



INVESTIGATING REPORT

of the railway accident
occurred on the 17th of November 2010, on the running wire I,
between the subway stations Piata Unirii – Timpuri Noi



FINAL EDITION

The 3rd of February 2011

NOTICE

With reference to the accident occurred on the **17th Of November 2010**, at 8:21 p.m., on the transport network belonging to SC METROREX SA on the running wire I between the stations Piata Unirii – Timpuri Noi, at the km 5+860 consisting of the derailment of the axle no. 8 from REM 175, Romanian Railway Investigating Body carried out an investigation, according to the provisions of the Government Decision no. 117/2010. Through the investigation, the information on the respective accident was gathered and analyzed, the conditions were established and the causes determined.

Romanian Railway Investigating Body investigation did not aim to establish the guilty or the responsibility in this situation.

Romanian Railway Investigating Body considers necessary to take corrective measures in order to improve the railway safety and to prevent the accidents, so it included in the report a series of safety recommendations.

Bucharest, the 3rd of February 2011

Approved by
Dragoş FLOROIU
Director

*I agree the compliance with the
legal provisions on the
investigation performance and
drawing up of this Investigation
Report, that I submit for approval*

Chief Investigator
Sorin CONSTANTINESCU

This approval is part of the Report for the investigation of the accident occurred on the 17th of November 2010, at 8:21 p.m., on the transport network belonging to SC METROREX SA on the running wire I between the stations Piata Unirii – Timpuri Noi, at the km 5+860 consisting of the derailment of the axle no. 8 from REM

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I. PREAMBLE

I.1. Introduction

With reference to the accident occurred on the **17th Of November 2010**, at 8:21 p.m., on the transport network belonging to SC METROREX SA on the running wire I between the stations Piata Unirii – Timpuri Noi, at the km 5+860 consisting of the derailment of the axle no. 8 from REM 175, Romanian Railway Investigating Body carried out an investigation, according to the provisions of the Government Decision no. 117/2010, in order to prevent accidents with similar causes, by establishing the conditions and determining the causes.

Romanian Railway Investigating Body investigation did not aim to establish the guilty or the responsibility, its aim being to improve the railway safety and to prevent the railway incidents or accidents.

I.2. Investigation process

According to the provisions of the art. 19, paragraph 2, of the Law 55/2006 on railway safety, corroborated with the art. 48(1) of the Regulations for the investigation of the accidents and incidents, for the development and improvement of Romanian railway and subway safety, approved by Government Decision no. 117/2010, on the 17th of November 2010, Romanian Railway Investigating Body decided to carry out an investigation on the accident occurred on the 17th of November 2010 on the transport network belonging to SC METROREX SA on the running wire I between the stations Piata Unirii – Timpuri Noi, at the km 5+860 by the derailment of the axle no. 8 from REM 175.

Given that the happenings are defined as accident according to the art. 3 letter l of the Law 55/2006 on railway safety, under the article 19 paragraph (1) of the Law no. 55/2006 on railway safety, corroborated with the art. 49, paragraph 2, letter a of the Regulations for the investigation of the accidents and incidents, for the development and improvement of Romanian railway and subway safety, approved by Government Decision no. 117/2010, the OIFR Director decided to start an investigation. So, through the decision no. 38 bis of the 31st of January 2011, of the OIFR Director, the investigation commission was appointed, consisting of:

- Pălăngeanu Nicu - main investigator, OIFR scientific Secretary
- Stoian Eduard - member, Head of Service OIFR
- Ciubeică Luigi - member, inspector at ASFR – ISF Bucharest
- Apostol Ioan - member, inspector SC Lines SC METROREX SA
- Zaharescu Mihai - member, inspector MR SC METROREX SA
- Andronescu Mihai - member, Head of Office MR SC METROREX SA

A. BRIEF PRESENTATION OF THE ACCIDENT

A.1. Brief presentation

On the **17th of November 2010**, at 8:21 p.m. the subway train no. 4221, composed of REM 173-174-175, was sent from the station Piata Unirii 1 to the station Timpuri Noi on the running wire I. The train was driven by locomotive driver and driver assistant and REM belonging to SC METROREX SA.

The train no. 4221 had the following composition:

- REM 173 the frame with the driving station A to the subway station Timpuri Noi;
- REM 174 the frame placed in the middle of the composition of the train;
- REM 175 the frame which was the last in the composition of the train, placed with the driving station A to the subway station Piata Unirii 1.

After leaving from the station Piata Unirii 1, at km 5+860, on an area in line, occurred the derailment of the axle no. 8 from the bogie 4 of REM 175 car B (axle 17 running direction).
The other axles of REM 175 and also of REM 173 and REM 174 did not derail.
No damages to REM 173, REM 174 and to the car A of REM 175 in the composition of the train.
No damages at the line on the running path.

After this accident the contact line “the 3rd rail” was damaged on a length of about 410 m.

Were damaged the following installations SCB agreement units of the path circuits TU-F1 and TU-F2 and also a landmark ATO.

No deaths or injuries.

A.2. Direct cause, contributing factors and root causes

A.2.1. The direct cause of the occurrence of this accident is the loss of guiding capacity of the wheel on the left (X head) of the axle no.8 (axle wheel) from REM 175, which led to the escalation of the rail on the left of the running path at the entry on the curve “V8” and the derailment of the wheel next to the kilometric position 5+858.

Contributing factors to the occurrence of this accident were the following:

- Displacement of material from the running surface of the wheel on the left of the axle no.8, in the area of the point A2 on the active flank of the wheel rim, followed by pulling out of the material on this surface and forming of some accumulations of material;
- Running, given the defects mentioned above, on a curve with radius of 190 m and over-elevation of 130 mm.

A.2.2. Underlying causes

None.

A.2.3. Root cause

None.

A.3. Severity level

According to the provisions of the art. 3, letter l of the Law no. 55/2006 on railway safety, the event by its consequences is categorized as railway accident.

According to the provisions of the art. 7, paragraph (1), letter b of the Regulations for the investigation of the accidents and incidents, for the development and improvement of Romanian railway and subway safety, approved by Government Decision no. 117/2010, the event is categorized as railway accident.

A.4. Safety recommendations

None.

B. INVESTIGATING REPORT

B.1. Description of the accident

On the 17th of November 2010, at 7:57 p.m. the subway train no. 4221 ran on the section Preciziei - Anghel Saligny, having a delay of 9 min to the running service record A1338.

The train was composed of the electric subway frames (REM) 173-174-175.

To the station Piata Unirii 1 there was no problem in the running of the train.

At 8:20 p.m., the train no. 4221 was sent from the station Piata Unirii 1, to the station Timpuri Noi on the running wire I.

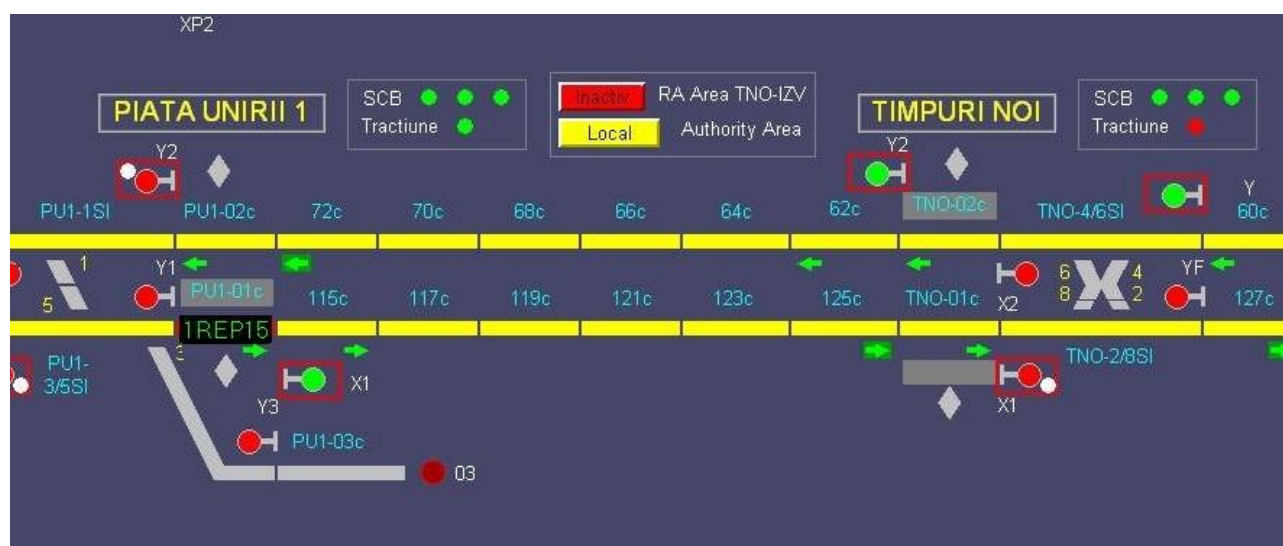
When entering the curve “V8” (deviation to the right) the bogie no.4, car B from REM 175, the wheel on the left of the axle no.8 (appeal wheel) escalated the railhead on the left of the running path and rolled on the railhead guided only by the check rail existing on the inner wire of the curve.

At km 5+858, after running a distance of 1083 m (towards the station Piata Unirii 1), at the exit from a curve with the radius of 190 m, on an area in line, the wheel on the left of the axle no. 8 of the bogie no. 4, car B from REM 175 (the last frame in the composition of the train) fell from the railhead on the left of the running path, on the sleepers end, involving in the derailment also the wheel on the right of the same axle.

REM 175 ran with the wheels of this axle derailed on a distance of 411 m the wheel on the left rolling towards the 3rd rail on the end of the wooden sleepers and the wheel on the right towards the axis of the path rolling also on the wooden sleepers. When the train stopped this axle was placed at the km 6+269.

Due to the running of REM 175 in this condition, the 3rd rail corresponding to the running wire I was damaged and taken out of the operation parameters on the area of the km 5+858-6+269.

The other axles of REM 175 and also the axles of the other REMs were not derailed and did not have specific signs of derailment.



B.2. The accident circumstances

B.2.1. Involved parties

The running section on which the accident occurred is managed by SC METROREX SA and maintained by its employees.

The path infrastructure and superstructure are managed by SC METROREX SA and maintained by the employees of Section LT 1.

Installations signaling, centralization and blocking (SCB) between the stations Piata Unirii 1 – Timpuri Noi are managed by SC METROREX SA and maintained by employees of Section SCB.

The installation of communication between the stations Piata Unirii 1 – Timpuri Noi is managed by SC METROREX SA and maintained by the employees of Section ATC.

The installation of power and electric traction is managed by SC METROREX SA and maintained by the employees of Section EE.

Installation of railway communication on the train is the property of SC METROREX SA and is maintained by the employees of SC ALSTOM Transport SA.

REMs in the composition of the train no. 4221 are the property of SC METROREX SA, are maintained, inspected and repaired by SC ALSTOM Transport SA authorized as railway supplier.

The investigation commission questioned the locomotive and REM driver and driver assistant.

B.2.2. Forming and equipments of the train

The subway train no. 4221 was composed of REM 173-174-175 having 6 cars, 24 axles, 114 m length.

The brake systems of the train were active, the safety and vigilance equipments (BOM), the equipment for the point control of the speed and hitchhiking (INDUSI) in the equipment of the train were active and instructionally working.

B.2.3. Railway equipments

Description of the rail path of the running wire 1 between the stations Piata Unirii 1-Timpuri Noi rail path in a horizontal plane

In a horizontal plane the rail path is built of a series of alignments and curves.

The geometric elements of the curve are:

- curve "V7" from the km 5+225 to km. 5+402, deviation to the left, radius $R = 150$ m, the length of the connection curve at the entry into the curve $L_{cl,i} = 47$ m, the length of the circular curve $L_{c.c.} = 83$ m, the length of the connection curve at the exit from the curve $L_{cl,e} = 47$ m, the over-elevation $h = 115$ mm, the limited running speed $V = 50$ Km / h, the over-enlargement $s = 10$ mm, the arrow $f = 83$ mm (at the measuring chord of 10 m / $R \leq 250$ m)

- curve "V8" from the km 5+535 to km 5+845, deviation to the right, radius $R = 190$ m, the length of the connection curve at the entry into the curve $L_{cl,i} = 73$ m, the length of the circular curve $L_{c.c.} = 164$ m, the length of the connection curve at the exit from the curve $L_{cl,e} = 73$ m, the over-elevation $h = 130$ mm, the running speed /limited speed) $V = 60$ Km / h, the over-enlargement $s = 6$ mm, the arrow $f = 66$ mm (at the measuring chord of 10 m / $R \leq 250$ m);

- curve "V9" from the km 6+332 to km 6+540, deviation to the left, radius $R = 352$ m, the length of the connection curve at the entry into the curve $L_{cl,i} = 51$ m, the length of the circular curve $L_{c.c.} = 65$ m, the length of the connection curve at the exit from the curve $L_{cl,e} = 92$ m, the over-elevation $h = 125$ mm, the running speed $V = 80$ Km / h, the over-enlargement $s = 0$ mm, the arrow $f = 142$ mm (at the measuring chord of 20 m – $R > 250$ m).

rail path in profile in long

The profile in long of the running path consists of a sequence of gradients and levels, its characteristics in the running direction of the train (mileage increasing direction) being the following:

- from the km. 5+007 to km. 5+329 level – subway station Piata Unirii 1;
- from the km. 5+329 to km. 5+462 ramp with gradient 17,00 ‰ ;
- from the km. 5+462 to km. 5+940 slope with gradient 3,00 ‰;
- from the km. 5+940 to km. 6+227 ramp with gradient 3,15 ‰;
- from the km. 6+227 to km. 6+418 slope with gradient 3,00 ‰.

Due to the geometric elements of the curves, the maximum running speed between the stations Piata Unirii 1-Timpuri Noi on the running wire I is limited on two areas as follows:

- 50 km/h on the area km 5+225-km 5+515
- 60 km/h on the area km 5+515-km 5+845

These speed restrictions were instructionally signaled.

Description of the rail superstructure corresponding to the running wire I Piata Unirii 1-Timpuri Noi

On the area km 5+500 – 6+500 the superstructure of the running path is made of rail type 49 E1, wooden sleepers (leaned on the prism of broken stone), the image of the sleepers being of 1734 pieces/km corresponding to the curves with radius $R < 500$ m.

On the image of the curves “V7”, “V8” and “V9” the clamping of the rails on the sleepers is flexible type “Pandrol Fastclip” and on the area in line between these the clamping is indirect type “K”.

On the entire distance the indirect clamping was complete and active, the sleepers were stuffed, the prism of broken stone complete, up to the upper side of the sleepers, providing the stability of the running path.

The rail temperature at the place of the accident was of $+21^{\circ}\text{C}$.

Description of the safety installation to control the railway traffic

The installation of traffic control on the running wire I between the stations Piata Unirii 1 – Timpuri Noi is electronic centralization Ebilock 950, type Bombardier.

Description of the installations of force and power supply

The contact line (the 3rd rail), component of the installation of force and power supply, is made of steel with low carbon content and high electrical conductivity, rail profile 40 STAS 3309-91, full with section 9000mm^2 .

B.2.4. Means of communication

The communication between the locomotive driver and the traffic operator was provided through the installation of radio-communications with recording.

B.2.5. Triggering the railway emergency plan

Immediately after the railway accident, triggering the intervention plan to remove damages and to restore train traffic was achieved by the circuit of the information mentioned in Chapter IV, 2nd Section of the HG. no. 117/2010 and by the Evacuation plan no. M 01.07/328/25.10.2010 specific procedure of SC METROREX SA.

At the place of the accident came representatives of ISU, SC METROREX SA, Romanian Railway Authority -AFER, Subway Police Operations Division.

To restore on the rails the rolling stock was required and guided the intervention car specialized with hydraulic winches belonging to SC METROREX SA.

B.3. Accident consequences

B.3.1. Deaths and injuries

None.

B.3.2. Material damages

The value of the material damages according to the estimates prepared by the owner of the rolling stock, of the means of intervention and of the public subway network infrastructure manager, is the following:

- at REM 175 will be communicated subsequently by SC METROREX SA

• at the line	vacate
• at the installations	8296.06 €
• at the contact rail	156477.82 lei

B.3.3. Consequences of the accident in the railway traffic

The traffic between the stations Piata Unirii 1-Timpuri Noi wire I was completely closed from the 17th of November 2010, 8:25 p.m. to the 18th of November 2010, 4:30 a.m.

B.4. External circumstances

On the 17th of November 2010, the temperature in the tunnel, in the area of the accident was of +21⁰C.

The visibility of the light signals was in accordance with the specific regulations in force.

B.5. Investigation course

B.5.1. The summary of the involved staff statements

The driver who drove the REM 173, in the composition of the train 4221, composed of TEM 173-174-175 on the 17th of November 2010 stated as follows:

- he came to work at 4:55p.m., at the shift MR Piata Unirii 1, having the command RU4, being directed to perform work on the train 42.
- At 5:30 p.m. he took over TEM 173-174-175 performing the work in normal conditions of safety and operation of the train.
- At 8:20 p.m. after the start from the station Piata Unirii 1, on the interstate, he notices the signaling of the voltage fluctuation 750V, he takes action to stop the train and performing the checking procedures, he finds the derailment of the car B at REM 175.
- He announces the traffic operator about the situation occurred in order to start the specific procedures in these situations.

The driver assistant who served the REM 173, in the composition of the train 4221, composed of TEM 173-174-175 on the 17th of November 2010 stated as follows:

- he came to work at 12:00 a.m., at the shift MR Piata Unirii 1, having the command 42.3, being directed to perform work on the train 42.
- At 8:20 p.m. after the start from the station Piata Unirii 1, on the interstate, he notices the lack of voltage 750V and after the train stop he opens the door of the cabin and looking along the train he finds the exit from the gauge of the REM.
- Going to the end of the train, he found the derailment of the first axle in the running direction from the REM 175.

B.5.2. Safety management system

At the time of the accident, SC METROREX SA as undertaking operating underway transport, has in completing phase its own safety management system, having the quality management certificate series SMC no. 306/ 16.10.2010 and has the Authorization to perform passenger subway transport series ASM nr. 001/ 24.10.2009.

B.5.3. Norms and regulations

In the investigation of the accident one took into account:

norms and regulations

- Instructions MR specific
- Instruction of standards and tolerances for the construction and maintenance of the rail - standard gauge lines no. 314M/1997;
- Instruction for the use of rail measuring cart 329M/2005;
- Instruction for movement 005M/2005;
- Instruction for signaling, 1985 edition.

sources and references

- copies of the documents submitted as annexes to the investigation file prepared by the investigation commission appointed through the note of the OIFR Director no. 38 BIS/31.01.2011;
- photos taken immediately after the accident by the members of the investigation commission;
- photos taken to REM 175 involved in the accident;
- documents on the lines maintenance provided by the responsible with their maintenance;
- results of the measurements performed immediately after the railway accident at the rail superstructure and at the REM 175;
- inspection and interpretation of the technical condition of the elements involved in the accident: infrastructure, railway installations and train;
- questioning of the employees involved in the occurrence of the railway accident;

B.5.4. Work of the technical installations, of the infrastructure and of the rolling stock

B.5.4.1. Data found on the line

Technical condition of the line before the occurrence of the railway accident

The last work performed at the rail superstructure before the date of the accident in the area of its occurrence, was performed on the 8th/9th of July 2010 and consisted of the replacement of the checkrail spacers from the km 5+600 to the km 5+800 on the interstate Piata Unirii 1 – Timpuri Noi, wire 1, 75 pieces.

At the last check with the rail measuring electronic cart performed before the date of the accident (respectively on the 14th of September 2010) there were no defects of the direction or of the cross level of the rail.

Findings and measurements performed at the line, after the occurrence of the derailment and the lift of the cars

a) *the checkrail of the curve “V8”*

on the entire length of the checkrail of the curve “8”, on its active side in several areas were found specific signs of the touch left on the inner side of the wheel on the right;



- b) the rail on the left of the running wire I Piata Unirii I-Timpuri Noi
at the km 5+858, on area in line, was found the sign left by the wheel bandage rim on the left on the rolling surface of the railhead



- c) the wooden sleepers
- starting from the km 5+858 and to the point where the train stopped, on the upper side of the wooden sleepers was identified the sign of rolling of the wheel rim on the right in the running direction.



- starting from the km 5+858 and to the km 6+269 on the left was found the sign of wheel bandage rim rolling on the sleepers end on the upper surface, the supports of the 3rd rail destroyed and the rail fallen (corresponding to the running wire)



d) measurements performed at the line

There were performed measurements of the gauge and of the cross level of the running path as follows:

- with the pattern type “GEISMAR”, from 2 to 2 sleepers, in the mileage increasing direction, from the km. 5+845 to the km. 6+269, the first measurement being at the km 5+845 and the last at the km. 6+300.

After the interpretation of the measured values was found that these did not exceed the tolerances at the gauge and cross level provided by the Instruction of standards and tolerances for the construction and maintenance of the subway rail 314 M/1997:

- with the rail measuring electronic cart type “GEISMAR”, from the km. 5+500 to the km. 6+500. After the interpretation of the records charts was found that the values of the gauge and of the cross level did not exceed the tolerances admitted by the Instruction of standards and tolerances for the construction and maintenance of the subway rail 314 M/1997.

B.5.4.2. Data found at the work of the rolling stock and of its technical installations

Findings on the REM in the composition of the train, at the place of stop of the train no. 4221

- the wheel on the right of the axle 8 (X head wheel) from the bogie 4, REM 175, car B (the 17th axle in the composition of the train, in the running direction) derailed to the left of the running path, from the interstate Piata Unirii 1 – Timpuri Noi, wire 1, being placed at the km 6 + 269;
- displacement to the outside of the running path of the derailed axle no. 8 was of about 60 cm;
- the X head wheel of the axle 8 from the REM 175 (on the left in the running direction) derailed from the left wire of the CF rail from the running path at the Km 5 + 858;
- the Y head wheel of the axle 8 from the REM 175 (on the left in the running direction) ran over the sleepers in the axle of the running path, marking with the bandage rim 757 sleepers;
- the X head wheel of the axle 8 from the REM 175 (on the left in the running direction) ran over the sleepers end towards the 3rd rail, marking with the bandage rim the bottom side of the clamping area of the consoles on the 3rd rail, respectively a number of 97 consoles;
- after the derailment, the wheels of the axle 7 from the bogie 4 of the REM 175, car B (the 18th axle in the composition of the train, in the running direction) remained on the running rails, being placed at the km 6+267 from the interstate Piata Unirii 1 – Timpuri Noi, wire 1;

- the 3rd rail from the km 5 + 858 to the km 6 + 269, wire 1 from the interstate Piata Unirii 1 – Timpuri Noi was pulled out from the support clips and fell on the prism of broken stone, being removed from the normal operation;
- at the place where stopped the axle 8 from the REM 175, the reducer of the axle 8 (series 090F) was found with the upper on the right side of the lower housing (the left in the running direction) on the left wire of the running path, had signs of friction as consequence of the displacement by sliding on the entire distance from the place of the derailment to the stop. The reducer of the axle 8 was placed to the outside of the running path (to the normal working position), displaced towards the 3rd rail with about 60 cm;
- the front side of the strut on the right of the bogie frame no. 4 of the REM 175 (on the left in the running direction), has signs of hitting by deformation of the surface from the contact with the 3rd rail (insulators arms, clamps and insulator covers from the 3rd rail);
- the metallic frame of the positioning window of the “MEGI” springs next to the X head wheel of the axle 8 from the REM 175 did not damage the housing of the axle bearing of the bogie next to the X head wheel of the axle 8 from the REM 175;
- an air filter from the electric engine of the bogie 4 REM 175 was found in the running path at the km position of 5+920, wire 1, from the interstate Piata Unirii 1 – Timpuri Noi, wire 1;
- at the km 5 +930 laterally to the running path on the right in the running direction was sensor fell from the bogie 4 of the REM 175, car B;
- the sensor on the right from the bogie 4 of the REM 175 (on the left in the running direction), was strongly deformed and hanging from the bogie frame;
- the distance (height) between the sensor placed on the rail and the sleepers in the running path was of about 170 mm;
- command and signaling installations in the driving station REM 175, car A were functional;
- the driving team of the train 4221 of the section Preciziei – Anghel Saligny was in normal work condition;
- after the derailment of the axle 8 from the REM 175 did not occur any fire starting, there was no loss of oil from the reducer 090F that displaced from the rail, the environment was not polluted with hydrocarbons;
- the cars of the train 4221 composed of REM173-174-175 had no broken window, no deformed doors, the installation of safety lightening was in normal operating condition;

Findings at the REM in the composition of the train no.4221 at SC ALSTOM Transport S.A.

The frames REM 173, REM 174 and REM 175 are type IV Arad and with the planned repair RR finished on the 27th of October 2010, after a number of 90 km of tests performed by SC ALSTOM Transport SA Romania.

Until the date of the derailment the frames ran 734 km, of which 544 km in the running of the electric subway trains operated by SC TMB METROREX SA Bucharest.

The measurements were performed based on the sheets of checks and tests specific to the lift repair type RR.

At the measurements and checks performed at the car B in the composition of the REM 175 involved in the railway accident, at SC ALSTOM Transport SA, were found the following:

- the distances between the inner sides of the axles no. 5, no. 6, no. 7 and no. 8 from the REM 175, obtaining values between 1359.60 – 1360.35 mm; (The sheet of checks and tests RMA –FM 034)
- the rims height of the X and Y head wheels from the axles no. 5, no. 6, no. 7 and no. 8 from the REM 175, obtaining values between 28.2 – 28.6 mm; (The sheet of checks and tests RMA –FM 067)
- the rims weight of the X and Y head wheels from the axles no. 5, no. 6, no. 7 and no. 8 from the REM 175, obtaining values between 32.5 – 32.8 mm; (The sheet of checks and tests RMA –FM 067)
- the rate qr of the X and Y head wheels from the axles no. 5, no. 6, no. 7 and no. 8 from the REM 175, obtaining values between 10.5 – 11 mm; (The sheet of checks and tests RMA –FM 067)

- the distance between the bottom side of the bearing housing of the axle (shoulder) and the frame of the bogie no. 3 from the REM 175 (series 681, year 1987), to both axles on the left and on the right, obtaining values between 104 – 106 mm; (The sheet of checks and tests RMA –FM 049)
- the distance between the upper side of the bearing housing of the axle (rubber buffer port) and addition on the frame of the bogie no. 3 from the REM 175 (series 681, year 1987), to both axles on the left and on the right, obtaining values between 27-29 mm; (The sheet of checks and tests RMA –FM 049)
- the stroke between the tubular half-coupling and the axle, at the axle no. 1 from the bogie no. 3 from the REM 175 (series 681, year 1987), obtaining the value of 20 mm; (The sheet of checks and tests RMA –FM 049)
- the stroke between the tubular half-coupling and the axle, at the axle no. 2 from the bogie no. 3 from the REM 175 (series 681, year 1987), obtaining the value of 20 mm; (The sheet of checks and tests RMA –FM 049)
- the difference of the diagonals at the running wheels of the bogie no. 3 from the REM 175 obtaining the value of 1 mm; (The sheet of checks and tests RMA –FM 040)
- the difference of the wheelbase of the axles of the bogie no. 3 from the REM 175, obtaining the value of 1 mm; (The sheet of checks and tests RMA –FM 040)
- the distance between the sleeper hanging and the frame of the bogie no. 3 from the REM 175 (series 681, year 1987), obtaining the value of 41 mm; (The sheet of checks and tests RMA –FM 048)
- the height of the cushion for the wheels diameter of 910-860 at the frame of the bogie no. 3 from the REM 175 (series 681, year 1987), obtaining the value of 60 mm; (The sheet of checks and tests RMA –FM 048)
- the distance between the bottom side of the bearing housing of the axle (shoulder) and the frame of the bogie no. 4 from the REM 175 (series 1131, year 91), at both axles, on the left and on the right, obtaining values between 104 – 112 mm; (The sheet of checks and tests RMA –FM 049)
- the distance between the upper side of the bearing housing of the axle (rubber buffer port) and addition on the frame of the bogie no. 4 from the REM 175 (series 1131, year 91), at both axles, on the left and on the right, obtaining values between 26-30 mm; (The sheet of checks and tests RMA –FM 049)
- the stroke between the tubular half-coupling and the axle, at the axle no. 1 of the bogie no. 4 from the REM 175 (series 1131, year 91), obtaining the value of 21 mm; (The sheet of checks and tests RMA –FM 049)
- the stroke between the tubular half-coupling and the axle, at the axle no. 2 of the bogie no. 4 from the REM 175 (series 1131, year 91), obtaining the value of 24 mm; (The sheet of checks and tests RMA –FM 049)
- the difference of the diagonals at the running wheels of the bogie no. 4 from the REM 175 obtaining the value of 1 mm; (The sheet of checks and tests RMA –FM 040)
- the difference of the wheelbase of the axles of the bogie no. 4 from the REM 175, obtaining the value of 1 mm; (The sheet of checks and tests RMA –FM 040)
- the distance between the sleeper hanging and the frame of the bogie no. 4 from the REM 175 (series 1131, year 91), obtaining the value of 45 mm-disturbed during the lifting intervention; (The sheet of checks and tests RMA –FM 048)
- the height of the cushion for the wheels diameter of 910-860 at the frame of the bogie no. 4 from the REM 175 (series 1131, year 91), obtaining the value of 60 mm; (The sheet of checks and tests RMA –FM 048)

- at the axle 8 from the bogie 4, on the X head wheel (the left in the running direction), in the area of the point A2 to the top tor of the rim is found a mark with release of material with a length of 35



mm, depth of 3 mm as consequence of an mechanic interaction and on the Y head wheel (the right in the running direction) in the area of the bevel of 45° from the outer side of the wheel (at a distance of about 150 mm in transverse plan to the position of the sign on the X head wheel) is found a marking by material repression on a length of 35 mm,

then, after about 500 mm another transverse hit with the length of about 30 mm and width of 4 mm in the area of the running plane with conic 1:10.

- when checking the dimensional rate (j) of the bearing pallet on the bogie no. 4 of the REM 175 was obtained the value of 0,05 which is within the value provided through the measuring sheet. (The sheet of checks and tests RMA-F.M. 050). Also, after opening the bearing pallet were found the following:

- on the running path were not found abnormal wears, nor marks with values higher than 0.3 mm;
- sealing cuffs were not damaged;
- fixing hauls of the bearing were not oval;
- the bearing was lubricated;
- the rings did not have exfoliations, signs of electric arch or material repressions on the running path;
- balls were in amount of 171 and had no sign of marking.

Data found immediately after the occurrence of the accident

When performing the checks at REM 173, in the composition of the train no. 4221 (the unit from where one was driving) were found:

- the installation INDUSI was in function and sealed,
- the safety and vigilance installation BOM in function,
- the installation speedometer with recording type DEUTA sealed and in function,
- the switches, the buttons, the signaling lamps of various installations of the train, functional,
- the installation of protection at the wheels spin-locking was in function, without error messages.

The air valves at the brake installations were found in normal working positions.

B 5.5 Interface man, machine, organization

The activity of the driving team of the train (the driver and the driver assistant) belonging to SC METROREX SA before the occurrence of the accident was performed according to the path sheets annexes in copies at the file, with compliance of the working schedule through was provided the legal rest time.

B 6 Analysis and conclusions

From the analysis of the findings performed at the place of the accident, of the measurements performed at the running path and the corresponding installations, at the subway frame, of the photos and of the statements of the train driving staff, resulted:

On the 17th of November 2010, the train composed of the REM 173-174-175 was directed to run as train no. 42 on the Subway line 3, between the stations Preciziei – Anghel Saligny. The train left from the station Preciziei at 5:12 p.m. and ran it 4 times. During the 5th time on the distance Preciziei – Anghel Saligny, as train 4221, after leaving the station Piata Unirii 1, the train enters on the curve “V7”, running with the maximum speed of 43 km/h, then on the curve “V8”, running with the maximum speed of 55 km/h. When entering on the curve “V8” (right deviation), with a radius of 190 m and over-elevation of 130 mm, the wheel on the left of the axle no.8 (appeal wheel) of the bogie no. 4, car B from the REM 175, and lost its guiding capacity, escalated the railhead on the left of the running path and ran on the railhead guided only by the checkrail existing on the inner wire of the curve.

After exit from the curve “V8” and the checkrail existing on the inner wire of the curve, at the km 5+858, the wheel on the left of the axle no. 8 derails from the head, outside the rail, running on the sleepers ends on a distance of 411 m, until the train stopped. In the derailment involves also the wheel on the right of the axle no. 8, of the bogie no. 4, that leaves the rail on the right of the running path, running on the sleepers between the rails, at a distance of about 600 mm to the right wire of the path.

The loss of the guiding capacity of the wheel on the left of the axle no. 8 (appeal wheel) of the bogie no. 4 was possible due to the material ripping from the active surface of the wheel rim, as consequence of the mechanic interaction with an object of high hardness. The place and the object that led to the rip of material in the area of the point A2 to the top tor of the rim could not be identified.

From the mark shape found on the active flank of the wheel rim it could be concluded that the impact took place while the running of the train in the direction Anghel Saligny – Preciziei. After changing the running direction of the train at the station Preciziei, on the distance Preciziei – Piata Unirii 1, the profile in line of the running path did not contain curves with low radii (under 300 m), that could have generate running conditions similar to these in the area of the curve “V8” (with radius of 190 m), so that on this distance was not affected the guidance capacity of the wheel on the left of the axle no. 8 (appeal wheel).

From the measurements performed at the elements of the running path was found that the values of the gauge and of the cross level of the path did not exceed the tolerances admitted by the Instruction of standards and tolerances for the construction and maintenance of the subway rail 314 M/1997.

From the measurements performed at the bogies of the car B of the REM 175 was found that the values of the dimensional rates were within the values admitted for operation by the technical and maintenance documentation of the REM type IVA.

B.7. The accident causes

B.7.1. Direct cause

The direct cause of the occurrence of this accident is the loss of guiding capacity of the wheel on the left (X head) of the axle no.8 (appeal wheel) from REM 175, which led to the escalation of the rail on the left of the running path at the entry on the curve “V8” and the derailment of the wheel next to the kilometeric position 5+858.

Contributing factors to the occurrence of this accident were the following:

- Displacement of material from the running surface of the wheel on the left of the axle no.8, in the area of the point A2 on the active flank of the wheel rim, followed by pulling out of the material on this surface and forming of some accumulations of material;
- Running, given the defects mentioned above, on a curve with radius of 190 m and over-elevation of 130 mm.

B.7.2. Underlying cause

None.

B.7.3. Root causes

None.

C. Safety recommendations

None.

Investigation commission:

- Pălăngeanu Nicu - main investigator
- Stoian Eduard - member
- Ciubeică Luigi - member
- Apostol Ioan - member
- Zaharescu Mihai - member
- Andronescu Mihai - member