

**Dominik Adamski, Łukasz Zawadka: Integration Tests of ETCS On-board Subsystems Based on the Requirements of the Technical Specifications for Interoperability of the ‘Control-Command and Signalling’ Subsystem**

Achieving the interoperability of the European rail system in each Member State requires many measures to standardise the adopted technical solutions and relevant regulations. However, it is likely that there may be some incompatibilities between individual subsystems, even if these subsystems are designed in accordance with standardised requirements. Interoperable rolling stock may be unable to move freely over an interoperable railway line due to some incompatibilities and differences in the versions of the installed firmware in the ETCS system devices. The article discusses the compliance tests of the proper integration of the on-board subsystem with the trackside subsystem, carried out by the Railway Research Institute.

**Keywords:** interoperability, control-command and signalling, ERTMS, ETCS, TSI, CCS

**Adrian Kaźmierczak: Role of Active Fire Protection Systems in Ensuring an Acceptable Level of Safety of Rolling Stock**

The article presents issues related to active fire safety systems used in rolling stock based on water extinguishing. The approach to active methods of fire protection and extinguishing is described in detail. The article presents the current standards, regulations and requirements regulating the use of active fire protection systems for railway vehicles in the European Union. An analysis of the elements influencing the efficiency, practicality and cost effectiveness of the extinguishing systems with the expected effectiveness of operation was carried out. The directions of development undertaken in order to develop tools for assessing the size of the threat and its prevention are presented.

**Keywords:** fire safety, rolling stock, requirements, active fire protection systems

**Władysław Koc: An Analytical Approach to Intertrack Space Widening on Railroad Curves**

The article addresses the issue of designing the geometry of a curved double track using the analytical design method principles. This allowed, similarly to other applications of the method, a complete overview of the issue and the method for determining the key parameters to be defined. The analytical method for determining the intertrack space axis and the outer and inner track axes is introduced, leading to the required value of the intertrack space widening. The widening is achieved by varying the length of the transition curves in the outer and inner tracks. With the track axis coordinates in the local coordinate system, these can be easily transferred to the PL-2000 two-dimensional Cartesian coordinate system, i.e., an element of the national spatial reference system. The analysis continues with the issue of the chainage of axes of the intertrack space and the mainline tracks. The applicability of the proposed method and its high precision are demonstrated by examining a wide radius range of circular curves.

**Keywords:** railway track, widening of the intertrack space, determining the curved track axis, railway line chainage

***Przemysław Rakoczy, Robert Bińkowski: Comparison of Fatigue Strength Calculation Methods for Monobloc Railway Wheels***

EN 13979-1 “Railway applications – Wheelsets and bogies – Monobloc wheels – Technical approval procedure – Part 1: Forged and rolled wheels” approves two types of calculation models for determining fatigue strength – a 3D model and a simplified axially symmetric model with an asymmetric load. Both model types vary considerably, which may affect the results to be achieved. In addition, the determination of the maximum (critical) fatigue cycle amplitude for wheels requires stresses to be analysed at a point during the complete wheel revolution. In the current EN 13979-1 procedures, the amplitude is determined in the place and in the direction with the maximum principal stress without considering changes to stresses at a point for other wheel angular positions. The paper explains methods for strength calculations of monobloc wheels acc. to EN 13979-1. Both standard-approved models for the same wheel were developed and calculated. Differences, advantages and disadvantages of each model were described and the results compared. The complete load cycle for a given point on the wheel body was also analysed and presented. The results of the above analysis were analysed and further research directions were specified to define the actual maximum fatigue load cycle amplitude in railway wheels.

***Keywords:*** monoblock railway wheels, fatigue strength, FEM analysis, fatigue load

***Marcin Słowiński: An Analysis of CFRP Application in the Construction of Rail Vehicles***

The aim of this article is to provide crucial information on CFRP composites and examples of their use in rail vehicle construction. The first part outlines the key characteristics of CFRP composites and compares their properties with conventional structural materials. Implementation examples of this group of composites for structural components of rail vehicles are discussed further. The final section of the article analyses the reasons for introducing composites of this type into the engineering practice of railways.

***Keywords:*** CFRP composites, carbon fiber, rail vehicle body, mass reduction

***Michał Szymański: Rails with Bainitic Microstructure***

The review article describes bainite as an example of a steel microstructure that can be successfully used in the production of railway rails. A comparison has been made between the key parameters to be met by railway rails: resistance to abrasive wear, resistance to flaking and presence of white etching layer for bainitic and pearlitic steel. The important role of residual austenite and the tempering process in shaping the mechanical properties of rails with bainitic microstructure has been discussed.

***Keywords:*** bainite, railway rails, white etching layer, abrasive wear, residual austenite, tempering