8th INTERNATIONAL CONFERENCE ON INDUSTRIAL ENGINEERING

INNOVATION CENTER OF THE FACULTY OF MECHANICAL ENGINEERING
&
INDUSTRIAL ENGINEERING DEPARTMENT, FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY OF BELGRADE, SERBIA

PROCEEDINGS

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29th-30th September 2022
Belgrade, Serbia

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8th INTERNATIONAL CONFERENCE ON INDUSTRIAL ENGINEERING - SIE 2022, PROCEEDINGS

Publisher
University of Belgrade Faculty of Mechanical Engineering, Belgrade

Printing firm
"PLANETA PRINT" d.o.o. Beograd

Published by decision of the Dean no. 20/2022 from 30.08.2022.
ISBN 978-86-6060-131-7
Printing: 150
Published 2022

CIP - Каталогизација у публикацији - Народна библиотека Србије, Београд

005.22(082)
658.5(082)
006.83:338.45(082)

MEĐUNARODNI simpozijum Industrijsko inženjerstvo (8 ; 2022 ; Beograd)
Proceedings / 8th International Symposium of Industrial Engineering [i. e.] SIE 2022, 29th-30th September 2022 Belgrade, Serbia ; [organizers] Innovation Center of The Faculty of Mechanical Engineering, University of Belgrade [and] Industrial Engineering Department, Faculty of Mechanical Engineering, University of Belgrade, Serbia ; editors Vesna Spasojević-Brkić, Mirjana Misita, Uglješa Bugarić. - Belgrade : University, Faculty of Mechanical Engineering, 2022 (Beograd : Planeta Print). - [10], 364 str. : ilustr. ; 30 cm

Tekst štampan dvostubačno. - Tiraž 150. - Str. [4]: Preface / editors. - Napomene i bibliografske reference uz radove. - Bibliografija uz svaki rad.

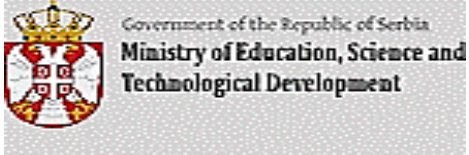
ISBN 978-86-6060-131-7

1. Mašinski fakultet (Beograd). Katedra za industrijsko inženjerstvo

a) Производња - Организација - Зборници b) Индустријски менаџмент - Зборници c) Индустрија - Систем квалитета - Зборници

COBISS.SR-ID 73704713

Sponzored by
Government of the Republic of Serbia
Ministry of Education, Science and Technological Development



OVERVIEW OF ACTIVITIES RELATED TO THE PROVISION OF LOGISTICAL SUPPORT DURING THE IMPLEMENTATION OF TYPE TESTS OF RAILWAY VEHICLES

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Abstract. *The logistical support necessary for the organization of type tests of rail vehicles is a complex task. Resources that must be provided are expensive and related to the complex organization of work in the field. On the other hand, the relevant European standards are technically more and more demanding, so the logistical support is also more extensive. In this paper, the focus is on the presentation of activities related to type tests of freight wagons. The testing of the brake system is shown in detail. For this test it is necessary to perform measurements on an open track, at different running speeds and different levels of vehicle loading. Given that the test is performed by decoupling the wagon, it is necessary to apply a number of technical measures that will ensure that the test is performed safely and with minimal risks. By applying the network planning method, it was shown that although there is a relatively small number of activities, each of them can be critical, i.e. in case of delay may cause additional costs, that can be identified during planning, but which are not recognized and most often not acknowledged by the purchaser of the testing.*

Key words: *railway vehicles, brake performance test, management of logistical support*

1.INTRODUCTION

As part of the approval procedure carried out by ERA (European Railway Agency) with the application of international TSI regulations, each vehicle must pass a series of tests before obtaining a permit in order to demonstrate that its application is safe and compliant with European standards, i.e. to demonstrate that the vehicle and all its components are compatible with the systems implemented on the Trans-European Rail network.

Below is an overview of the most important type tests, which must be performed in the approval process of one standard freight wagon. All these tests are complex, expensive and require good organization in order to achieve a successful implementation and a positive financial outcome for a testing laboratory. These tests include:

1. Testing of static strength,
2. Determination of the torsional constant,
3. Buffing impact test,
4. Brake performance test,
5. Measurement of noise emitted by rail vehicles.

For certain freight wagons, it is necessary to carry out tests related to checking the safety against derailment. These tests are carried out by a small number of laboratories in Europe because special measuring systems are applied and specific expert knowledge in the dynamics of railway vehicles is required. Accreditation for these type of tests increases the competitive ability of a testing laboratory.

As an example, more detailed is presented a description of the activities, required resources and the engagement of subcontractors during the implementation of brake performance test.

2. BRAKE PERFORMANCE TEST

This test is carried out on a straight and level track with a mean gradient over the stopping distance below 3‰ and the maximum gradient on the whole test section up to 5‰. Preferably outside populated areas and without level crossings. The test section should be of sufficient length for acceleration,

uncoupling and then for safe stopping of the rail vehicle being tested. The tests are carried out at the maximum designed speed and with different degrees of loading of the wagons, in order to determine the stopping distances, necessary for the safe stopping of the wagon within train composition in regular operation.

For the test purposes, the test train composition consists of a locomotive, a passenger coach on which the special hook is installed for uncoupling the wagon being tested. During test rides in that passenger wagon are the test performers. At the end of the test composition is the wagon that is tested. The wagon should be in the condition „ready for traffic“. Figure 1 shows the composition ready for testing in the case of testing one tank car for the transportation of petroleum products.

Figure 1. Tank wagon Zacns in the test train composition [5]

The composition accelerates and after reaching the desired speed, the wagon being tested is decoupled from the rest of the composition using a special hook with a pneumatic locking mechanism, installed on the passenger wagon (Figure 2).

Figure 2. Special hook installed on the passenger wagon

The testing wagon automatically begins to brake to a stop. For testing, a measurement acquisition device is used for collecting and storing measurement signals connected with sensors for monitoring measured quantities. The entire measuring system must complies with referent standards in terms of measuring range and accuracy class.

Speed, stopping distance, deceleration and pressure in the main brake pneumatic components are measured as a function of time. For the braking process the most important is to record brake pipe pressure and cylinder pressure. Typical record of measured parameters during one test ride is presented in Figure 3 [5].

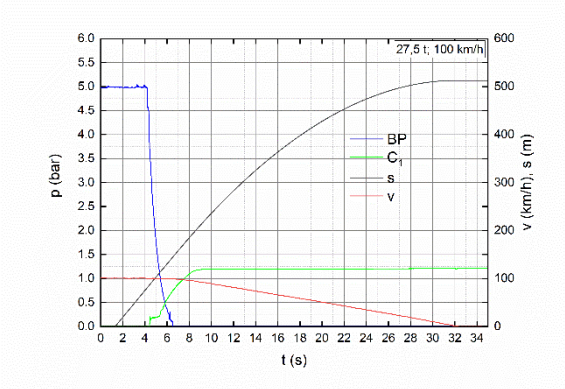

Figure 3. Typical record of measured parameters vs. time during braking of Zacns wagon [5]

Determining the braking performance, i.e. the braking mass of the wagon, is based on the results of measuring the stopping distance of the wagon.

Figure 4. Loading-unloading of different types of freight wagons [2, 3, 4]

Loading and unloading is done at the loading ramp, with loads that may vary depending on the type of wagon. The quantities of the payload that need to be loaded range from 60 for 4-axle wagons and even over 100 t for 6-axle wagons. Figure 4 shows the loading of three different wagons. For the transport of

containers, concrete blocks and the filling of a tank for the transport of petroleum products [2, 3, 4]. In addition, there are other special wagons for transporting bulk cargo, palletized goods, road semi-trailers, steel coils and complete road vehicles etc.

3. ORGANIZATION OF LOGISTICAL SUPPORT

In order to achieve stabile project flow, the planning process is a very important stage in the project life cycle. The planning process itself is very complex and consists of several sub-phases, and during it the key parameters of the project are identified and certainty of the project outcomes. During the planning phase, the project management deals with the exchange of information about the project with purchaser and negotiate with subcontractors. Planning can be defined as: determination of all activities, their duration and required resources and determination of the dynamics of their realization in accordance with the anticipated deadlines for the completion of the examination as a whole or some of its phases [1, 6].

The quality of the network plan is reflected in as many parallel activities as possible. If the network narrows from a parallel flow to one activity and then expands again, that activity represents a bottleneck and should, if possible, avoid such situations or provide enough resources so that the activity does not get delayed. Given that activity duration is deterministic, for the organization and management of activities related to brake performance test, the application of a network diagram and CPM (Critical Path Method) is suitable. The network diagram (Figure 5) clearly shows the activities, as well as which activity precedes which.

Considering the number of activities and different subcontractors that need to be engaged during the test, the most important aspect of the organization is timeliness, i.e. it is necessary that everyone are ready to carry out the planned activity at the appropriate moment. The absence or delay of any activity jeopardizes the realization of the test and increases the costs. Given that it is a matter of occasional and temporary hiring of certain resources and subcontractors, when planning, it should be considered that there are high risks related to their availability [1, 2, 3, 4]. Practice showed, that during tests, direct and good communication with subcontractors involved in logistical support is the best way to control the implementation of the activities.

Below is an overview of subcontractors, their tasks, and the activities they should perform.

The list of subcontractors:

- Subcontractor 1: Forwarder,
- Subcontractor 2: Railway operator 1,
- Subcontractor 3: Railway operator 2,
- Subcontractor 4: Owner of the passenger coach,
- Subcontractor 5: Lifting company with auto-crane,
- Subcontractor 6: Railway infrastructure.

These subcontractors should perform following tasks:

- Subcontractor 1 - provides customs papers and organize delivery of wagons to the initial test location,
- Subcontractor 2 - provides transport from abroad, if necessary,
- Subcontractor 3 - provides the locomotive for testing,
- Subcontractor 4 - provides passenger coach for test crew and measuring equipment,
- Subcontractor 5 - loads and unloads cargo according to the loading plan every test day. This subcontractor should be at the loading ramp at the right time ready for loading-unloading,
- Subcontractor 6 - provides the testing section, the traffic controller, the loading-unloading ramp.

Activities related to provision of logistical support for brake performance test are:

A. Customs affairs and vehicle transport to the testing location,
B. Preparation of wagons for testing,
C. Cargo delivery and preparing loading crane,
D. Delivery of the passenger coach and its preparation,
E. Arrival of the locomotive for testing,
F. Test train composition formation,
G. Provision of test sections and traffic controllers,
H. Testing of braking performance,
I. Unloading of wagons and disassembling of measuring equipment,
J. Returning the wagon to the customer.

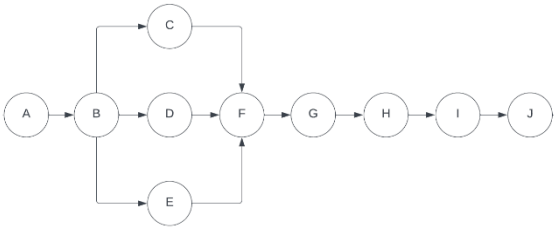

Figure 5. Network diagram

Figure 5 presents activity network with activities on the nodes (A-O-N), but without showing their

duration. It is assumed if the activity starts in time, it will certainly be finished. There are some risks not related to subcontractors, but to weather conditions. During tests regular conditions are with absence of wind and the rails should be dry. If the rain or wind appear, the test must be interrupted. The risk may be partially managed by monitoring the weather forecast.

Based on the network diagram, it can be determined three critical paths. There is no clearly defined bottleneck, but rather all the activities are equaly important and critical for the test.

The resource base is very limited, considering that there are only few available subcontractors for all activities defined in the project.

The budget is defined in advance, assuming certain possible risks and delays. The costs primarily depend on whether the activities are carried out according to the planned dynamics. In some cases, if there is a deviation from the plan and a necessary interruption of the implementation of the test, it is possible to stop some costs, but for most of the reserved resources, it is necessary to pay the reservation costs, i.e. compensate the subcontractor for the lost profit due to the non-use of the resource in question.

In the situation of a small number of subcontractors who can provide a certain services related to testing, it is very difficult to contractually oblige the subcontractors to compensate for the damage caused by their omissions.

4. CONCLUSIONS

In the future, advanced techniques and simulations should be applied in managing approval tests of wagons [6]. This will improve risk managment and minimize possible deviations from the plan [1].

In this way, the focus of the laboratory's work will be on improving the procedures and testing methods themselves, providing additional quality to purchasers and increase of confidence in the test results.

In order to remain competitive on the European market, it is necessary to improve all these aspects of the laboratory work simultaneously and continuously.

Acknowledgement

Authors express gratitude to Ministry of Education, Science and Technological Development of Republic of Serbia, Project Contract 451-03-9/2022-14/200105.

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