



MINISTERUL TRANSPORTURILOR

AGENȚIA DE INVESTIGARE FERROVIARĂ ROMÂNĂ - AGIFER



INVESTIGATION REPORT

for the incident happened on the 17th of February 2015
in the branch of the Railway County Craiova,
in the railway station Drăgășani, in the running of the passenger train Regio no.2455,
consisting in the breakage of the driving axle from the diesel multiple unit AM 917



Final version
23rd of November 2015

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A. PREAMBLE

A.1. Introduction

Romanian Railway Investigating Body, hereinafter referred to as OIFR, currently Romanian Railway Investigating Agency-AGIFER, performs investigations according to the provisions *Law no.55/2006* on the railway safety, with further amendments, hereinafter referred to as *Law on the railway safety*, of the Government Decision no.716/2015 concerning the organization and functioning of Romanian Railway Investigating Agency – AGIFER and for the amendment of the Government Decision no.21/2015 on the organization and functioning of the Ministry of Transport as well as of the *Regulations for the investigation of the accidents and incidents, for the development and improvement of Romanian Railway and metro safety*, approved by the Government Decision no.117/2010, hereinafter referred to as *Investigation Regulations*.

The purpose of OIFR investigation, currently AGIFER is the improvement of the railway safety and the prevention of the railway accidents and incidents

The investigation is independent of any legal inquiry and aims never to establish the guilty or the responsibility.

A.2. Investigation process

According to the art.19, paragraph 2 from the *Law on the railway safety*, corroborated with art.49 from the *Investigation regulations*, OIFR, currently AGIFER, in the situation of a technical failure of the structural subsystems or of the interoperability constituents, can open an investigation and make investigation commissions for the gathering and analysis of technical information, establishment of occurrence conditions, including the causes definition and, if case, issuing of safety recommendations for the prevention of some similar accident and for the improvement of railway safety.

Taking into account the reasons from the Note no.2/20.02.2015 drawn up by the head of Department for the Investigation of Failures of Structural Subsystems and Interoperability Constituents with reference to the opening of an investigation for the technical failure of the interoperability constituent „wheelset of the motorised train” that in slight different conditions could lead to an accident, OIFR director decided to open an investigation and to appoint an investigation commission.

So, through the decision of OIFR director no. 164 from the 20th of February 2015, one established the investigation commission consisting staff from OIFR, currently AGIFER, as follows:

Marian ZAMFIRACHE	investigator	- investigator in charge
Tudor CIOLACU	investigator	- member
Dan CIUCEA	investigator	- member
Mitu-Costel AFANASE	investigator	- member

B. SUMMARY OF THE INVESTIGATION REPORT

Summary

On the 17th of February 2015, at about 11:10 o'clock, in the branch of the Railway County Craiova, in the running of the passenger train Regio no.2455 (belonging to the railway passenger undertaking SNTFC „CFR Călători” SA), in the railway station Drăgășani, km 240+600, the axle journal of the axle no. 1 broke (left side in the running direction) from the motorised train AM 917, between the switch no.2 and the entry semaphore signal Y of this station.

The place of the technical failure is presented in the picture 1.

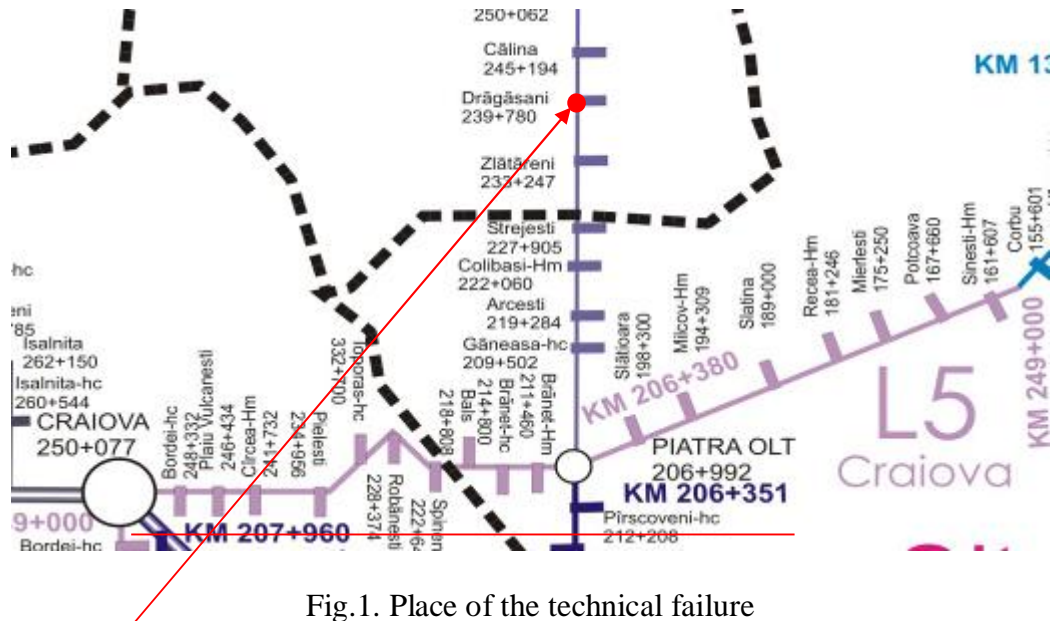


Fig.1. Place of the technical failure

From the first checking, one noticed the breakage of the axle journal at the short part of the driving axle.

The passenger train Regio no.2455 consisted in the diesel multiple unit AM 917, driven from the driving cab I, first in the running direction.

The DMU AM 917, being the passenger train Regio no.2455, as well as the drivers and the train crew, driver and conductor, belong to the railway passenger undertaking SNTFC „CFR Călători” SA.

Following the technical failure of the interoperability constituent „wheel set of the motorised train”, the running line Drăgășani – Zăvideni was closed between the hours 11.57-15.21.

No damage at the lines or equipments was registered.

The driving axle (axle no.1) of the DMU AM 917 had to be replaced.

There were interruptions in the train traffic.

No victims or casualties were registered.

Causes and contributing factors

Direct cause

The direct cause of the incident was the exceeding of the fatigue limit of the material from which the driving axle no.25083 was made of, in conditions of overstress under the efforts consisting in tensile-compressive and rotative bending.

Contributing factors:

- appearance of stress concentrators as holes and micro-cracks that, during the time led to the appearance of cross fatigue cracks on the surface of the axle journal to the connection with the section of 133 mm diameter;
- performance of ultrasonic inspection at the driving axle no.25083 without the inspection of the axle journal areas.

Underlying cause

Non-performance of the ultrasonic inspection on the axle journal surfaces in order to find out the cross fatigue cracks, initiate at the surface, infringing the provisions from the point 3.1 of „Instructions for the ultrasonic inspection of the DMU axles” – drawn by ICPTT in 1975. It was possible because the Repair section Pitești of SC „CFR-SCRL Brașov” SA was not getting the necessary technical equipments to perform a such ultrasonic inspection.

Root cause

Ambiguity of the provisions from the Technical Specification Code ST8 – 2004 „Planned inspections type Pth3, RT, R1, R2, RM at the DMU series 700-900-1000”, concerning the periodicity and place where the ultrasonic inspection of the DMU axles is made.

Severity level

According to the incident classification stipulated at art.8 of the *Regulations for the accident and incident investigation, for the development and improvement of Romanian railway and metro safety*, approved by Government Decision no.117/2010, taking into account the activity where it happened, the technical failure of the interoperability constituent „wheel set of the motorised train” is classified as railway incident according to art.8, Group C, point 3.16, letter a).

Safety recommendations

With reference to the incident happened in the running of the passenger train Regio no.2455, one found out that the breakage of the driving axle from the motorised train AM 917 happened in fatigue conditions, because the appearance on the surface of the axle journal of stress concentrators as holes and micro-cracks that, during the time, led to the appearance of cross fatigue cracks on the surface of the axle journal.

The cross fatigue cracks could be identified if the ultrasonic inspections performed at the driving axle no.25083 had covered also the axle journal areas. It was possible because the Repair section Pitești of SC „CFR-SCRL Brașov” SA was not getting the technical equipments necessary to make this ultrasonic control.

Taking into account these above mentioned, the investigation commission recommends Romanian Railway Safety Authority – ASFR to ensure that:

1. the supplier of the railway critical services SC „CFR-SCRL Brașov” SA shall revise the reference document used for the planned inspections made at the DMU series 700-900-1000, so it be put in line with the provisions and regulations existing for the ultrasonic inspection of the axles of the DMU. In this respect, the reference document shall contain clear provisions on the periodicity and place where the ultrasonic inspection of these axles is made.
2. The regulation framework applicable to the activities of inspection/repair at the DMU has enough provisions in order to guarantee that:
 - Economic operators that supply this type of services use the technical equipment necessary to perform all the activities stipulated in the applicable reference documents;

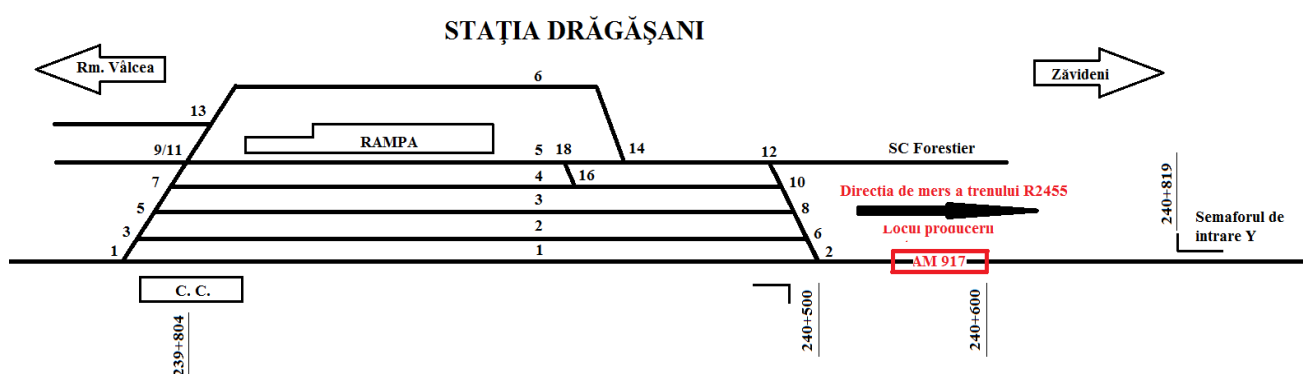
- Monitoring of these economic operators is an efficient one.

C. INVESTIGATION REPORT

C.1. Incident presentation

On the 17th of February 2015, the passenger train Regio no.2455, consisting in the DMU AM 917, was to run upon „Working timetable of the trains Regio in the branch of the Railway County Craiova” – valid for 2014/2015”, from the originating station Drăgășani up to the railway station Râmnicu Vâlcea.

At 11:05 the passenger train Regio no.2455 consisting in the DMU AM 917 was dispatched from the railway station Drăgășani, line no.2, to Zăvideni. After the train left the railway station Drăgășani, between the switch no.2 and the entry semaphore Y of the railway station Drăgășani, the journal of the driving axle broke, first in the running direction, picture 2.



Picture 2. Incident site in the railway station Drăgășani

At the visual inspection of the driving axle, one found out the breakage of the axle journal on left side of the running direction, respectively from the short part of the axle – picture no.1.



Picture no.1 – breakage of the axle journal on the left side in the running direction, respectively from the short part of the driving axle

The maximum running speed in the area where the axle journal broke was 70 km/h.

The breakage of the driving axle happened at 28 km/h speed, the motorised train AM 917 being stopped at 11:07:16 o'clock, at km 240+600, after running about 113 m from the departure from the railway station Drăgășani.

The motorised train AM 917 ran, from the railway station Drăgășani to depot Pitești, after the replacement of the driving axle.

Resuming of the railway traffic on the running line between the railway stations Drăgășani and Zăvideni was made on the 17th of February 2015, at 15:21 o'clock.

The incident did not generate any victims or wounded .

C.2. Incident circumstances

C.2.1. Involved parts

The track infrastructure and superstructure, where the railway incident happened, are managed by CNCF „CFR” SA – branch of the railway county Craiova. The maintenance of the railway superstructure is performed by the specialized staff of Track District no.2 Drăgășani, belonging to Track Section L3 Râmnicu Vâlcea.

The interlocking system (SCB) from the railway station Drăgășani type SBW is managed by CNCF „CFR” SA and maintained by the employees of District SCB Piatra Olt, belonging to the Section CT1 Craiova, branch of the railway County Craiova.

The railway communication equipment from the railway station Drăgășani is managed by CNCF „CFR” SA and maintained by the employees of SC TELECOMUNICAȚII CFR SA.

The railway communication equipment of the DMU AM 917 is owned by the railway undertaking SNTFC „CFR Călători” SA and maintained by the employees of SC „CFR-SCRL Brașov” SA – Track Section Pitești.

The DMU AM 917, consisting the passenger train Regio no.2455 is owned by the railway undertaking SNTFC „CFR Călători” SA, and its maintenance and the planned inspections are ensured by the specialized staff of SC „CFR-SCRL Brașov” SA – Track Section Pitești.

The crew of the train Regio no.2455, on the 17th of February 2015, that is the driver and the conductor, were from the railway undertaking SNTFC „CFR Călători” SA – branch of the railway county Craiova.

C.2.2. Train forming and equipments

The passenger train Regio nr.2455, consisting in the DMU AM 917, has the next composition: gross tonnage 30 tons, 2 axles, automatic necessary braked weight according to the working timetable 19 tons, real 19 tons, and the necessary hand braked weight according to the working timetable 3 tons, real 15 tons and a length of 14 m.

C.2.3. Presentation of the railway equipments involved in the incident

C.2.3.1. Lines

Presentation of the track

In the area of the incident, the marking of the track on the site is a straight one and the long section is a flat one.

Presentation of the track superstructure

In the incident area, the track superstructure consists in rail type 65, welded track, concrete sleepers T 17, indirect fastening type K. The track bed was complete.

In the incident area, km 240+600, the accepted maximum speed according to „The working timetable of the trains Regio in the branch of the railway county Craiova” – valid for 2014/2015”, for the passenger train no.2455 was 70 km/h.

C.2.3.2. Equipments

The railway station Drăgășani is provided with SCB equipment type SBW, and the running and the shunting in the railway station is according to the semaphores and signals given by the agents with portable instruments.

The train running between the railway stations is upon free pass system.

C.2.3.3. Rolling stock

DMU AM 917:

- 2 axles diesel multiple unit (a driving axle), series 900;
- Wheel-base - 8.490 mm;
- Length with buffers - 15.200 mm;
- Diameter of the running tread of the new tyre - 1.000 mm;
- Weight in service condition without passenger - 21.000 kg;
- Weight in service condition with passenger - 30.000 kg;
- Maximum load on the axle - 15.000 kg;
- Maximum speed in sle-propelled condition - 70 km/h;
- Type of engine – VOLVO PENTA TAD 720 VE - 169 kW;
- Gear box – ALLISON 3000 SP – is an automatic one 4 speed and hydraulic converter for start;
- Type quill drive – Mylius 200, with bevel gears and incorporated reverser;
- driving axle, manufactured in 1991, stock number CFR 25083, series 46, from the cast batch S 77918/91 and made of the material 34 MOCrNi 15X;
- free axle, manufactured in 1982, stock number CFR 24905, is from the cast batch 35195/82 and made of the material 34 MOCrNi 15X;
- the cock of the automatic brake, type St-60, with the handle of the cock of the driver were on fast braking;
- equipment for the punctual control of speed type INDUSI and that of safety and vigilance type DSV were in service and sealed;
- the speed recorder, type IVMS, was sealed and in normal operation condition.

C.2.4. Communication means

The communication between the locomotive staff and the movements inspectors was ensured through radio-telephone equipments.

C.2.5. Start of the railway emergency plan

Soon after the breakage of the axle journal, the start of the intervention plan for the removal of the damages and resuming of the train running was made through the information flow stipulated in *Investigation Regulations*, after which the representatives of CNCF “CFR” SA, public railway infrastructure manager, of the railway undertaking SNTFC „CFR Călători” SA and of Romanian Railway Authority – AFER came at the incident site.

The passenger train Regio no.2455 was cancelled on the distance Drăgășani – Râmnicu Vâlcea and the passengers were transferred in additional train no.11295, formed in the railway station Drăgășani.

C.3. Incident consequences

C.3.1. Fatalities and wounded

None

C.3.2. Material damages

The railway incident generated damages only at the DMU AM 917, estimated valuea being 11.808,88 lei without VAT.

C.3.3. Incident consequences in the railway traffic

The railway incident generated train delays as follows:

- passenger train Regio no.2075 cancelled between Drăgășani – Rîmnicul Vâlcea and the passenger train no.11297 ran additionally between Zăvideni - Râureni;
- passenger train Regio no.2076 cancelled between Zăvideni – Piatra Olt and the passenger train no.12292 ran additionally between Drăgășani – Piatra Olt;
- passenger train Regio no.1521 cancelled between Drăgășani – Păușa and the passenger train no.11295 ran additionally between Zăvideni – Păușa;
- passenger train Regio no.1522 cancelled between Păușa – București Nord and the passenger train no.11294 ran additionally on the same distance;
- passenger train no.11295 had 54 minutes delay;
- passenger train no.11292 had 86 minutes delay;
- passenger train no.9485 had 24 minutes delay .

C.3.4. Incident consequences Consequences of the incident on the environment

None.

C.4. External consequences

On the 17th of February 2015, at about 11.00 o'clock, the visibility at the incident site was good, cloudless sky, air temperature +12°C.

The visibility of the signal positions was according to the provisions of the specific regulations in force.

C.5. Investigation

C.5.1. Brief presentation of the testimonies of the involved staff

From the testimonies of the staff belonging to the railway undertaking SNTFC „CFR Călători” SA resulted the next relevant issues:

With reference to the operation

After the departure of the passenger train Regio nr.2455 from the line II of the railway station Drăgășani, at 11:05 o'clock, and the crossing of the DMU AM 917 over the switch no.2, one heard a bang on the left side of the driving cab no.I (active one), then one took measures for stopping. After the inspection one found out that the driving axle was broken on the left side.

With reference to the management of Depot Pitești

One knows the provisions of the Instruction for ultrasonic inspection of the axle from the motorised trains, drawn up by ICPTT in 1975, as well as, in the repair workshop Pitești neither the rolling bearing are removed nor the dismantling of the quill drive. These issues were not notified to the the superiors.

From the testimonies of the staff belonging to the railway public infrastructure administratorului CNCF „CFR” SA the next issues resulted:

After the order given for the exit of the passenger train Regio nr.2455 from the line II and the clearing of the exit semaphore, during the visual inspection one found out the train stop after running 100 m from the movements inspector point no.2. At 11:43 o'clock, the DMU AM 917 was declared out of service

From the testimonies of the staff belonging to the economic operator SC „CFR-SCRL Braşov” SA – Section Piteşti, that was ensuring the maintenance of the DMU AM 917 the next relevant issues resulted:

The staff in charge with the control of the ultrasonic inspection performance knows the provisions of the Instructions for the ultrasonic inspection of the axles for motorised trains, drawn up by ICPTT in 1975. The last ultrasonic inspection was performed on the 5th of May 2014 in the repair workshop of Depot Piteşti. For the performance of the ultrasonic inspection, the driving axle was removed from the DMU 917 and cleaned without the removal of the axle boxes, respectively the removal of the of the rolling bearings from the axle journal.

The ultrasonic inspection was performed with a ultrasonic flaw detector type USN 50 and ultrasonic transducer type WB 45° and WB 60°. For the inspection of the wheel hub one used the transducer type WB 45°, and for the quill drive area transducer type WB 45° și WB 60°. The axle journal, respectively the area where it broke, was not inspected for the identification of the possible fatigue cross cracks, because the axle boxes were not removed and because the lack of transducer type WB 35°. One tried an inspection of the areas 3 and 4 with a transducer type WB 60° appliend on the axle body, back to the wheel boss, comparing those 2 axle journals, without putting in evidence the crack echo, but this working way is not provided by the instructions.

On the 05th of June 2012, this axle was submitted to the ultrasonic inspection, without putting into evidence the crack echo, following the collision between the DMU and fallen rocks.

The ultrasonic inspection at the axles of the motorised trains is performed meeting completely with provisions of the Instructions for the ultrasonic inspection of the axles from DMUs, drawn up by ICPTT in 1975, because in the Workshop Pitesti there is no possibility to remove the rolling bearings from the axle journal.

C.5.2. Safety management system siguranței

Safety management system of the railway infrastructure administrator

At the incident time CNCF „CFR” SA, as railway infrastructure administrator had its own railway safety management system implemented, according to the provisions of the Directive 2004/49/CE on the community railway safety, of the Law no.55/2006 on the railway safety and of the Ministry of Transports'Order no.101/2008 on the granting of the safety authorization to the railway infrastructure administrator/managers in Romania, getting:

- Safety Authorization – Part A identification no.ASA09002 – through which Romanian Railway Safety Authority confirms the acceptance of the safety management system of the railway infrastructure manager;
- Safety Authorization – Part B identification no. ASB11006 – through which Romanian Railway Safety Authority confirmed the acceptance of the disposals of the railway infrastructure manager for the compliance with the specific requirements necessary to guarantee the railway infrastructure safety, in the design, maintenance and operation, including, if case, in the maintenance and operation of the interlocking system.

Safety management system of the railway passenger undertaking

At the incident time SNTFC „CFR Calatori” SA, as railway passenger undertaking had its own railway safety management system implemented, according to the provisions of the Directive 2004/49/CE on the community railway safety, of the Law no.55/2006 on the railway safety and of the Minister of Transports’ Order no.535/2007 (amended through the Minister of Transports and Infrastructure’s Order no.884/2011 and supplemented through the Minister of Transports and Infrastructure’s Order no.2179/2012) on the granting of the safety certificate for the performance of the railway transports in Romania and got:

- Safety Certificate – Part A identification no. UE RO1120130021 – granted by Romanian Railway Safety Authority through which there is confirmed the acceptance of the safety management system of the railway undertaking in accordance with the Directive 2004/49/EC and with the applicable national legislation;
- Safety Certificate – Part B identification no. UE RO1220140077 – granted by Romanian Railway Safety Authority through which there is confirmed the acceptance of the disposals adopted by the railway enterprise in order to comply with the specific requirements necessary for the safety operation on the relevant network according to the Directive 2004/49/EC and with the applicable national legislation;

At the time of the incident SC „CFR-SCRL Braşov” SA – Repair section Piteşti, as economic operator that performs activities connected and adjoining to the railway transports, got :

- Railway supplier authorization series AF no.6102 granted on the 13th of December 2013, valid up to the 12th of December 2018, for the railway critical service „Motorised rolling stock inspections and repairs”;
- Technical Agreement series AT no.1107, granted on the 4th of October 2012, valid up to the 3rd of October 2016 for the railway critical service „Planned inspections type PTH3, RT, R1, R2, RM, occasional repairs and preparing of the DMU series 900 for the winter”.

Regulation way of the performance of the ultrasonic inspection (CUS) at the axles of the DMU series 900 through specific norms and regulations

Instructions for the ultrasonic inspections of the axles from the DMU, drawn up by ICPTT in 1975, stipulate the next:

- instructions are applied in the Rolling stock Mechanic Enterprise Braşov. The instructions can be also applied in the depots that perform repairs by lifting the axles of the DMU (Chapter.1.1. Application field, purpose);
- for the performance of ultrasonic inspection with transverse inclined wave on the lateral side of the axle it is necessary to remove the bushings from the axle journals and the obturating bushings (Chapter.1.1. Application field, purpose);
- ultrasonic inspection with transverse inclined wave of the axle journals surfaces is performed with the feeler of 35° (WB35) for the identification of the cracks afferent to the failure no. 3, corresponding to the area where the breakage of the axle journal, in the investigated case.

Disposal of SNTFC „CFR Călători” SA management no.5/28.02.2002 (that appears as reference document at the Technical Specification code ST8-2004 - „Planned inspections type Pth3, RT, R1, R2, at the DMU series 700-900-1000”) at the Annex7 stipulates that, at the DMU series 900, interval RR, RG, RK is 24 months, respectively 106.000 km, and „the ultrasonic inspection is compulsory to be performed at 2 years in the repairing workshops (MARUB Braşov). In case of infringement of this deadline and non-performance of the planned repair, the depot shall issue an order to SC MARUB Braşov, for the performance of ultrasonic inspection”.

According to SNTFC „CFR Călători” SA Note – Department SC PM AII no.12/271/2003, ultrasonic inspection shall be performed according to the Disposal of SNTFC „CFR Călători” SA management no.5/28.02.2002, respectively at 2 years or at reaching the norm of 106.000km. Ultrasonic inspections shall be performed at MARUB or in depots only with the removed axle, by the staff belonging to MARUB or SC „CFR-SCRL Braşov” SA. For ultrasonic inspections one shall

apply the provisions existing in the Instructions for the ultrasonic inspection of the axles from the DMUs, drawn up by ICPTT in 1975.

The railway norm „Railway vehicles. Types of planned inspections and repairs. Time norms or norms of km run for the performance of planned inspections and repairs”, approved by Order of Ministry of Transports and Infrastructure no.315/2011, amended by the Ministry of Transports and Infrastructure’s Order no.1359/2012 from the 30th of August 2012, stipulates the performance only of repairs type RG at 3 ± 1 years/250 thousands km.

The Technical Specification Code ST8 – 2004 amended with the lists of changes LM 8 – 2009 și LM 8/1 – 2009 (list that is not stipulated in the Annex of the Railway Technical Agreement) and LM 8/2-2011 – reference document basis for the granting of the Railway Technical Agreement series AT no.1107/2012, at the chapter 5 „Schedule of the DMU inspections” does not stipulate at the works performed at these DMUs, at any type of inspection, performance of ultrasonic inspection at the wheelsets. On the other hand, at the chapter 9 „Documents and records drawn up after the inspections”, it is stipulated that „Ultrasonic inspection sheet CUS – ST8 – R02” is drawn up after each inspection, and at the chapter.7 „List of laboratories, testing benches and special devices used in the checking and control of the main characteristics” is stipulated at point 1 „Equipment for ultrasonic inspection”.

According to the Note from the Sheet ST8-R02 „Ultrasonic inspection sheet” annex at the Technical Specification code ST8-2004 - „Planned inspections type Pth3, RT, R1, R2 at the motorised trains series 700-900-1000”, „Ultrasonic inspection at the DMUs is performed at SC MARUB Braşov, according to the Disposal 5/2000” (from the controls made by the investigation commission resulted that the number of the disposal refers to in the above mentioned note is actually 5/2002, sheet ST8-R02, containing from this point of view a drawing up mistake).

In „*Instruction for the repair of the wheelsets from the railway vehicles*” no.931/1986, at Annex 2 – „Ultrasonic inspection of the wheelsets” is stipulated the performance of the ultrasonic inspection at the DMU axles „at the repair of axles by removal”, according to „Instructions for the ultrasonic inspection of wheelsets from the the DMU” and that „one performs complete ultrasonic inspection”.

From the analysis of the submitted documents, one found out the next issues about the safety management system:

- SNTFC „CFR Călători” SA, as railway passenger undertaking had implemented its own safety management system and uses for transports DMU that it repairs/controls at different economic operators authorized and provided with technical agreements by Romanian Railway Authority – AFER;
- in the investigated case the DMU AM 917 was repaired/inspected by the economic operator SC „CFR-SCRL Braşov” SA in the Repair Workshop Piteşti, that gets railway supplier authorization and railway technical agreement for the railway critical service „Planned inspections type PTH3, RT, R1, R2, RM, occasional repairs and preparations of the DMU series 900 for the winter”;
- according to the Technical Specification code ST8-2004 - „Planned Inspections type Pth3, RT, R1, R2, at the motorised trains series 700-900-1000” that is the reference technical document for the granting of the Railway Technical Agreement series AT no.1107 for the above mentioned railway critical service, the ultrasonic inspection of the axles from the DMU is performed in accordance with the provisions of *Instructions for the ultrasonic inspections of the axles from the motorised trains, drawn up by ICPTT in 1975*;
- following the visits at the headquarters of SC „CFR-SCRL Braşov” SA – Repair Workshop Piteşti and of information supplied by the representatives of this economic operator, one concluded that, following an insufficient technical endowment (lack of equipments for the removal of the rolling bearings and of the bushings from the axle journal, as well as of the inclined transducer 35° - WB 35), at the driving axles from the DMU series 900 from the stock of depot Piteşti one did not performed ultrasonic inspection with transverse inclined wave on surface of the journals in order

to identify the cross fatigue cracks, initiated at the surface, operation stipulated at point 3.1. from *Instructions for the ultrasonic inspection of the DMU axles*, drawn up by ICPTT in 1975.

As conclusion, the provisions from the Technical Specification code ST8-2004 - „Planned inspections type Pth3, RT, R1, R2, at the DMU series 700-900-1000” are ambiguous, without specifying clearly:

- the period of time for the performance of the ultrasonic inspection, because at chapter 9 „Documents and records drawn up after the inspections”, is stipulated that „Ultrasonic inspection sheet– ST8 – R02” is drawn up after each inspection type, and in the Disposal of the General Manager of SNTFC „CFR Călători” SA no.5/2002 (reference document of this technical specification) is stipulated that, the ultrasonic control is performed every 2 years;
- the place where the ultrasonic inspection is performed, because, according to the Note from the sheet ST8-R02 „*Ultrasonic Inspection sheet*” annex at the Technical Specification code ST8-2004, „*Ultrasonic inspection at the DMU is performed at SC MARUB Braşov, according to the Disposal 5/2000*”, and at the chapter 7 „*List of laboratories, testing benches and special devices used for the checking and control of the main characteristics*” at position 1 is mentioned „*Device for ultrasonic inspection*”.

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

In the railway incident investigation one took into account:

Norms and regulations:

- Instructions for the ultrasonic inspection of the DMU axles – drawn up by ICPTT in 1975;
- Disposal no.5/28.02.2002 of SNTFC „CFR Călători” SA management;
- Note of SNTFC „CFR Călători” SA - Department SCPMAII no.12/271/2003;
- Railway norm „Railway vehicles. Types of planned inspections and repairs. Norms of time and km run for the performance of planned inspections and repairs”, approved by Order of Ministry of Transports and Infrastructure no.315/2011;
- Order of Ministry of Transports and Infrastructure no.1359/2012 from the 30th of August 2012 for the amendment of the Railway norm „Railway vehicles. Types of planned inspections and repairs. Norms of time and km run for the performance of planned inspections and repairs”, approved by Order of Ministry of Transports and Infrastructure no.315/2011;
- Technical Specification, code ST8 – 2004, „Planned inspections type Pth3, RT, R1, R2, at the DMUs series 700-900-1000”, as well as the List of changes at ST8 – 2004, code LM8 – 2009, code LM 8/1 – 2009 and code LM 8/2-2011;
- Order no.290/2000 on the technical acceptance of the products/services for the construction, modernization, maintenance and repair of the railway infrastructure and rolling stock, for the railway and metro transport;
- Regulations for the Railway Technical Operation no.002, approved through the Order of the Ministry of Public Works, Transports and Lodgings no.1186 from the 29th of August 2001;
- Instruction for the repair of the wheelsets of the railway vehicles no.931/1986;
- Railway Technical Norm NTF 81-002:2004 „Railway vehicles. Wheelsets, general quality technical conditions ”, approved by Order of Ministry of Transports, Constructions and Tourism no.1826 from the 07th of October 2004;
- Instructions for the operation and maintenance of two axle DMU series 900 with engine Volvo Penta and automatic gear box Allison – 2008 - edition 2, issued by SC MARUB SA Braşov;
- Regulations for hauling and braking no.006/2005 approved by Order of Ministry of Transports, Constructions and Tourism no.1815/2005;
- Instructions for the activity of the locomotive staff no.201/2006 approved by Order of Ministry of Transports, Constructions and Tourism no.2229/2006;
- Regulations for the accident and incident investigation, development and improvement of Romanian railway and metro safety, approved through Government Decision no.117/2010.

Sources and references:

- statements of the employees involved in the railway incident;
- acts and documents submitted by the involved economic operators;
- minutes, concluded on site and in depot Pitești;
- pictures of the DMU AM 917 in depot Pitești and of the incident site;
- testing report no.3011-016 from the 25th of August 2015 drawn up by the Department of Rolling Stock of Romanian Railway Notified Body.

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

C.5.4.1. Data about the lines

One did not perform any measurement at the line, because its technical condition did not influence the breakage of the axle journal of the axle from the DMU AM 917.

C.5.4.2. Data about the railway equipments

The interlocking system - SCB from the railway station Drăgășani was in good condition.

C.5.4.3. Data about the working of the rolling stock and of its technical equipments

Findings at the motorised train AM 917:

Manufacturing data and data of the performance of the planned repairs:

- manufactured on the 02th of December 1935 at factory „Nicolae Malaxa” București;
- last planned repair type RG – major overhaul of the motorised train, by its lifting from the axles/bogies, was performed on the 20th of April 2011, at SC PETROUTILAJ SA Câmpina, up to this time the DMU had run 218.138 km. According to the Railway Norm "Railway vehicles. Types of planned inspections and repairs. Norms of time and km run for the performance of planned inspections and repairs", the deadline for planned repair is established at every 3±1 years or 250.000 km.

Date and place of the last planned inspections:

- the planned inspection type RT in the depot Pitești was performed on the 27th of January 2015, the DMU resuming its run on the 30th of January 2015. Between the 30th of January 2015 and the 17th of February 2015 the motorised train ran 2.778 km;
- the intermediary inspection type Pth3 was performed on the 16th of February 2015 in depot Pitești;

Findings at the DMU at the incident site:

- driving axle (axle no.1), first in the running direction, broken in the area of the axle journal on the left side;
- driver cock type St-60 on fast braking;
- the equipment of safety, vigilance and control of train speed, DSV and INDUSI in service and sealed;

Findings from depot Pitești, following the removal of the wheel set and dismantling of the quill drive:

- the profile of the tyres was in accordance with the conditions imposed by the provisions of art.221 from *Regulations for Railway Technical Operation no. 002/2001*;
- the gear assembly with bevel drive pinion and the crown wheel, of the driving axle, fără dinți afectați, free of pitting and no wear;
- the inner teeth of the crown wheels and the reverse idler gear for the change of the running direction, looked normal, without traces of hit, burr or pitting;
- roller bearings for the support of the quill drive casting, the bearings for the support of the axle crown wheel, as well as the roller bearings for the support of the axle-boxes on the axle journal were in normal working conditions, without heating traces;

- the gear oil from the quill drive had a suitable appearance, without scrapings traces;
- the axle has breakage 100%, new in the area of the journal left side running direction (picture no.2);

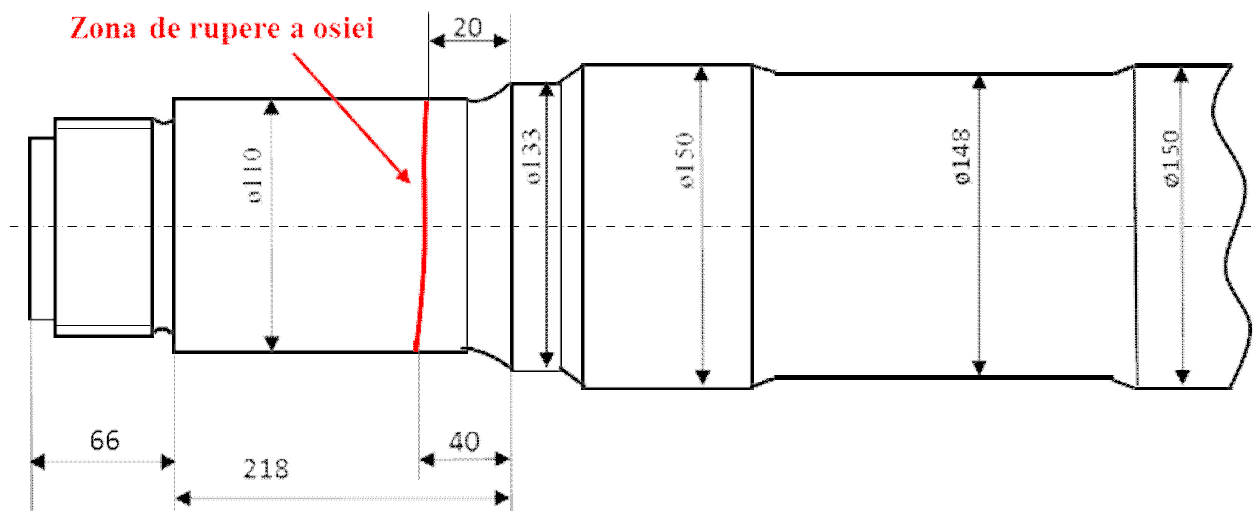


Picture no.2 –

section of the axle journal

breakage

- the brakage section is slightly inclined and has the next space quotas:
 - maximum distance as against the wheel body 70 mm;
 - minimum distance as against the wheel body 50 mm;
 - maximum distance between the breakage area and the connection area of the axle journal and the the sealing ring 40 mm;
 - minimum distance between the breakage area and the connection area between the axle journal and the sealing area 20 mm.



Picture 3 Breakage area

- the driving axle has the stock number CFR 25083, resulting from the cast batch S 77918/91 series 46 and is made of material 34 MOCrNi 15X in 1991 (picture no.3).



Picture no.3 – end of driving axle

Date and way of the ultrasonic inspection performance (CUS) from the last major overhaul type RG up to the axle breakage:

- on the 25th of November 2010, at SC PETROUTILAJ SA Câmpina, at the performance of the major overhaul type RG;
- on the 5th of June 2012, at depot Pitești by the staff belonging to SC „CFR-SCRL Brașov” SA – Repair Workshop Pitești, after running 64.225 km from the major overhaul, following the collision between the DMU and fallen rocks;
- on the 5th of May 2014, at depot Pitești by the staff belonging to SC „CFR-SCRL Brașov” SA – Repair Workshop Pitești, at the inspection type RT, after running 166.300 km from the major overhaul, respectively after running 102.075 km from the previous ultrasonic inspection;

The ultrasonic inspection at the driving axle performed at depot Pitești by the staff belonging to SC „CFR-SCRL Brașov” SA – Repair Workshop Pitești was made partially because the axle boxes were not removed, respectively the rolling bearings from the axle journal were not removed. In these conditions one could not identify the appearance of some possible cracks on the surface of the axle journal.

Findings at the driving axle – stock number CFR 25083, series 46, cast batch S 77918/91

Because the railway undertaking does not get (SNTFC „CFR Călători” SA) a data basis for the evidence of the trasability of the wheelsets from the DMUs, one could not get an evolution of the axle in operation, only from the 20th of April 2002, from the data basis of depot Pitesti.

So, the trasability of the driving axle manufactured in 1991, stock number CFR 25083, series 46, from the cast batch S 77918/91, made of material 34 MOCrNi 15X, after 2002 is:

- on the 20th of April 2002 it arrived at depot Pitești together the DMU AM 932 after the majoroverhaul type RG, performed at SC MARUB SA Brașov;
- on the 25th of February 2003 the DMU AM 932 was taken at SC MARUB SA Brașov for the replacement of diesel engine, when this axle was submitted to ultrasonic inspection after running 35.000 km;
- on the 27th of November 2003, after running 80.900 km, the DMU AM 932 was taken at depot Pitești, with the quill drive out of service, the axle being sent to SC MARUB SA Brașov for repair;
- on the 6th of May 2004, after the repair of the quill drive and the performance of the ultrasonic inspection, the axle was put at the DMU AM 926;
- on the 8th of February 2005 the ultrasonic inspection at this axle was performed in the depot Pitești by the staff belonging to SC MARUB SA Brașov;
- on the 1st of November 2006 the ultrasonic inspection at this axle was performed in depot Pitești by the staff belonging to SC MARUB SA Brașov;

- on the 10th of September 2007, after running 326.000 km, because the failure of the quill drive, the axles were changed between the motorised trains AM 926 and AM 997, DMU out of service in depot Pitești with the gear box;
- on the 19th of May 2009, the DMU AM 997 was routed for major overhaul to MARUB SA Braşov and before at SC PETROUTILAJ SA Câmpina;
- on the 20th April 2011 the wheelset with stock number CFR 25083, series 46, cast batch S 77918/91 came back in depot Pitești, assembled at the DMU AM 917, that performed the major overhaul at SC PETROUTILAJ SA Câmpina;
- after the repair type major overhaul and up to the breakage of the axle journal, the DMU AM 917 ran 218.135 km.

Data resulted from the technical expertise at the axle stock number CFR 25083, cast batch S 77918/91:

For the more clear establishment of the causes that led to the breakage of the axle journal, Romanian Railway Investigating Body, according to the provisions of art.52, paragraph (1), letters b) and d) from the *Investigation Regulations*, requested SNTFC „CFR Călători” SA, through the address no.4110/ 666 / 2015, the performance of the technical expertise of the axle breakage section.

The testing report, after the technical expertise performed by AFER – ONFR – Rolling stock laboratory, concerning the mechanical tests, chemical analysis and metalographic inspections at the driving axle, series 46, cast batch S 77918/91, steel mark 34MoCN15X put in evidence the next issues:

- measuring of the roughness and the microscopic examination of the breakage area:
 - following the measurement of the roughness one found out exceeding of the values imposed by the working drawing S-404A on the whole surface of the axle journal;
 - the breakage of the axle was a quasi transverse one, on its axis, through the journal of diameter of 110 mm, resulting a part completely detached from the journal of about 250 mm length. The distance against the beginning of the section of diameter 133 mm is varying from 18 mm to 30 mm. Those two surfaces of the breakage show a fatigue breakage (progressively) on about 80% from the total surface;
 - on the exterior surface of the detached axle journal, one found out both rust spots on the breakage perimeter and at the ends of the bushings assembled on the journal, and of the friction/scratching traces left by the extraction bushings, on the length of the first bushing from the breakage. The same traces (rust reddish spots) were found out at the edges of the extraction bushing situated at the journal breakage. The same spot, in correspondence with the group of scratch marks from the axle journal, was found also on the inner surface of the extraction bushing from which one concluded that the ring displaced slightly along the journal generating line, maybe also a turn of the journal. Furthermore, on the surface of the broken journal can be observed presence of some circular spots of burn, white-grey, confirming a thermic intervention on the material, maybe from an electric arc;
 - the breakage surface (fracture from the detached journal) is preponderant like a fatigue breakage (progressively). This aspect is typical for the case where the breakage started through high stresses and ended through low stresses. On the inferior part one can observe the end breakage area, maybe with material removal, that was settled and burnished during the repeated contacts. On the flat perimeter of the section one can observe multiple radial scratch marks” (small edges) , that are the start of the breakage from the exterior surface, under the stress stretching – compression of the axle. The under-stressing periods (during the crack opening) one can observe on the fatigue breakage some “hardening lines”. The shape of those lines shows the stress to which the axle was subject (stretching-compression, above mentioned). The front line consisting in the partial overlapping of two start areas of the breakage, started with concave aspect in relation to the initial centre. As the breakage progressed, the line became horizontal, than became corrugated to its ends and transformed in the convex line to the end of breakage, it showing a stress to rotary bending of the axle. On the perimeter of the breakage surface

(fracture opposite to the journal rested inside the wheel) one did not put in evidence the axle breakage initiations, because the material impresses and its settlement after the breakage. But, it is more visible the last part of the final breakage, with granular texture of the material. The distorted material is transported, stored and pressed as some oxidized crusts on the fracture edges;

- macrographic examination (sulphur printing through Baumann method), performed on a cross part taken from the immediate vicinity of the breakage area, showed sulphur points relative uniformly distributed, without segregations, the fact being assessed as acceptable;
- the microscopic examination (heat attack in solution HCl 50%) performed on a cross part taken from the immediate vicinity of the breakage area, showed a slight general porosity, whose synopsis is corresponding to the figure 1, according to the annex A, scale „2” from STAS 11961/1-83;
- establishment of the chemical composition of the material through the spectrum method, performed on the sample taken from the middle of the radius of the axle section, showed that the determined values are between the imposed values of STAS 1947-71;
- the tensile test, performed on three samples applying a tensile force on one sample up to its breakage, for the determination of the mechanical characteristics (conventional yield strength, ultimate strength, elongation at breakage and necking breakage), showed that the values got are between the imposed values, the quality coefficient being over the imposed reference value;
- the bending test by shock (impact bending strength), using 6 samples, 3 longitudinal sampling and other 3 cross sampling, performed through rupture, from one impact, with pendulum machine, one standard sample with middle channel, put free on two supports, led to values over the limit of the values imposed for impact bending strength;
- hardness test Brinell on the cross section was performed through the establishment of the values of the hardness Brinell in 24 points disposed on the direction of 2 diameters. The hardness differences Brinell between the testing points from the edge of the section and those situated to the center shows a slight non-uniformity of the material structure, it being insignificant;
- microscopic examination (microstructure, purity level) showed:
 - close to the breakage area, crushing surface layers overlapped and material edges, resulted after distortion and seizure of the inner ring (extraction bushing) on the axle. In the serious distorted material, between the crushing layers there are generated a lot of microcracks, about parallel with the axle surface;
 - at the exterior surface of the section in the micro area corresponding to the „burn” spots microcracks distinguish, on their path can be observed the material tendency of shelling on the axle surface;
 - the crushing layers continue in depth of 1,5...2,0 mm. Close under the crushing layers, the microstructure presents needle martensite structure, constituent specific to a surface micro-hardening. The depth of the layer reaches 0,35...0,50 mm. This fragile constituent – martensite – permits the appearance of holes and microcracks on the axle surface, that spreads to the middle of the section, becoming tendencies to fracture;
 - the micro-aspect of the grooves, identified microscopic, shows the forming of rough edges in the axle journal surface, favorable also for microcracks opening and breakage;
 - the microcracks networks, started from the axle journal edges, mechanic and thermic affected, presents dissemination, inter and intra crystalline to the section centre;
 - in the section centre, the structure is preponderant bainitic sorbitol, resulted following a hardening treatment and tempering at high temperature. Close to the breakage area (at 17 mm from the fracture), the sorbitol constituents are more gross and irregular than those soft in the middle of the section;
 - the dimension of the structural granulation, analyzed at the scale 100:1, corresponds to the parameters 8,0-8,5-7,5, according to SR EN ISO 643:2013;
 - the purity level, with maximum score parameter on types of inclusion, on different micro areas, under the maximum one accepted for alloy steel.

Conclusion, the results got following the examinations and tests emphasize the next:

- the axle breakage happened because the fatigue, in conditions of over-stress (under stress consisting in tensile-compression and rotary bending), starting from the holes and the microcracks on the surface of the journal to the section connection of diameter 133 mm;
- causes of stress concentrator were the serious distortions with material transport, folding, material crushing and scratch marks (fine splintering from the material), resulted from the seizure/turn of the inner ring, correlated with successions of super-heating (thermic influence) and local cooling, that transformed the surface structure of the journal in a hardening structure, fragile. An unfavourable influence, with superficial cracking of the material, had also the burn spots coming, probably, from an electric arc.

C.5.5. Interface man-machine-organization

The driver of the DMU AM 917, consisting the passenger train Regio no.2455 from the 17th of February 2015 got driving licence valid for the DMU series 900 and authorization for the one-driver system for the passenger trains. According to the medical and psychological approvals, he was able for the position of driver DMU.

Depot driver – ultrasonic inspection operator at SC „CFR-SCRL Braşov” SA – Repair Workshop Piteşti, that performed, in depot Piteşti, the last ultrasonic control of the driving axle no.25083, cast batch 77918/91, from the DMU AM 917, is authorized to perform „Ultrasonic inspection of the rolling stock elements, using the ultrasonic flaw detector type USN-50 for the control of: wheelsets of the DMUs, LDE, LDH, tyres for the manufacturing failures, assembled solid wheels”, according to the authorization series CN no.219 from the 26th of November 2013, valid up to the 26th of November 2014. The failure detector used type USN-50 has „Certification for technical control” no.93/05.12.2013 valid up to the 4th of December 2014.

C.5.6. Similar previous events

On the 7th of May 2014, in the branch of the railway county Timișoara, in the running of the passenger train Regio no.9612 (belonging to the railway passenger undertaking SNTFC „CFR Călători” SA), in the railway station Timișoara Nord, km 1+775, line no.124, a railway accident happened, consisting in the derailment of the right wheel from the DMU AM 979, first axle in the running direction, following the breakage of the driving axle in the inner area of the quill drive.

The above mentioned railway accident was investigated by Romanian Railway Investigating Body - OIFR, the investigation being ended by the drawing up of an investigation report, in it being issued four safety recommendations for the solving of the next issues:

1. Revision of the regulation framework for the performance of the ultrasonic inspection at the axles of the DMUs series 900, so one establishes clearly:
 - planned inspections /repairs when the ultrasonic inspection is performed;
 - interval of time/km for the performance of the ultrasonic inspection;
 - unit and staff that perform the ultrasonic inspection.
2. The establishment of the technical conditions for operation, with reference to the maximum accepted difference between the rolling circle diameters of the wheels from the driving axles of the two axle DMUs series 900, equipped with engine Volvo Penta and automatic gear box Allison, in the situation of their coupling, multiple-unit control.
3. Creating and implementing of a data basis that permits the identification of the trasability of the axles from the DMUs.
4. Working out of some regulations for the performance of the ultrasonic inspection at the axles of the DMUs series 79 type LVT.

Following the sending of the investigation report, Romanian Railway Safety Authority - ASFR analyzed OIFR safety recommendations and notified that it will take into account the recommendations no.1 and no.3, considering that the requirements of the recommendations no. 2 and 4 are covered by the actual regulation framework.

C.6. Analysis and conclusions

C.6.1. Conclusions on the technical condition of the railway infrastructure

Taking into account the findings, presented in the chapter *C.5.4.1. Data about the lines*, and *C.5.4.2. Data about the railway equipment* one can state that the technical condition of the railway infrastructure did not influence the incident occurrence.

C.6.2. Conclusions on the technical condition of the motorised train AM 917

On the 25th of November 2010, at the major overhaul at SC Petroutilaj SA Câmpina, the driving axle no.25083, cast batch 77918/91 was submitted to a complete ultrasonic inspection without putting in evidence crack echo.

After this date the driving axle was also submitted to two ultrasonic inspections in depot Pitești, it being performed by the staff belonging to SC „CFR-SCRL Brașov” SA – Repair Workshop Pitești, without checking the surfaces of the axle journals for the identification of the cross fatigue cracks appearance, initiated on the surface.

The ultrasonic inspections performed by SC „CFR-SCRL Brașov” SA were not complete because, at the moment of the inspections at Repair Workshop Pitești, this economic operator had neither a ultrasonic transducer type 35° nor the technical endowment necessary to remove the rolling bearings and the bushings from the axle journal.

In these conditions the cross fatigue cracks, initiated on the surface driving axle journal, could not be identified, it leading finally to the keeping in operation of the wheelset, without having the guarantee that it is proper from technical point of view.

C.6.3. Analysis of the incident occurrence

According to the results got following the examinations and tests performed in the laboratory, one found out that the breakage of the driving axle no.25083, cast batch 77918/91 in the area of the axle journal, happened in fatigue in overstress conditions în condiții de suprasolicitare (combined tensile, compressive, rotation bending) and was initiated from cavities and microcracks existing on the railway journal surface to the area with 133 mm diameter. și a fost inițiată din cavități și microfisuri situate pe suprafața fusului spre racordarea cu tronsonul de diametru 133 mm.

Appearance of the stress concentrators was generated by the serious distortions with material transport, folding, material crushing and scratch marks (fine splintering from the material), resulted from the seizure/turn of the inner ring, correlated with successions of super-heating (thermal influence) and local cooling, that transformed the surface structure of the journal in a hardening structure, fragile. An unfavourable influence, with superficial cracking of the material, had also the burn spots coming, probably, from an electric arc.

Then, these microcracks have developed during the time, generating cross cracks in the cross section of the axle, and finally, on the 17th of February 2015, leading to the breakage of the axle in the axle journal area.

D. CAUZELE INCIDENTULUI

D.1. Direct cause

The direct cause of the incident was the exceeding of the fatigue limit of the material from which the driving axle no.25083 was made of, in conditions of overstress under the efforts consisting in tensile-compressive and rotative bending.

Contributing factors:

- appearance of stress concentrators as holes and micro-cracks that, during the time led to the appearance of cross fatigue cracks on the surface of the axle journal to the connection with the section of 133 mm diameter;
- performance of ultrasonic inspection at the driving axle no.25083 without the inspection of the axle journal areas.

D.2. Underlying cause

Non-performance of the ultrasonic inspection on the axle journal surfaces in order to find out the cross fatigue cracks, initiate at the surface, infringing the provisions from the point 3.1 of „Instructions for the ultrasonic inspection of the DMU axles” – drawn by ICPTT in 1975. It was possible because the Repair section Pitești of SC „CFR-SCRL Brașov” SA was not getting the necessary technical equipments to perform a such ultrasonic inspection.

D.3. Root cause

Ambiguity of the provisions from the Technical Specification Code ST8 – 2004 „Planned inspections type Pth3, RT, R1, R2, RM at the motorised trains series 700-900-1000”, concerning the periodicity and place where the ultrasonic inspection of the motorised train axles is made.

D.4. Additional remarks without relevance for the incident causes

During the investigation, following the controls made at the depot Pitești and at SC TEHMIN-BRAȘOV SRL one identified diesel multiple units series 900 with the system of multiple control and diagnosis, which this type of diesel multiple units are equipped after the major overhaul, through which one can put in connection the diesel engines speed, if these operate in coupling, in multiple command, does not allow the introduction of the running tread diameters of the driving axles. In this situation, the running of the coupled diesel multiple units having differences of the diameters of the running treads over the maximum limit of 5 mm imposed by the provisions of the Note drawn by SNTFC „CFR Călători” SA no.12/271/2003 leads to the appearance of additional inner stresses in the body of the driving axle, stresses that can generate the appearance of stress concentrators and, finally, at the axle breakage.

We underline that, this issue was identified as contributing factors of the railway accident from the 7th of May 2014, when at the entrance in the railway station Timișoara Nord, the driving axle of the diesel multiple units AM 979 broke (from the same constructive series as the diesel multiple units involved in the investigated incident).

E. MEASURES TAKEN

Following the breakage of the driving axle with the park number CFR 25083, series 46, from the charge S 77918/91, from the diesel multiple unit AM 917, on the 17th of February 2015, the railway undertaking SNTFC ”CFR Călători” SA took the next measures:

- disposed the identification of all axle from the charge no.77918/91, performance of ultrasonic inspection at all these axles and their keeping in operation provided that they will be ultrasonic inspected monthly, during a year;
- made a working team consisting in specialists from SNTFC ”CFR Călători” SA and SC „CFR-SCRL Brașov” SA, that went to Timișoara depot for drawing up the regulations necessary in the ultrasonic inspection performance, using a wheel set non-equipped, in order to simulate the crack

echo. Following this action, the working team established the next regulations for the ultrasonic inspection at the driving axles:

- using of transducer MWB 60° for the inspection of the grooves area susceptible for the crack appearance (failure no.6 from the Instruction ICPTT 1975) and the way to proceed;
 - periodicity of the performance of the ultrasonic inspection be 6 months;
 - depots Pitești and Suceava shall make the efforts to buy the transducer MWB 60° for the performance of ultrasonic inspection;
 - in order to identify the failures of the axle journal (failures 3 and 4 from the Instruction ICPTT 1975) the depots shall make the steps at AFER for the manufacture of set pieces with varying degrees of incidence that allow the use of transducer B2S-0o, that equipped the depots.
- The minutes concluded at the meeting of the commission at the depot Timisoara was sent to all branches of SNTFC "CFR Călători" SA, that have diesel multiple units series 900 and one disposed the purchasing of transducers type MWB 60°.

F. SAFETY RECOMMENDATIONS

With reference to the incident happened in the running of the passenger train Regio no.2455, one found out that the breakage of the driving axle from the diesel multiple unit AM 917 happened in fatigue conditions, because the appearance on the surface of the axle journal of stress concentrators as holes and micro-cracks that, during the time, led to the appearance of cross fatigue cracks on the surface of the axle journal.

The cross fatigue cracks could be identified if the ultrasonic inspections performed at the driving axle no.25083 had covered also the axle journal areas. It was possible because the Repair section Pitești of SC „CFR-SCRL Brașov” SA was not getting the technical equipment necessary to make this ultrasonic control.

Taking into account these above mentioned, the investigation commission recommends Romanian Railway Safety Authority – ASFR to ensure that:

1. The supplier of the railway critical services SC „CFR-SCRL Brașov” SA shall revise the reference document used for the planned inspections made at the diesel multiple units series 700-900-1000, so it be put in line with the provisions and regulations existing for the ultrasonic inspection of the axles of the diesel multiple units. In this respect, the reference document shall contain clear provisions on the periodicity and place where the ultrasonic inspection of these axles is made.
2. The regulation framework applicable to the activities of inspection/repair at the diesel multiple units has enough provisions in order to guarantee that:
 - Economic operators that supply this type of services use the technical equipment necessary to perform all the activities stipulated in the applicable reference documents;
 - Monitoring of these economic operators is an efficient one.

*

* *

This report shall be sent to Romanian Railway Safety Authority – ASFR, to the railway passenger undertaking SNTFC „CFR Călători” SA, to the railway public infrastructure manager CNCF „CFR” SA, to the society for the maintenance, inspection and repair of the motorised rolling stock SC „CFR - SCRL Brașov” SA.

Members of the investigation commission:

Marian ZAMFIRACHE	investigator	- investigator in charge
Tudor CIOLACU	investigator	- member
Dan CIUCEA	investigator	- member
Mitu-Costel AFANASE	investigator	- member