

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

No. 2003/Proj./Bangalore/2/2 Pt.III

New Delhi, dated: 15.09.2011

Managing Director,
Bangalore Metro Rail Corporation,
III Floor BMTC Complex
K.H.Road, Shanthinagar,
Bangalore-560027

Sub: Sanction for introduction of Standard Gauge coaches manufactured by Hyundai - Rotem/ Korea for Passenger Services on Mahatma Gandhi Road-Baiyappanhalli section of Bangalore Metro Railway (Standard Gauge)

Ref: Your office letter No. BMRCL/E-70(c)/Vol-4/2011-123477 dated 16.08.2011

In reference to above, sanction of Ministry of Railways, Railway Board is hereby communicated for running of coaches manufactured by Hyundai - Rotem / Korea as per drawing No RGA10001CEO Rev. 'A' and RGA10002 CEO Rev. 'A' for DMC, TC and DMC coaches respectively coupled together, finally to be increased upto 6 cars comprising 2 no. each of DMC, TC and motor coaches, with maximum axle load of 15.0t, for Public Carriage of Passengers on Mahatma Gandhi Road-Baiyappanhalli Standard Gauge section of BMRCL network up to a maximum speed of 75 Kmph subject to terms and conditions as given in the RDSO's final speed certificates and amendments as the case may be and Joint Safety Certificate, Track Certificate accompanying the above referred letter.

Sanction is further subject to recommendations/suggestions made by CRS/Southern Circle Bangalore and CCRS/LKO vide their letters No. Q.15013/1/2011-BMRCL/315 dated 29.08.2011 and Q-15013/01/2011 तदति Dated 31.08.2011 respectively and agreed to by the Board, as under:

- (i) BMRCL should ensure to get all the Maintenance Manuals and instructions related to rolling stock approved by RDSO and also to develop a mechanism to get their various maintenance practices audited periodically by RDSO.
- (ii) Conditions mentioned in para 13(e) of the letter No. Q-15013/01/2011-BMRCL/315 dt. 29.08.2011 to be modified as "In case any secondary air spring of a coach gets deflated during the run, the maximum speed of the train shall be brought down to 60 kmph on tangent track and 25 kmph on curved track having radius sharper than 190 m immediately and the train shall be withdrawn from service and brought for attention, to a depot or taken to a siding, as situation demands, at the earlier opportunity and in any case, not later than after completion of "that particular run to its immediate destination". The indication for air spring having deflated shall be made available to the Drivers (Train Operators).

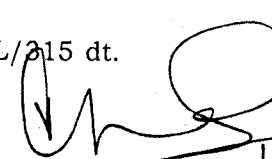

(Rajiv Chaudhry)
Executive Director (Woks Plg.)
Railway Board

No. 2003/Proj./Bangalore/2/2 Pt. III

Copy forwarded for information to:

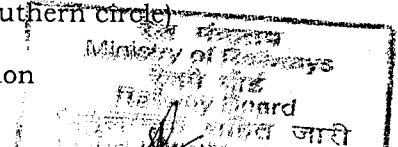
- (i) The Chief Commissioner of Railway Safety, Ashok Marg, Lucknow-226001 w.r.t. his endorsement संख्या-क्यू-15013/01/2011.तदति dated 31.08.2011 - 1
- (ii) CRS, Southern Circle in reference to letter No. Q-15013/01/2011-BMRCL/315 dt. 29.08.2011 - 3

New Delhi, dated 15.09.2011


For Secretary Railway Board

Copy to :

- (i) Commissioner of Railway Safety, all Circles (except Southern circle)
- (ii) Director General, RDSO, Manak Nagar, Lucknow.
- (iii) Secretary, Ministry of Urban Development for informaion



2011/01/2011
2/2011
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E.D. CIVIL ENGG. (G)
F.T.S. (RECEIPT) No. 2663)
DATE 1/9/11

भारत सरकार
नागर विमानन मंत्रालय
रेल संरक्षा आयोग
GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION
(COMMISSION OF RAILWAY SAFETY)

अशोक मार्ग, लखनऊ-226 001
Ashok Marg, Lucknow - 226 001

संख्या -क्यू- 15013/01/2011.त0वि0

दिनांक:31.08.2011

सेवा में,

सचिव (सिविल इंजी.),
रेल मंत्रालय (रेलवे बोर्ड),
रेल भवन,
नई दिल्ली ।

[ध्यानार्थ : EDCE(G)]

विषय:Introduction of Standard Gauge Coaches manufactured by M/s Hyundai - Rotem / Korea to drawing no.-RGA 10001 CEO Rev.A. (for DMC) and RGA 10002 CEO Rev.A (For TC) of M/s Hyundai -Rotem / Korea for Public Carriage of Passengers on Baiyappanahalli - Mahatma Gandhi Road Standard Gauge Electrified Double Line Section of BMRCL.

संदर्भ: रेल संरक्षा आयुक्त, दक्षिण परिमण्डल, बंगलुरु का पत्र सं0- Q-15013/01/2011-BMRCL/315 दिनांक 29.08.2011

The case related to Introduction of Standard Gauge Coaches manufactured by M/s Hyundai - Rotem / Korea to drawing no.-RGA 10001 CEO Rev.A. (for DMC) and RGA 10002 CEO Rev.A (For TC) of M/s Hyundai -Rotem / Korea for Public Carriage of Passengers on Baiyappanahalli - Mahatma Gandhi Road Standard Gauge Electrified Double Line Section of BMRCL vide letter under reference is forwarded for necessary action with following conditions:

1. It shall be ensured by BMRCL to get all the Maintenance Manuals and instructions related to rolling stock approved by RDSO (Ministry of Railways) and also to develop a mechanism to get their various maintenance practices audited periodically by RDSO.
2. Conditions mentioned in para 13(e) of the letter under reference to be modified as " In case any secondary air spring of a coach gets deflated

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during the run, the maximum speed of the train shall be brought down to 60 Kmph on tangent track and 25 Kmph on curved track having radius sharper than 190m immediately and the train shall be withdrawn from service and brought for attention, to a depot or taken to a siding, as situation demands, at the earliest opportunity and in any case, not later than after completion of " that particular run to its immediate destination". The indication for air spring having deflated shall be made available to the Drivers (Train Operators).

This issues with the approval of Chief Commissioner of Railway Safety.

31-08-2011

(सित्तम प्रकाश)

उप रेल संरक्षा आयुक्त (यॉत्रिक)

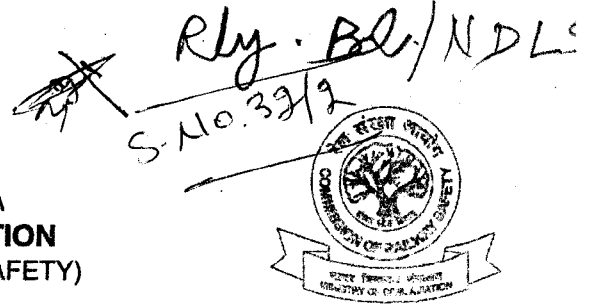
संलग्नक : उपरोक्त

प्रतिलिपि प्रेषित :

रेल संरक्षा आयुक्त, दक्षिण परिमण्डल, बंगलुरु ।



भारत सरकार
नागर विमानन मंत्रालय
(रेल सुरक्षा आयोग)
GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION
(COMMISSION OF RAILWAY SAFETY)



DINESH KUMAR SINGH

रेल सुरक्षा आयुक्त, दक्षिण परिमंडल
7, शेषाद्री रोड, गांधीनगर, बेंगलूर - 560 009
COMMISSIONER OF RAILWAY SAFETY
SOUTHERN CIRCLE
7, SESHADRI ROAD, GANDHINAGAR
BANGALORE - 560 009

सं No. No.Q.15013/1/2011-BMRCL / 315

दिनांक Date : 29.08.2011

✓ The Secretary (Civil Engineering),
Ministry of Railways,
Railway Board,
Rail Bhavan,
NEW DELHI -110 001

Through Chief Commissioner of Railway Safety, Lucknow.

Sir,

Sub: Sanction for introduction of Standard Gauge Coaches manufactured by M/S Hyundai-Rotem/Korea for Public Carriage of Passengers on Baiyyappanahalli – Mahatma Gandhi Road Standard Gauge Electrified Double Line Section of BMRCL

Ref: BMRCL letter No. BMRCL/E-70(C)/Vol.4/2011-12/3478 dated 16.08.2011

1. BMRCL has applied for sanction for introduction of Standard Gauge Passenger Coaches supplied by M/S Hyundai-Rotem/Korea for passenger services on Baiyyappanahalli – Mahatma Gandhi Road Standard Gauge Electrified Double Line Section of BMRCL.
2. The track on Bangalore Metro line has been laid on Standard Gauge (1435 mm) network. The mode of traction is 750 V DC 3rd rail bottom collection.
3. The Bangalore Metro coaches are designed and manufactured by M/S Hyundai-Rotem/Korea with air suspension at secondary stage as per their General Arrangement drawing No. RGA10001CEO Rev. 'A' for Driving Motor Coaches (DMC) and as per their General Arrangement drawing No. RGA10002CEO Rev. 'A' for Trailer Coaches (TC). The primary

suspension is provided with Conical Rubber Springs. The air springs in the secondary suspension are provided with emergency rubber springs to act in case of deflated air springs. Vertical and lateral dampers are provided to optimize the suspension. The design speed of SG coaches is 90 Kmph and the maximum axle load capacity is 15t. The train composition is 3 cars consisting of two driving motor coaches (DMC) and one trailer coach (TC) as per drawing No. RGA00001CEO Rev.A.

4. The passenger coaches have been designed jointly by Hyundai-Rotem/Korea and Mitsubishi Electric Corporation (MELCO)/Japan. First five train sets after manufacture by Hyundai-Rotem in their works in Korea have been tested and commissioned on the Main line on M.G. Road – Baiyyappanahalli Section.
5. With a view to assess the speed potential and Emergency Braking Distance (EBD) of the above coaches, detailed Oscillation trials up to a maximum speed of 85 kmph, Emergency Braking Distance (EBD) trials up to a maximum speed of 75 kmph and long confirmatory runs have been conducted by RDSO on Mahatma Gandhi Road - Baiyyappanahalli section of SG network of BMRCL in empty and loaded conditions with air spring in full inflated, partially deflated and fully deflated conditions. During the trials, the maximum speed was restricted to 50 kmph at stations, 45 kmph on curves of 120 m radius and 25 kmph on curves of 100 m radius in Depot.
6. The assessment criteria for suitability and riding quality considered by RDSO are:
 - i) Maximum vertical and lateral acceleration measured on car floor of car body as near to Bogie Centre as possible to be within 0.27g.
 - ii) Maximum dynamic wheel unloading ($\Delta Q/Q$) to be within 0.50.
 - iii) Maximum values of Ride Index (RI), both vertical and lateral, calculated on the basis of vertical and lateral accelerations recorded during the trial, to be 2.50 in inflated conditions of air springs and to be 3.0 in deflated condition of air springs.
 - iv) General indication of stable running characteristics of the vehicle as evidenced by the movement of the bogie on straight and curved track and by the acceleration readings and instantaneous wheel load variations.
 - v) The accelerations and spring displacements should decay within 2 to 3 cycles.
7. The results of Oscillation trials and long confirmatory runs are contained in RDSO report No. RDSO/2011/TG/MT-1117/F Rev.-0 Dt. 11.07.2011 with Addendum slip No. 1. The results of EBD trials are contained in RDSO report No. RDSO/2011/TG/MT-1118/F Rev. 0 Dt. 11.07.2011. The results

indicate satisfactory riding up to a maximum speed of 85 kmph in inflated condition of air springs in both loaded and empty condition and up to a maximum speed of 70 kmph in deflated/partially deflated condition of air springs in both loaded and empty condition. The maximum emergency braking distance recorded during the trials was 174.10 m. at a speed of 75 kmph in loaded condition with push button on the wet rail against the specified requirement of 179 m.

8. Based on the results of oscillation trials, EBD trials and long confirmatory runs, RDSO have issued a provisional speed certificate for operation of the DMC and TC coaches in formation of DMC-TC-DMC up to a maximum speed of 75 kmph in inflated condition of air suspension over Bangalore Metro SG network subject to certain conditions/stipulations as contained in the Provisional Speed Certificate issued vide RDSO's letter No. MC/BMRC dated 13.07.2011 and Amendment No. 1 to this letter issued vide their letter No. MC/BMRC dated 12.08.2011.
9. There are sharp curves with a radius of up to 120m on Main line and up to a radius of 100m in depots in Baiyyappanahalli – Mahatma Gandhi Road Standard Gauge Electrified Double Line Section of BMRCL. Curves sharper than 190 m radius have also not provided with check rails. As per BMRCL, the bogie of these coaches has been designed to negotiate small radius curvature of up to 100 m in Main line and up to 90 m in Depots. The design has been checked by the General Consultants (Systra-PBI-Rites-OC) of BMRCL and also by independent international consultant namely M/s Interfleet Technology/UK and found to be complying with the above mentioned technical specifications.
10. The static test results obtained during factory acceptance test of bogie in Korea in respect of major parameters as submitted by BMRCL are discussed below:
 - i) Maximum wheel unloading in the worst track conditions ($\Delta Q/Q$) should not exceed 60%. The requirement specified by BMRCL was that it should be $< 50\%$ in inflated condition and should be $< 60\%$ in deflated condition of air springs. The design values were 33.9% in inflated and 51.3% in deflated condition. The actual values recorded in the static test at HR Korea factory were 44% in inflated condition and 59% in deflated condition. The values of maximum wheel unloading ($\Delta Q/Q$) recorded during the oscillation trials conducted by RDSO are also within 50%.
 - ii) Bogie rotational resistance (x-factor) should not exceed 0.1 under the worst combination of bogie rotation and curve entry. The x-factor for radius of 120 m curve on main line has been measured at bogie rotational speeds of 0.2 deg./sec, 0.4 deg./sec. and 0.5 deg./sec with turn table test rig at HR factory Korea. The x-factor at 0.8 deg./sec.

has been calculated to be 0.0416 in inflated condition and 0.0797 in deflated condition. The extrapolation method of HR has, however, been contested by the International Consultant M/S Interfleet Technology/UK. As per M/S Interfleet Technology/UK, the test result is within specified limit in case of inflated condition of air springs but in case of deflated condition, the result is exceeding the specified requirement of 0.08.

- iii) The x-factor for radius of 90 m curve on main line has been measured at bogie rotational speeds of 0.4 deg./sec. with turn table test rig at HR factory Korea as 0.0473 in inflated condition and 0.0754 in deflated condition.

- 11. BMRCL have also submitted the report of vehicle dynamic analysis done with the validated vehicle model with Vampire vehicle model. The validation of the vehicle model has been done in accordance with GM/RC 2641. As per the report, the vehicle running stability is acceptable, the derailment quotient is below the limit value of 1.0 and the ride quality and carbody acceleration on the simulated new and worn condition of track and wheels are acceptable.

- 12. BMRCL has certified that Rolling Stock is electromagnetically compatible with the signalling system.

- 13. Taking into consideration the reports of oscillation trials, EBD trials, long confirmatory run conducted by RDSO and other clarifications given by BMRCL and based on the Provisional Speed Certificate issued by RDSO certifying that the Standard Gauge Metro Coaches supplied by M/S Hyundai-Rotem/Korea are fit for operation up to a maximum speed of 75 kmph in inflated condition of air suspension, I recommend sanction for introduction of these coaches on Baiyyappanahalli – Mahatma Gandhi Road section of BMRCL at a maximum speed of 75 kmph in inflated condition of air springs and up to a maximum speed of 60 kmph in deflated condition of air springs subject to following conditions/stipulations :
 - a) Observance of all permanent and temporary speed restrictions in force and/or those that may be imposed from time to time on account of track, OHE, Signalling and Interlocking and on any other account.

 - b) Observance of all the conditions and stipulations laid down in the Safety Certificate along with concomitant Track and Bridge Certificates and other annexures enclosed with the application for introduction of Standard Gauge Metro Coaches supplied by M/S Hyundai-Rotem/Korea on Baiyyappanahalli – Mahatma Gandhi Road section by BMRCL.

- c) Observance of all conditions stipulated in RDSO's provisional speed certificate issued vide RDSO's letter No. MC/BMRC dated 13.07.2011 and Amendment No. 1 to this letter issued vide their letter No. MC/BMRC dated 12.08.2011.
- d) In the inflated condition of air springs, the maximum speed shall be restricted to 50 kmph at stations. For the curves sharper than 190 m and up to 120 m, the maximum speed shall be restricted to 40 kmph and for 100 m radius it shall be 20 kmph. For curve having radius of more than 190 m permissible maximum speed will be 10% lower than the maximum speed as per table no. 4.15 of RDSO Oscillation Trial report no. RDSO/2011/TG/MT-1117/F Rev.-0 Dt. 11.07.2011.
- e) In case any secondary air spring of a coach gets deflated during the run, the maximum speed of the train shall be brought down to 60 kmph on tangent track and 25 kmph on curved track having radius sharper than 190m immediately and the train shall be withdrawn from service and brought for attention, to a depot or taken to a siding, as situation demands, at the earliest opportunity and in any case not later than after completion of its round trip. The indication for air spring having deflated shall be made available to the Drivers (Train Operators).
- f) The performance of electrical insulation of the Track structure may be ascertained and complied with by BMRCL. Certificates may be issued by the Director(s) of BMRCL as to the ability of the available electrical insulation in the track to ensure safety of the running trains, before operation is started.
- g) The Parameters of Standard Gauge Metro Coaches manufactured by M/s Hyundai-Rotem/Korea shall be maintained within following limits:
- | | |
|---|-------------------------|
| i) Maximum axle load (DMC/TC) | : 15.0t |
| ii) Maximum tractive effort per DMC | : 10.13t |
| iii) Maximum braking force DMC/TC | : 7.09t |
| iv) Maximum CG height from rail level in empty & loaded condition | : not exceeding 1525 mm |
- h) Compliance of all the conditions stipulated by Railway Board while giving technical clearance for :
- i) Traction and Power Supply system vide Railway Board's Letter No. 2010/Elect(G)/148/I Pt. I dated 11.2.2011,
 - ii) Signalling/Train control and communication system vide Railway Board's Letter No. 2010/Proj./BNG/30/2 dated 31.8.2010,
 - iii) Provisional approval for Track structure for Standard Gauge system of Bangalore Metro vide Railway Board's Letter No. 2010/Proj./Bangalore/1/5 dated 11.4.2011 and 28.7.2011, and

- iv) Provisional approval for Schedule of Dimensions for Bangalore Metro (SG) vide Railway Board's Letter No. 2010/Proj/Bangalore/30/4 dated 08.08.2011.
- i) The concerned Officer of BMRCL shall certify that Kinematic profile of rolling stock is within the kinematic envelop of these coaches as shown in Fig. no. 1(AG), Figure no. 1(TNL/AG/ELE), Figure No. 4(A), Figure no. 7(ELE), Fig. no. 7(AG) and Fig. No. 7(TNL) of BMRCL SOD during operation.
- j) Before initiating the operation of Bangalore Metro Coaches, BMRCL shall certify the track fitness and safety and fitness of the rolling stock depending on the actual condition of the bogie suspension system, wheel, axle and other safety related components.
- k) Before operation of the trains, BMRCL shall ensure that SOD is approved by Railway Board and the infringements, if any, to the approved SOD are condoned by Railway Board.
- l) The driving gear mounted on the axle infringes the Schedule of Dimensions Item 5 of Chapter III –Rolling Stock of Schedule of Dimensions for Standard Gauge of BMRCL as provisionally approved by Railway Board with certain changes vide their letter No. 2010/Proj/Bangalore/30/14 dated 08.08.2011. BMRCL has applied for condonation for the infringement to Railway Board. BMRCL shall ensure that approval for the same from Railway Board is obtained before operation of the trains.
- m) Lubrication of the gauge face of outer rail of the track on curves daily before start of the first train service of the day.
- n) Before introducing the coaches into regular service for public carriage of passengers, the coaches shall be run in the section in train formation without passengers on board for at least three days. The train operators shall also be given road learning during day and night.
- o) In view of rolling stock operation on elevated track in urban areas, high quality regular maintenance and safety audit checks of sub-system like Brakes, Bogie suspension, Roller Bearing and Wheel sets etc shall be ensured by BMRCL. BMRCL shall draw a suitable maintenance regime for the coaches and shall deploy suitably trained staff and ensure availability of required spares for regular maintenance of the rolling stock.
- p) Repeat/fresh oscillation trials are to be conducted to assess/validate riding quality and stability with worn out wheels and rails. These repeat trials are required to be done when wheel and rail wear are

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very close to their maximum permitted value. For this purpose, Chief Engineer of BMRCL shall ensure that proper record of wear in wheel and rail is kept and timely action taken.

- q) RDSO has issued a provisional speed certificate. The issue of final speed certificate shall be pursued by the BMRCL and it shall be ensured by BMRCL that the oscillation trials are conducted by RDSO with Measuring Wheel for measurement of lateral forces along with other parameters with new wheel and worn wheel profile as BMRCL has confirmed that trials will be carried out with measuring wheel when full stretch of the East-West Corridor (18.1 km.) is likely to be available by the year 2013 as stated in their letter No. BMRCL/E-70(C)/2011-2012 dated 17.05.2011.
 - r) For further training to drivers (train operators) in driving technique and monitoring of their skills, a competent supervisor shall be deputed in each train for the initial 03 months. Each supervisor will keep record of working of the train operators monitored by him which shall be scrutinized by the officer nominated by CEE/GM(O&M) every month and corrective action, if any required, shall be taken promptly.
 - s) The wear pattern of rails on curves shall be kept under watch. Similarly wheels of coaches shall be closely monitored for abnormal wear and cracks.
14. The application from BMRCL for sanction for introduction of Standard Gauge Passenger Coaches supplied by M/S Hyundai-Rotem/Korea for passenger services on Baiyyappanahalli – Mahatma Gandhi Road Standard Gauge Electrified Double Line Section of BMRCL is forwarded duly recommended for sanction with stipulations as above in para 13. The application along with Joint Safety Certificate, Track and Bridge Certificate and other documents containing details of Rolling Stock and Brake Calculations, the Report of Deflection test of Bridges and other supporting documents are enclosed.

Yours faithfully,



(DINESH KUMAR SINGH)
Commissioner of Railway Safety
and
Commissioner of Metro Railway Safety

Encl: As above.