MINISTRY OF TRANSPORTS AND INFRASTRUCTURE
ROMANIAN RAILWAY AUTHORITY - AFER

ROMANIAN RAILWAY INVESTIGATING BODY

INVESTIGATING REPORT

of the railway accident
occured on the 28th of September 2012, in the railway station Târgu Jiu

Final edition
The 15th January2013

NOTICE

Concerning the railway accident occured on the 28th of September 2012, at 05.36, in the Branch of the Regional Center for Railway Operation, Maintenance and Repairs Craiova, on the running section Petroșani – Târgu Jiu (single, electrified line), in the railway station Târgu Jiu, at the stabling on the line 4, in the Y end of the station, consisting in the derailment of the first axle from the first bogie of the locomotive ED 91 53 0 474030-0, secondary at the freight train no. 84790, belonging to the railway undertaking SNTFM „CFR Marfă" SA Bucharest, Romanian Railway Investigating Body performed an investigation, according to the provisions of the *Law no. 55/2006 on the railway safety and the Government Decision no. 117/2010 for the approval of the Regulation for the investigation of accidents and incidents, development and improvement of railway safety on the railway and the metro network in Romania.*

Through the performed investigation, the information concerning the occurrence of this accident was gathered and analyzed, the conditions were established and the causes determined.

The Romanian Railway Investigating Body considers that necessary to take corrective measures for the improvement of the railway safety and the prevention of the accidents, which for he issued in the present report a series of safety recommendations.

Bucharest, the 15th of January 2013

Approved by

Director,
Nicolae SANDU

I ascertain the compliance with the legal provisions concerning the investigation and the drawing up of this investigating report that
I submit for approval
Chief Investigator
Eugen ISPAS

This notice is part of the Report for the investigation of the railway accident happened on the 28th of September 2012, at 05.36, in the Branch of the Regional Center for Railway Operation, Maintenance and Repairs Craiova, on the running section Petroșani – Târgu Jiu (simple, electrified line), in the railway station Târgu Jiu, at the stabling on the line 4, after passing over the switch no. 24, in the Y end of the station, trough the derailment of the first axle from the first bogie of the locomotive ED 91 53 0 474030-0, secondary at the freight train no. 84790.

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A. PREAMBLE

A.1. Introduction

In accordance with the provisions of the Law no. 55/2006 on the railway safety and the Government Decision no. 117/2010 for the approval of the Regulation for the investigation of the accidents and incidents, for the development and improvement of Romanian railway and subway safety, Romanian Railway Investigating Body, hereinafter referred to as OIFR, performs investigation which aims to improve the railway safety and to prevent the railway incidents or accidents.
OIFR's investigation is performed independently from any inquiry and does not aim to establish the guilty or the responsibility.

In the content of this investigation report, the below terms and abbreviations have the following meanings:

a) OIFR – Romanian Railway Investigation Body;
b) CNC „CFR" SA – National Railways Company ;
c) CZM – Regional Freight Center;
d) CREIR CF - Regional Center for Railway Operation, Maintenance and Repairs;
e) SNTFM "CFR Marfă" SA – National Company for Railway Freight Transport;
f) SC IRLU SA Bucharest, Simeria Repairs Division– IRLU Simeria;
g) SC IRLU SA Bucharest, Craiova Repairs Division– IRLU Craiova;
h) Regulation - Regulation for the investigation of accidents and incidents, development and improvement of Romanian railway and subway safety, approved by Government Decision no. 117/2010;
i) Railway Safety Law– Law no. 55/2006 on the railway safety.

A.2. Investigation process

According to:
- the art 19, paragraph 2 from the *Railway Safety Law*,
- the art. 48 from the *Regulation*
and taking into account:
- the informative note of the General Traffic Safety Inspectorate from CNCF "CFR" SA from the 28th of September 2012;
- and the informative paper of the Regional Traffic Safety Inspectorate from the Branch CREIR CF Craiova from the 28th of September 2012;
- defining of the railway event as accident, according to the art. 3, paragraph (1), from the Railway Safety Law and art. 7, paragraph (1) point b) from the Regulation,
OIFR decided to start an investigation in this case.

Through the Decision no. 96, from the 28th of September 2012 of OIFR director was appointed an investigation commission for this railway accident, consisting as follows:

- Florin Cristian STOICA - OIFR investigator investigator in charge;
- Alin RADOVICI - state inspector member;
- Florentin CAPĂȚÎNĂ - state inspector member.

B. INVESTIGATION REPORT BRIEF PRESENTATION

B.1. Brief description

On the 28th of September 2012, in the running of the freight train no. 84790, belonging to the railway undertaking SNTFM „CFR Marfă" SA, consisting in 33 wagons, 132 axles, 814 tons, 520 meters long, on the running section Petroșani – Târgu Jiu, at the stabling on the line 4, at 05.36, in the railway station Târgu Jiu, after the passing over the switch no. 24, at the Y end of the station, the first axle, of the first bogie from the locomotive ED 91 53 0 474030-0, secondary at the train was derailed.

Following this accident, the traffic between the railway stations Târgu Jiu and Ecaterina Teodoroiu was closed at the moment of the accident occurrence up to 07.26, on the 28th of September 2012.

Following this accident were no injured or casualties.

B.2. The direct cause

The direct cause of this accident was the significant load transfer from the axle no. 1, which affected the guidance capacity and the safety coefficient against derailment, it leading to the climbing of the right wheel flange, in the running direction, on the head of rail corresponding to the exterior curve rail, its running on the rail about 900 mm, followed by the derailment of the axle, with the left wheel inside the track.

B.3. Contributing factors

The existence of failures at the locomotive, presented below:
- a difference of 2,19 mm between the wheel diameters of the wheels from the axle no. 1 (compared with 0,3 mm admitted by the specific regulations in force for the turned axles);
- a difference between the wheel diameters:
  - axle no. 1 and axle no. 2 of 21,38 mm;
  - axle no. 1 and axle no. 3 of 19,9 mm,

compared with 4 mm admitted in the operation by the specific regulations in force, without the adjustment of the tolerances;
- differences between the loads on the wheels without balancing:
  - 3,4% between the load on the left and the right wheel of the axle no 3;
  - 2,9% between the load on the left and the right wheel of the axle no 4;
  - 4,5% between the load on the left and the right wheel of the axle no 5;
  - 3,4% between the load on the left and the right wheel of the axle no 6;

compared with ±2% admitted in the operation by the specific regulations in force, without adjusting additions;
- the existence of witness marks, on the active flank of the wheel flange on the right side in the running direction of the axle no.1, resulted from the turning of the wheel;
- overcoming the horizontal clearance admitted between side rubber buffers and bogie frames:
  - 20 mm compared with the minimum 22 mm at the bogie no. 1;
  - 37 mm compared with the maximum 28 mm at the bogie no. 2.

B.4. Underlying cause

Non-compliance the technological processes of repair of locomotives, in the sense that the locomotive was routing without performing all instructional checks.

B.5. Root causes

None.

B.6. Safety recommendation
None.

C. INVESTIGATING REPORT

C.1. Accident presentation

On the 28th of September 2012, at 05.15, the freight train no. 84790 (belonging to the freight undertaking SNTFM „CFR Marfa" SA), was dispatched from railway station Petroșani to the railway station Târgu Jiu.

The freight train no. 84790 was composed from 33 wagons, 132 axles, 814 tons, 520 meters long, hauled by the locomotive EA 40 0 830-6, with locomotive ED 91 53 0 474030-0 secondary, both belonging to the freight undertaking SNTFM „CFR Marfă" SA, with drivers from the same railway undertaking.

The train ran without technical or safety problems until the accident. Before the accident the train stopped and stationed in the railway station Ecaterina Teodoroiu.

The derailment occurred at a distance of 8.10 m from the heel joint the switch no. 24 by climbing wheel right in the running, running it on the rail head 900 mm, followed by its fall outside the rail while the left wheel fall inside the rail.

At a distance of about 50 m from the derailment place, one found the fastening screws connecting the bracket that supports the vertical damper from the first axle, left wheel in the running direction.

When the train stopped, the locomotive ED 91 53 0 474030-0 ran a distance of about 25 meters derailed and was on the connection section between the switch no. 24 and the track no. 4, having the first axle from the first bogie derailed (in the running direction).

C.2. Accident circumstances

C.2.1. Involved parties

The infrastructure and superstructure of the track where the accident occured are administrated by CNCF „CFR" SA. The maintenance of the superstructure is made and maintained by the employees of L5 Section Târgu Jiu from CREIR Craiova.

The interlocking system from the railway station Târgu Jiu are maintained by the employees of the CT 4 Section Târgu Jiu from CREIR Craiova.

The communication equipment from the railway station Târgu Jiu is administrated by CNCF „CFR" SA and is maintained by the employees of SC "Telecommunicații CFR" SA.

The communication equipment from the locomotive is owned by the railway undertaking SNTFM "CFR Marfă" and maintained by the employees of SCRL Brașov.

The locomotive involved in the derailment and the wagons of the train no. 84790 are owned by the railway undertaking SNTFM „CFR Marfă" SA.

C.2.2. Composition and train equipment

The freight train no. 84790, belonging to the freight undertaking SNTFM „CFR Marfă" SA, consisting from 33 wagons, 132 axles, 814 tons, hand braked according to the timetable 122 tones, actually hand braked 399 tones, automatic braked according to the timetable 407 tones, actually automatic braked 672 tones and 520 meters length.

The automatic brake of the train was active, the safety and vigilance device (DSV) and the automatic train protection system (INDUSI) of hauling locomotive EA 40 0 830-6 equipment were active and in operation, the safety and vigilance device (DSV) and the automatic train protection

system (INDUSI) of the secondary locomotive ED 91 53 0 474030-0 equipment were sealed and off.

C.2.3. Description of the rail equipment involved at the accident

C.2.3.1. Tracks

Route presentation

By reference to the track alignment, in the derailment area, it is in curve with a radius **R**=210 meters, left deviation in the running direction and a cant of the track of **h**=15 m.

Superstructure presentation

In the derailment area, the superstructure is composed of rail type 49, concrete and wooden sleepers with indirect fastening type K, excepting the sleeper nr. 12 (numbered from the heel joint from the switch no. 24 to the station axle), were the fastening was unsuitable (on the right end of the running direction, the metallic plate was not fastened on the sleeper and was put between the 11th and 12th sleepers).

Photo 1. The place where the climbing of the right wheel flange, in the running direction, on the head of rail, corresponding to the exterior curve rail happened.

The place of the derailment is on the curve after the switch no. 24, at 8,10 m from the last joint, on the deflecting section of this switch.

The track bed was non riddled.

C.2.3.2. Equipment

Contact line of the installation of force and power supply is made of catenary and its supporting system on concrete pillars.

The railway station Târgu Jiu is equipped with interlocking system type CR3 with control operation and vertical desk and the running section is equipped with automatic block system.

C.2.3.3. Locomotives

Preliminary findings made in the railway station Târgu Jiu at the locomotive ED 91 53 0 474030-0

- the locomotive ED 91 53 0 474030-0 was stopped and with the axle 1 derailed on the connection curve of track no. 4;
- there were no findings of axial movement or swarf at the joint between wheel rim and tyre;
- there were no findings of wheel flats;
- automatic brake: good;

- direct brake: good;
- hand brake: good;
- air compressor: normally worked
- condition of the air manometers: good and verified;
- position of the drivers brake valve: braking;
- tightness of the brake equipment: good;
- the safety and vigilance device (DSV) equipment: sealed and in operation;
- the automatic train protection system (INDUSI) sealed and off;
- speed recording equipment type IVMS sealed and in operation;
- the bracket that supports the vertical damper from the first axle on the left side in the running direction was detached from the fastening screws from the rear.

C.2.4. Communication facilities

The communication between the driver and the movement inspector was ensured through radio-telephone equipment.

C.2.5. Start of the railway emergency plan

Immediately after the railway accident, the intervention plan for the removal of the damages and for the restoration of the traffic was made in accordance with the provisions from the *Regulation for the investigation of the accidents and incidents, for the development and improvement of Romanian railway and subway safety*, approved by the Government Decision no. 117/2010, according which, at the accident place came the representatives of Romanian Railway Authority – AFER, of the railway public infrastructure administrator CNCF „CFR" SA - Branch of the Regional Center for Railway Operation, Maintenance and Repairs Craiova and of the railway undertaking SNTFM „CFR Marfă" SA.

For the lifting of the derailed locomotive ED 91 53 0 474030-0 and its re-railing one used local means.

For the restoration of the traffic between the railway stations Târgu Jiu and Ecaterina Teodoroiu, from the railway station Ecaterina Teodoroiu one routed the assistant locomotive EC 019, belonging to SNTFC, that hauled the passenger train no. 2080, arrived in railway station Ecaterina Teodoroiu at 05.48. At 06.30, the assistant locomotive EC 019 was routed to the railway station Targu Jiu and shunted the rake of wagons of the train no. 84790 in the railway station Ecaterina Teodoroiu, at 07.23.

C.3. Accident consequences

C.3.1. Fatalities and injuries

None.

C.3.2. Material damages

The value of the material damages, according to the estimations drawn up by the owner of the rolling stock and the railway public infrastructure administrator, is:

Material damages	
at the locomotives	0
at the lines	0
intervention train	0
TOTAL	**0**

C.3.3. Consequences of the accident in the traffic

The accident affected the railway traffic, generating the delay of 7 trains with a total of 303 minutes.

The railway traffic between the railway stations Ecaterina Teodoroiu and Târgu Jiu was closed on the 28th of September 2012, from 05.36 until 07.26.

C.4. External circumstances

On the 28th of September 2012, between 23.00 and 07.00, the visibility was good, the temperature was about $+12^0$ C.
The visibility of the light signals was in accordance with the provisions of the specific regulations in force.

C.5. Investigation course

C.5.1. Summary of the involved staff testimonies

The investigation commission questioned the driver which drove the locomotive EA 40 0 830-6, hauling the train and the driver from the secondary locomotive ED 91 53 0 474030-0 in the railway station Târgu Jiu.

The driver of the locomotive EA 40 0 830-0, which was hauling the freight train no. 84790 stated:

- at the entry in the railway station Târgu Jiu with permissive indication (”two yellow lights”) at the track no. 4, after running about 20 meters from the entry on the stabling tracks he heard a suspicious noises and then informed by the driver of the locomotive ED 91 53 0 474030-0 to brake, because this locomotive derailing;
- he took measures for the quick brake and after the train stopped and assurance the locomotive to keep stopped, he got down from the cab and found out that the secondary locomotive ED 91 53 0 474030-0 had the first axle from the first bogie derailed in the running direction. He notified by radiotelephone the movement inspector from the station Târgu Jiu and by telephone with the dispacher, the head of the shift, the driver instructor, head of traction unit and waited for the investigation commission.

The driver of the locomotive ED 91 53 0 474030-0, secondary at the freight train no. 84790 stated:

- at the entry in the railway station Târgu Jiu on the track no. 4, after running about 20 meters from the entry on the stabling tracks he notified the driver of the locomotive EA 830 that they derailed.

C.5.2. Safety management system

At the moment of the accident, CNCF “CFR” SA, as manager of the railway infrastructure, had implemented its own railway safety management system, according to the provisions of the *Directive 2004/49/EC on the Community railway safety, the Law no. 55/2006 for railway safety and of the Minister of Transport’s Order no. 101/2008 on the granting of the safety authorization to Romanian railway infrastructure administrator/manager*, getting**:**

- Safety Authorization – Part A, identification number ASA 09002 – by which Romanian Railway Safety Authority, from Romanian Railway Authority – AFER agrees the acceptance of the safety management system of the railway infrastructure manager;
- Safety Authorization – Part B, identification number ASB 09007 – by which Romanian Railway Safety Authority, from Romanian Railway Authority – AFER agrees the acceptance of the dispositions taken by railway infrastructure manager in order to comply with the specific requirements necessary to ensure the railway infrastructure safety, in the designing, maintenance and operation, including if case, maintenance and operation of the system for the traffic control and signaling.

At the moment of the accident occurrence, SNTFM "CFR Marfă" SA, as railway undertaking had implemented its own railway safety management, according to the provisions of the *Directive 2004/49/EC on the Community railway safety, the Law no. 55/2006 for railway safety and of the Minister of Transports' Order no. 535/2007 for the approval of the norms for the granting of the railway transport licenses and the safety certificates in order to perform railway transport on Romanian railways*, got:

- Safety Certificate – Part A, identification no. CS0024 – by which Romanian Railway Safety Authority, from Romanian Railway Authority – AFER agrees the acceptance of safety management system of the railway undertaking, in accordance with the national legislation;
- Safety Certificate – Part B, identification no. CSB0060 – by which Romanian Railway Safety Authority, from Romanian Railway Authority – AFER agrees the acceptance of the dispositions taken by the railway company in order to comply with the specific requirements necessary for the safety operation on the relevant network, in accordance with the Directive 2004/49/EC and the national legislation.

C.5.3. Norms and regulations. Sources and references for the investigation

In the investigation of the railway accident one took into account the next:

<u>*Norms and regulations:*</u>

- *Regulation for the investigation of accidents and incidents, development and improvement of the railway safety on Romanian railway and subway network*, approved by Government Decision no. 117/2010;
- *Regulation for railway technical operation no. 002*, approved by Minister Of Public Works, Transports and Housing's Order no. 1186 from 29.08.2011;
- *Instruction for the repair of pairs of wheelset from the railway vehicles no. 931* from 1986;
- *Railway technical norm R.T.N. 81-002/2004. Railway vehicles. Wheelset. General technical requirements for quality*, approved by Minister of Transports, Constructions and Tourism's Order no. 1826/07.10.2004;
- *Order of the Directorate General for Traction no. 310/4/a/2800/col. 1993 – Technical requirements for operating electric locomotive axles – CFR;*
- *Instruction for the establishment of the deadlines and order of the track inspections no. 305* approved by Minister of Transport`s Order of no. 71/17.02.1997;
- *Instruction of norms and tolerances for the track construction and maintenance – lines with standard gauge no. 314/1989*;

<u>*Sources and references:*</u>

- copies of the documents asked for the investigation commission members, enclosed to the investigation file;
- photos taken soon after the railway accident by the members of the investigation commission;
- photos taken on the involved locomotive ED 91 53 0 474030-0, at the accident place;
- documents on the maintenance of the tracks, provided by the persons in charge with their maintenance;
- results of the measurements made soon after the accident at the superstructure of the track;
- results of the measurements made soon after the accident at the locomotive;
- examination and interpretation of the technical condition of the elements involved in the accident: infrastructure and locomotive.
- questionnaires of employees involved in railway accident.

C.5.4. Operation of the technical equipment, infrastructure and rolling stock

C.5.4.1. Data found out on the track

<u>Findings and measurements at the track, after the derailment</u>

From the first trace from the lateral surface, between the rails, of the rail corresponding to the inner line of the curve, in the reverse direction of the train running, measurements of the gauge (E) were

made with the gauge measuring and of the cross level of the track (N), in the points marked equidistant at 2,5 meters.
The values measured comply with the provisions of the *Instructions of norms and tolerances for constructions and maintenance of tracks-lines with standard gauge no. 314/1989,* corresponding to the speed on deflecting section of 30 km/h, speed restriction of 15 km/h over switch no. 24.

C.5.4.2. Data on the operation of the rolling stock and its technical equipment

Findings and measurements at the train's locomotives on the 2nd of October 2012:

- the clearance between the rubber side buffers and the bogie frame don't correspond to the values prescribed by applicable regulations in force, so that the clearance between the rubber buffers and the bogie frame side P1 from the right side of the bogie being 20 mm and 37 mm and the permissible values are between 22 to 28 mm, the distance between the axlebox and the bogie frame of the axle no. 2 are 43 mm and 22 mm and the permissible values are between 29 to 33 mm;
- after measuring axle loads were found exceeding the prescribed values as follows:
  - at the axle no. 3 the difference between the load on the left wheel and the right wheel was 3,4 %, so the limit of 2 % was exceeded with 1,4%,
  - at the axle no. 5, the difference between the load on the left wheel and the right wheel was 4,5%, so the limit of 2% was exceeded with 2,5%;
- after measuring wheel diameters were found exceeding the prescribed values (for driving axles 1 mm) as follows:
  - a difference of 2,19 mm between the wheel diameters (left-right) at the axle no. 1.
  - a difference of 2,19 mm between the wheel diameters (left-right) at the axle no. 2.
  - a difference of 1,53 mm between the wheel diameters (left-right) at the axle no. 4.
  - a difference of 2,18 mm between the wheel diameters (left-right) at the axle no. 6.

  The axles no.1, 2 and 6 were turned at IRLU Simeria.

Photo 2 Scoring existing on the axle no. 1, derailed wheel

- difference between the wheel diameters of the wheelsets at the first bogie in the running direction is 19,19 mm, (the wheel diameters of the axle no. 1 and the wheel diameters of the axle no. 2);
- difference between the wheel diameters of the wheelsets at the second bogie in the running direction is 12,80 mm, (the wheel diameters of the axle no. 5 and the wheel diameters of the axle no. 6);

  The measurements were made on the lathe to measure wheel diameters belonging IRLU Craiova which have AFER technical approval;
- presence of oil in the tank of the equipment for the lubrication of the flange of wheel (equipment type Secheron);
- the height of the buffers centres, measured on vertical from the superior level of the rails:
  - at the bogie no. 1, left side 1040 mm, right side 1034 mm,

- at the bogie no. 2, left side 1049 mm and right side 1040 mm, **Admitted value is between 1045 and 1060 mm**.

From the analysis of documents provided showed that the locomotive entered into IRLU Simeria to perform a repair type RT (but some sheets appear repair type R2, R1 and others like RT) and was issued order for turning axles no.1, 5 and 6.

At check of the revisions sheets was found to not comply with the time or mileage standards for maintenance and repairs planned railway vehicles engines as they are set according to Table 3.1 Annex 1 of Minister of Transports and Infrastructure`s Order no. 1359/2012.

Following the planned technical revision wasn't issued the Declaration of Conformity because IRLU Simeria does not yet a Railway Technical Agreement for provide this critical railway service.

On the 22th August 2012, IRLU Simeria was submitted to AFER the address no. 15/58/3rd of August 2012, registered with no. 16940/22th of August 2012, without the visit of evaluation.

C.6. Analysis and conclusions

C.6.1. Conclusions on the technical condition of the track superstructure

On the 28th of September 2012, the train no. 84790 had entrance order on the line no.4 from the railway station Târgu Jiu, entry on deflecting section.
To access on the deflecting section from the railway station with a maximum speed of 15 km/h, driver took timely steps braking, so that at 05:32:43 the train passed over the entry signal with a speed of 29 km/h, and within 472 meters train speed decreased from 29 km/h to 15 km/h, then the train run 236 meters with a speed of 13 km/h. Within 88 meters, the speed of the train decreased from 13 km/h to 0 km/h and the train stopped at 05:35:38.
In the area of the railway accident the long profile of the track is 1,8 ‰ gradient, slope the running direction of the train.
Point of its occurrence escalating rail on the outside rail of the curve by wheel on the right side of the first axle of the locomotive (in the running of the train) are located on the connection curve between the switch no. 24 and the line no. 4.
From the first trace from the lateral surface, between the rails, of the rail corresponding to the inner line of the curve, in the reverse direction of the train running, was performed checks of the gauge (E) and the cross level of the track (N) with track gauge and superelevation measuring device**,** in the points marked equidistant at 2,5 meters.
The values measured comply with the provisions of the *Instructions of norms and tolerances for constructions and maintenance of tracks - lines with standard gauge no. 314/1989,* corresponding to the speed on deflecting section of 30 km/h, speed restriction of 15 km/h over switch no. 24.

C.6.2. Conclusions on the technical condition of the locomotives from the train composition

On the 2nd October 2012, at the locomotive ED 91 53 0 474030-0 at IRLU Craiova, after the derailment occurrence, was made the follows measurements:
- measurements of the tire's sizes from the locomotive's wheels, including the quota „D" (back to back dimension), in 3 points, the measured values were according to the values prescribed instructional, in accordance with the *Regulation for railway technical operation no. 002/2001* and Instruction no. 931/1986;
- no flats were found at any locomotive's tires;
- there were no traces of axial displacement or swarf at the joint between wheel rim and tyre;
- were not found structural or functional defects of the transverse coupling, the coupling length of 998 mm (in the measurement sheet from IRLU Craiova, made during repair type RK value is 997 mm);
- after the measurement of the loads on the axles and the mechanical clearance were found exceeding of the prescribed values, as follows:
  - at the axle no. 3 the difference between the load on the left wheel and the right wheel was 3,4%, the limit of 2% being exceeded with 1,4 %,

  - at the axle no. 5, the difference between the load of left wheel and the right wheel was 4,5%, the limit of 2% being exceeded by 2,5%;
  - the clearance between the rubber side buffers and the bogie frame P1 on the right side being of 20 mm, respectively of 37 mm, and the permitted values are between 22 and 28 mm, the distance between the axlebox and the bogie frame at the axle no. 2 is 43 mm, respectively 22 mm, and the permitted value is between 29 and 33mm.
- after measuring wheel diameters were found exceeding the prescribed values (for driving axles 1 mm) as follows:
  - a difference of 2,19 mm between the wheel diameters (left-right) at the axle no. 1.
  - a difference of 2,19 mm between the wheel diameters (left-right) at the axle no. 2.
  - a difference of 1,53 mm between the wheel diameters (left-right) at the axle no. 4.
  - a difference of 2,18 mm between the wheel diameters (left-right) at the axle no. 6.

The measurements were made on the lathe to measure wheel diameters belonging IRLU Craiova which have AFER technical approval.

- presence of oil in the tank of the equipment for the lubrication of the flange of wheel (equipment type Secheron);
- the height of the buffers centres, measured on vertical from the superior level of the rails:
  - at the bogie no. 1, left side 1040 mm, right side 1034 mm,
  - at the bogie no. 2, left side 1049 mm and right side 1040 mm, admitted value is between 1045 and 1060 mm.

C.6.3. Analysis and conclusions on the derailment of the secondary locomotive of the train no. 84790 that occurred on the 28th of September 2012

After analyzing the findings at the place where the accident occurred, of the technical condition of the involved locomotive, of the photos took at the accident place, as well as the testimonies of the involved employees, one can conclude that the railway accident happened in the following conditions:

- the derailment took place at a distance of 8,10 meters from the heel joint of the switch no. 24 through the climbing of the right wheel, in the running direction;
- starting from this point on the head of the right rail it can be observed on a 900 mm distance a running rail from the flange of wheel, followed by a print on the outer side surface on the head of rail;
- after rolling of the flange of axle no. 1 on the head of connection rail from the right side on a 900 mm distance, the right wheel of axle no.1 derailed in the exterior of this rail, at the same time with the fall of the wheel from the left side between the two rails, which left a specific fall trace and rolling on the metal fasteners of the rail on the metal plates (vertical screw rods and clamps type K), and hitting traces on the coach screws and running on sleepers;
- derailment specific tracks have been recorded over a length of about 25 m.

D. ACCIDENT CAUSES

D.1. Direct cause

The direct cause of this accident was the significant load transfer from the axle no. 1, which affected the guidance capacity and the safety coefficient against derailment, it leading to the climbing of the right wheel flange, in the running direction, on the head of rail corresponding to the exterior curve rail, its running on the rail about 900 mm, followed by the derailment of the axle, with the left wheel inside the track.

Contributing factors

The existence of failures at the locomotive, presented below:

- a difference of 2,19 mm between the wheel diameters of the wheels from the axle no. 1 (compared with 0,3 mm admitted by the specific regulations in force for the turned axles);
- a difference between the wheel diameters:
  - axle no. 1 and axle no. 2 of 21,38 mm;

- axle no. 1 and axle no. 3 of 19,9 mm,

compared with 4 mm admitted in the operation by the specific regulations in force, without the adjustment of the tolerances;

- differences between the loads on the wheels without balancing:
  - 3,4% between the load on the left and the right wheel of the axle no 3;
  - 2,9% between the load on the left and the right wheel of the axle no 4;
  - 4,5% between the load on the left and the right wheel of the axle no 5;
  - 3,4% between the load on the left and the right wheel of the axle no 6;

compared with ±2% admitted in the operation by the specific regulations in force, without adjusting additions;

- the existence of witness marks, on the active flank of the wheel flange on the right side in the running direction of the axle no.1, resulted from the turning of the wheel;
- overcoming the horizontal clearance admitted between side rubber buffers and bogie frames:
  - 20 mm compared with the minimum 22 mm at the bogie no. 1;
  - 37 mm compared with the maximum 28 mm at the bogie no. 2.

D.2. Underlying causes

Non-compliance the technological processes of repair of locomotives, in the sense that the locomotive was routing without performing all instructional checks.

D.3. Root causes

None.

E. SAFETY RECOMMENDATIONS

None.

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This Investigating Report will be transmitted to Romanian Railway Safety Authority, to the public railway infrastructure administrator CNCF „CFR" SA and to the railway freight undertaking SNTFM „CFR Marfă" SA.

Members of the investigation commission:

- Florin Cristian STOICA - OIFR investigator investigator in charge;
- Alin RADOVICI - state inspector member;
- Florentin CAPĂȚÎNĂ - state inspector member.