which use GSM and at the station area ZigBee. Using these wireless communication forms the system will be able to remain in good operating condition with maximum capacity and safety of railway operation.

All of the devices have three levels of logic. The basic level controls the communication (between two devices), the life-signal functions, the power supply and the emergency behaviour. The second level („field logic”) controls the relays, signals, etc. and shows the „real-time” states of the objects. The third level („timetable logic”) includes the part of the timetable concerning a certain device. Train is identified by the device, which is able to transmit it to the appropriate direction by controlling the relays and signals.

The control devices can transmit life-signal continually. If system can not send the above mentioned life-signal the system will alert the supervisory staff immediately. The devices should be placed on site (e.g. near to relays, signals etc.). Central switching room and hundreds of miles of copper cable

from the outside object to the central interlocking room are not needed, since each element of the system can communicate with one another.

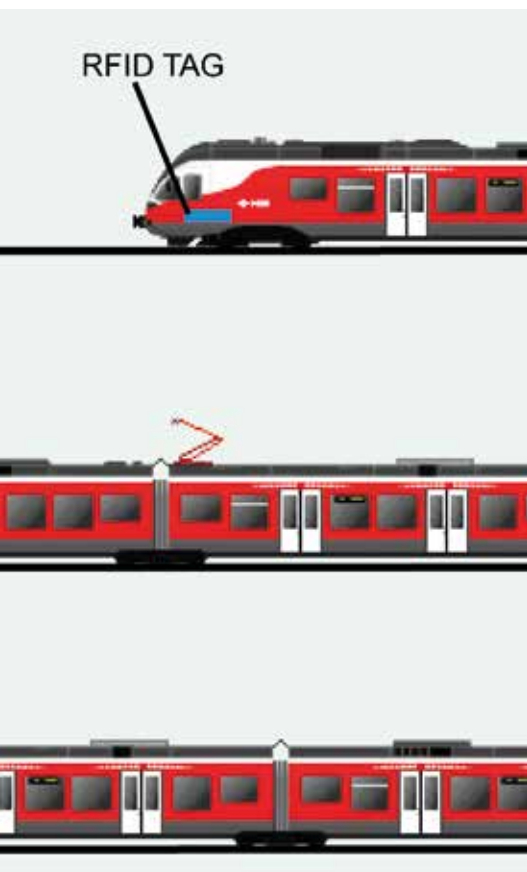
The intactness of the system is assured by the self-protection mechanism continuously monitoring its own integrity. In case it detects malfunctioning, damaged or destroyed system elements, it sends an immediate alarm signal and the identifying information of these elements to the computer based supervising centre. Having this information, the staff of the centre can identify the number, the location and the importance of the damaged system elements.

Thanks to the modular system design the inoperative and faulty elements can be simply removed from the network and replaced with a new one. Using the RFID technology a new kind of solution of line track vacancy detection will be available eliminating the false occupation signal caused by foreign objects or damage of the track.

The network of the RFID-based control devices is capable of creating higher quality in the real-time monitoring and management of the safety of the railroad transport system, in the tracking and the quality of the vehicles, the traffic dependent control of all elements of the rail superstructure maintenance and in addition of the passenger information system.

Reference

[1] J,Papp; D, Tokodi; Gy, Schuster: Study of How to Implement an Intelligent Railway System in Hungary. SISY-2015 IEEE 13th International Symposium on Intelligent Systems and Informatics. 329 p. Szabadka, Szerbia, 2015. pp. 199-204.



Products of FUX Co. for Constructors of Railway Overhead Line Systems

Catenary System from Hungary

FUX Co., has more than 20 years of experience in the manufacturing of bare and insulated overhead conductors, underground cables as well as contact wires and other conductors for railway overhead line systems.

▶ Within the field of railway overhead line systems our main product is the contact wire, which we can produce in compliance with any standard and with any cross section (Fig.1). We make contact wires not just for main and side railway lines and trams but for underground and public transport as well. Our most popular product is the general purpose Cu-ETP grade contact wires. This grade allows for train speeds up to 160km/h (Table 1a and 1b).

Another popular product is the CuAg0,1 grade, which is applicable for speeds up to 250km/h. On higher capacity lines magnesium alloyed materials are used. We have experience with manufacturing from this grade as well. Considering the increasing number of high capacity lines we are plan-

ning to expand our manufacturing capacity in this area. We show CuAg0,1 grade as an example in Table 1. More information can be found about our contact wires in our railway catalog on our homepage or through our colleagues. Contacts are at the end of the page.

Our second important railway product category is the stranded conductor. Copper and bronze conductors are subcategories of this (Fig.2). These are mainly suspension and grounding conductors. For these stranded conductors we draw the wires from Cu-ETP and CuMg0,4 (BzII) grade materials. We can produce these with any



Figure 1 Contact wire

standard specified cross section in the range of 10 to 500mm². Just like with the contact wires, we are ready to meet any customer requests beyond the requirements of the standards.

We also make stranded aluminum conductors from AL1 and AL3 grade for overhead railway lines (Fig.3). Their recommended use is grounding, feed and feedback conductors. From both grade of aluminum we can manufacture conductors in the 15 to 1000 mm² range. The packaging and the



Figure 2 Copper (stranded)

table1.b The dimensions of the CuAg0,1 contact wires

nominal cross section mm ²	wire diameter, mm			groove width,mm			weight kg/km
	AC	BC	BF	AC	BC	BF	
80	10.6	-	-	5.6	-	-	712
100	12	12	11.04	5.6	6.92	6.92	889
107	12.3	12.24	11.35	5.6	6.92	6.92	952
120	13.2	12.85	12.27	5.6	6.92	6.92	1067
150	14.8	14.5	13.6	5.6	6.92	6.92	1334

table1.a The properties of the CuAg0,1 contact wires

CROSS SECTION	mm ²	80	100	107	120	150
Min. tensile strength	N/mm ²	365	360	350	350	350
Min. breaking load	kN	28.3	34.9	36.3	40.7	50.9
Elongation at break	(A200) %	3-10	3-10	3-10	3-01	3-10
Modulus of elasticity	kN/mm ²	120	120	120	120	120
Electrical conductivity at 20°C	m/(Ohm*mm ²)	≥ 56.3	≥ 56.3	≥ 56.3	≥ 56.3	≥ 56.3
Specific resistance at 20°C	10 ⁻⁸ Ohm*m	≤ 1.777	≤ 1.777	≤ 1.777	≤ 1.777	≤ 1.777
Electrical resistance at 20°C	Ohm/km	≤ 0.229	≤ 0.183	≤ 0.171	≤ 0.153	≤ 0.122
Linear coeff. of thermal exp.	10 ⁻⁵ /K	1.7	1.7	1.7	1.7	1.7
Specific mass	10 ³ kg/m ³	8.89	8.89	8.89	8.89	8.89

Figure 4 Railway map



Figure 3 Aluminum (stranded)



delivery is always performed according to the specifications of our customers. More information can be found about our stranded products on our homepage or through our colleagues.

In the field of power network we also produce general and special purpose ACSR, ASC and AASC conductors and insulated conductors. We recommend these products for the power supply of overhead railway conductors.

The company also has DIN EN ISO 9001 and 14001 and PLUREL certificates. We are also ready to comply with other requirements and tests from institutes specified by our customers. A good example of this is our

AFER certificate that was required by the Romanian State Railways. Both the quality of our products and our certificates are due to our well-equipped testing laboratory. We can not only perform the standard mechanical and electrical tests but also special tests. These are mainly the measuring of transient phenomena, lifetime tests and high current tests. Our laboratory also makes development work possible, which helps us provide answers to our partners arising questions and solve their problems.

We export our products to Central and Northern Europe. Considering our railway products Fig.4 shows our major partners in the product category. We have good relationship with numerous partners, not only on a business but profession basis as well. We try to handle special request in a flexible way, thinking together with our partners if needed. We not only offer our products for our future partners but our experience in production and the profession as well. Our technical team is committed to

FUX Co., is the exclusive manufacturer in Hungary which offers complete railway overhead line systems including conductors and other elements. Our important products are contact wires, stranded copper and bronze and aluminium conductors. The stranded products are made on the whole range of demands like suspension, holding, ground and power supply conductors. Our products also include high voltage strengthened and unstrengthened, bare and insulated aluminum conductors. We are not specialized in producing the usual solutions alone rather we try to meet special customer requests with flexibility and high quality results.

Dr. Dina Aswad

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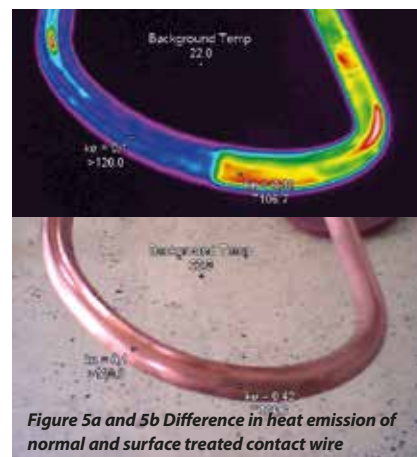


Figure 5a and 5b Difference in heat emission of normal and surface treated contact wire

development and is constantly working on new products. This is the reason why FUX Co., has a number of technical patents.

We publish many of our results at conferences. Our new development is the surface treated contact wire. The surface treatment is performed without any extraneous material addition. This treatment gives more advantages in the applications. For example the lower operating temperature or larger current carrying capacity due to the increased heat emission of the treated surface. Principal calculations show that concerning icing there is an advantage of the treated contact wires against as-manufactured conventional contact wires (Fig.5a and 5b). To prove these calculations GYSEV installed a pilot section with this type of contact wire. Continuous monitoring is performed on this critical section. (Railway Pro, vol. IX, no. 1.2(104), pp. 54-58. 2014)

We are also working in cooperation with the Hungarian State Railways on reducing the cost of insulated ground conductors. We have also involved the Hungarian national authorities in the work. Our goal is to develop an insulated ground conductor that complies with the European operational requirements at a lower cost.

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Electrification and developments in Western Hungary's north-south rail transport

Further GYSEV Lines Go Electric



The conditions of rail transport on the line network of GYSEV Co., will be significantly improved by the end of 2016: last autumn electrification was completed on the strategic and in terms of international rail transport relevant railway line No. 16 (Hegyeshalom-Szombathely) while construction of the catenary system on section Szombathely-Zalaszentiván of the line No. 17 is expected to be finished by the end of this year.

Kövesdi Szilárd

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GYSEV announced last November that they had finished electrification of the line section Mosonszolnok-Csorna-Porpác thereby enabling electric traction along the entire railway line No. 16. Within the frameworks of the transport development project funded by the European Union, GYSEV has installed electric overhead cables along 87 kilometres of railway line.

The main aim of the refurbishment and modernisation of the railway line was to facilitate a fast and efficient rail connection between Central and Northern Europe and the Adriatic region via Western Hungary, which has largely favourable terrain. After passing Bratislava, Csorna and Szombathely the transport corridor continues toward Zagreb, Rijeka and Trieste.

The investment has reduced travel times, noise and air pollution on the section. Besides electrification, high platforms of 55 cm as well as a modern outdoor lighting system and rain shelters have been built at all stations and at frequented stops of the railway line. All these investments have increased its attractiveness and im-

proved simultaneously the competitiveness of rail passenger and freight transport of the region.

Modernization works on the 48 km long Szombathely - Zalaszentiván line commenced in March 2016. The investment concerns the electrification of the line, track replacement and relocation in several places as well as the construction of new platforms. The refurbishment of the railway line is implemented with support of the EU Cohesion Fund with amount of 43M EUR.

On this line section, which has high priority both in terms of international and commuter traffic, several innovations are planned to be implemented during the construction. Within the project catenary will be set up along 48 km and important infrastructure works are to be executed too such as the full replacement of the tracks at several places or their relocation due to the construction of higher platforms. Retrofitting of seven level crossings is also part of the project. At the stations and stops of the railway line new platforms with 55 cm height will be built along



with the installation of benches, rain shelters, new pathways and bike stands.

„The electrification along a total length of 135 km is a huge step forward not only for GYSEV but also in terms of the railway transport of Hungary itself. The development enables us to use our new EMUs on further line sections and to operate electric locomotives instead of diesel vehicles for InterCity traffic. Also, we should not forget that using electric traction vehicles in freight transport significantly reduces noise pollution and environmental impact. We hope that the electrification and the additional developments will increase our freight volumes both in domestic and transit transport” – explained Szilárd Kövesdi, CEO of GYSEV Co.

Thanks to another related project GYSEV will be implementing a further development on the Szombathely-Zalaszentiván railway section in the first half of 2017: the centralised traffic control of the line will be performed from a new Operational Control Centre in Szombathely and an up-to-date passenger information system at the stations will provide further assistance for the passengers.

GYSEV Co. is a railway company operating in Western Hungary and Eastern Austria. It is held to 65.6% by the Hungarian State, to 28.2% by the Republic of Austria and to 6.1% by the construction company STRABAG SE. GYSEV offers passenger-focused and integrated services and is developing dynamically. It conducts public passenger services on a total length of railway lines of 535 km and is also involved in rail freight through its subsidiary GYSEV CARGO Co., which is held to 100% by GYSEV Co.

3rd International Conference on Railway Innovation in Europe

First circular and invitation for papers



Budapest, 10-12 October 2017

Organized by: Innorail Kiadó és Konferencia Kft. (Innorail Publishing and Conference Ltd.)
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The second InnoRail Budapest conference was held in October 2015. The conference was called into being by Hungarian professionals committed to rail transport with the objective of thinking together about the present of rail transport, in order to foster its future development.

▶ The 2015 Conference rallied a total of 423 participants from 29 countries. Excellent speakers - 60 from other countries and 41 from Hungary - have offered presentations and contributed to the creation of a level of quality unknown in Hungary before. In summary, we can state that this tradition-creating event achieved its objective and created a veritable forum for an exchange of views between different professional fields of railway infrastructure, for the discussion of practical issues and for presenting novel innovative developments, tools and methods.

We are hereby inviting you to participate in InnoRail 2017, the third conference in the series to be organized in Budapest.

Official languages of the conference are **English, Hungarian and Russian.**

The first day of the conference will feature plenary sessions while the other two days will be organized into parallel section meetings and, as a novelty, panel discussions in the topics of RAILWAY INFRASTRUCTURE and RAILWAY INFORMATION TECHNOLOGY. The section on railway information technology will be organized in cooperation with and under the auspices of Rolling-

NET Congress. Rolling-NET focuses, first of all, on rolling stock related IT, telecommunications, safety technology and automation systems and developments, with special emphasis on the gaining ground of Internet of Things (IoT) in rail applications.

Another novelty is that, following Rolling-NET's well-proven practice, we will put a greater emphasis on networking - participants will be offered the opportunity of organizing discussions with each other by way of the homepage of the Conference, already prior to the event. This invention also facilitates the creation of ever more useful business discussions among actors of the European railway scene.

Abstracts are most welcome in all three languages, in the following topics:

Infrastructure construction and management

Signalling, traffic management

Railway IT, telecommunications and safety technology systems

Energy supply, catenaries and lighting technology

Rolling stock development, production, operation and maintenance

Infrastructure operators from Hungary and abroad, industrial partners, researchers and theoretical and practical experts are all most welcome to the conference.

Deadlines

31 March 2017: Submission of abstracts (verbal and poster alike)

15 April 2017: Confirmation of the acceptance of presentations

31 May 2017: Deadline for early registration with discount price

15 September 2017: Deadline for the submission of the entire text of the presentations

20 September 2017: Registration closes

25 September - 6 October 2017: Organization of discussions among the participants by way of the homepage of the conference.

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