

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

No. 2012/Proj./Jaipur/30/7 Vol.II

New Delhi, date 13.03.2015

Managing Director,
Jaipur Metro Rail Corporation Ltd.,
Khanij Bhavan,
Behind Udyog Bhavan, C-Scheme
Jaipur- 302005.

Sub: Introduction of operation of Standard Gauge Jaipur Metro Rail Corporation Limited's (JMRCL) 'RS8' coaches manufactured by M/s BEML, India with air suspension arrangement at secondary stage to BEML's Drawing Nos. 555-00003AD for Driving Trailer (for 'DT' Coaches) and 555-00002AD for Driving Motor (for 'M' Coaches) over Jaipur Metro Standard Gauge (SG) system.

Ref: (i) Ministry of Civil Aviation's letter No. Q.16015/01/2014-15-T.W. dated 18.02.2015.
(ii) RDSO's Interim speed certificate no.UTHS/18/JMRCL dt. 12.05.2014 and 23.07.2014

In reference to letter cited above, provisional sanction of Ministry of Railways, Railway Board is hereby communicated for running of 'RS8' coaches manufactured by M/s BEML, India with air suspension arrangement at secondary stage to BEML's Drawing Nos. 555-00003AD for Driving Trailer (for 'DT' Coaches) and 555-00002AD for Driving Motor (for 'M' Coaches) over Jaipur Metro Standard Gauge (SG) system at a maximum permissible operating speed of 60 (SIXTY) kmph. Sanction is further subject to conditions mentioned in letter under reference (i), as below:-

1. It shall be ensured by the JMRCL to develop a mechanism to get their various maintenance practices audited periodically by RDSO.
2. Signalling system as approved by Railway Board shall be verified and certified by ISA as well as the Executing Authorities and their clarifications shall be submitted to the Commission with the Opening Documents.
3. There is no infringement to any of the dimensions as per approved Schedule of Dimension for Standard Gauge for Jaipur Metro Standard Gauge(SG) System.
4. At present one Scissor Crossover 1 in 9 have been provided near Chandpole station. This is not permitted as per the approved Schedule of Dimension. This infringement should be removed.

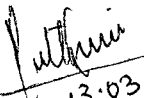
5. JMRC shall ensure that the limits of Noise and Vibration parameters of the Metro System are within the permissible limits as per legal and statutory requirement of India.
6. The maximum permissible speed of rolling stock is restricted to 60 kmph. For raising the speed up to 80 kmph performance of rolling stock should be observed for two months from the date of its introduction for public carriage of passengers. After satisfactory performance of rolling stock during the period of two months fresh application for raising the speed of 80 kmph should be submitted to Commission along with following documents:-
 - a). Performance report of satisfactory performance of rolling stocks during period of 2 months. This report should be submitted by Director/JMRC incharge of rolling stock.
 - b). Public opinion obtained under Item 15.
7. JMRC should ensure proper maintenance of rolling stock, propulsion equipment, control systems, signalling and interlocking, track, OHE and structures.
8. At least 4 fire extinguishers should be provided in each coach below seat near to door. Instructions to operate fire extinguishers should be written near fixing place of extinguishers.
9. Observance of all permanent and temporary speed restriction enforced and/or those that will be enforced from time to time on various accounts.
10. Observance of all conditions laid down in RDSO's interim Speed Certificate and concomitant Track Certificate, Bridge Certificate and Joint Safety Certificate submitted by JMRC.
11. Ensuring adequate road learning and training of train operators and testing their knowledge by Director (Operations & Systems)/JMRC.
12. Ensuring adequate training of station operators and controllers in working of Metro system and testing their knowledge by Director (Operations & Systems)/JMRC.
13. Adequate training of staff who will maintain the rolling stock, signalling and interlocking installations, OHE and track and their knowledge is being tested by Director (Operations & Systems).
14. Smoke detector should be provided in all coaches on programme basis. On detection of smoke by smoke detector, automatically "Siren" should sound in affected Coach & driving cab and there should be automatic application of brakes and flasher light should lit automatically.
15. After putting new rolling stock in service, public opinion regarding various passenger amenities/ facilities provided in coaches should be obtained. Public opinion may be obtained by designing and opening user friendly web page on JMRC web site or otherwise.

16. Fire fighting system in coaches is inadequate. State-of-art fire fighting system should be installed in coaches on programmed basis.

17. Emergency evacuation system provided in train set is inadequate. JMRC has informed that in emergency fully loaded train can be evacuated in 30 minutes. This time is very high especially in case of emergency like fire. State-of-art evacuation system should be provided in train set on programme basis.

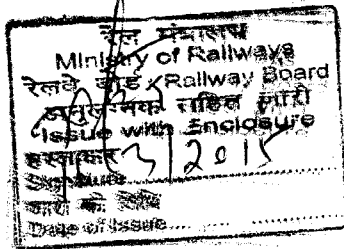
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o/c


13.03.15
(Ruth Changsan)
Dir. /Works (Plg.)
Railway Board
Ph. 011-23097061

Copy forwarded information to:

- (i) The Chief Commissioner of Railway Safety, Ashok Marg, Lucknow-226001 w.r.t his letter number Q.16015/01/2014-15-T.W. dated 18.02.2015.
- (ii) Director General, RDSO, Manak Nagar, Lucknow.



**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)**

No. 2012/Proj./Jaipur/30/7 Vol.II

New Delhi, dated 10.04.2015

Managing Director,

Jaipur Metro Rail Corporation,
khanij Bhawan,
Behind Udyog Bhawan, C-Scheme
Jaipur-302005.

Sub:- Introduction of operation of Standard Gauge Jaipur Metro Rail Corporation Limited's (JMRCL) 'RS8' coaches manufactured by M/s BEML, India with air suspension arrangement at secondary stage to BEML's Drawing Nos. 555-00003AD for Driving Trailer (for 'DT' Coaches) and 555-00002AD for Driving Motor (for 'M' Coaches) over Jaipur Metro Standard Gauge SG) system.

Ref: (i) Ministry of Civil Aviation's letter No. Q.16015/01/2014-15-15-T-W dated 18.02.2015.
(ii) This office letter of even No. Dated 13.03.2015.

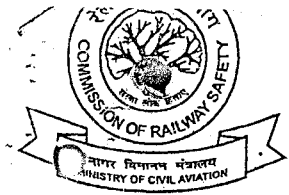
In continuation to this office letter under reference (i) and as recommended by CCRS vide letter under reference (i), provisional sanction of Ministry of Railways, Railway Board for running of 'RS8' coaches manufactured by M/s BEML, India with air suspension arrangement at secondary stage to BEML's Drawing Nos. 555-00003AD for Driving Trailer (for 'DT' Coaches) and 555-00002AD for Driving Motor (for 'M' Coaches) over Jaipur Metro Standard Gauge (SG) system at a maximum permissible operating speed of 60 (SIXTY) kmph is further subject to the condition that JMRCL should get all their maintenance manuals and instructions related to Rolling Stock approved by RDSO (Ministry of Railway) within six months.

All other conditions mentioned vide this office letter under reference stand unchanged.


10-04-15
(Ruth Changsan)
Director/ Works Plg.
Railway Board.
Ph. 011-23097061

Copy to - (i) The Chief Commissioner of Railway Safety, Ashok Marg, Lucknow-226001 w.r.t his letter number Q.16015/01/2014-15-T.Q. Dated 18.02.2015.

(ii) Director General, RDSO, Manak Nagar, Lucknow.



नागर विमानन मंत्रालय

(रेल संरक्षा आयोग)

GOVERNMENT OF INDIA

MINISTRY OF CIVIL AVIATION

(COMMISSION OF RAILWAY SAFETY)

N.E.Rly. 31-140, N.Rly. 23-290
फैक्स / Fax-0522-2233095, 2233087
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पूर्वोत्तर रेलवे, मं.रे.प्र. कार्यालय परिसर
16, अशोक मार्ग, लखनऊ-226001

N.E. Railway, DRM OFFICE CAMPUS
16, Ashok Marg, Lucknow-226 001

No. Q.16015/01/2014-15-T.W.

Date-18-02-2015

सेवा में,
सचिव,
रेल मंत्रालय (रेलवे बोर्ड),
रेल भवन,
नई दिल्ली ।

SOP

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Rm
EDW&P*

[ध्यानार्थ:ED(W&P)]

विषय: Introduction of operation of Standard Gauge Jaipur Metro Rail Corporation Limited's (JMRCL) 'RS8' coaches manufactured by M/s. BEML, India with air suspension arrangement at secondary stage to BEML's Drawing Nos. 555-00003AD for Driving Trailer (for 'DT' Coaches) and 555-00002AD for Driving Motor (for 'M' Coaches) over Jaipur Metro Standard Gauge (SG) system.

संदर्भ: रेल संरक्षा आयुक्त, पश्चिम परिमंडल, मुंबई के

- (i) पत्र सं-42-5/6/361 दिनांक 31.07.2014
- (ii) पत्र सं-42-5/6/607 दिनांक 28.11.2014
- (iii) पत्र सं-42-5/6/717 दिनांक 03.02.2015

The above subjected case, forwarded by Commissioner of Railway Safety, Western Circle, Mumbai vide letters under reference pertains to sanction for introduction of operation of subject rolling stock over Jaipur Metro Standard Gauge (SG) system to be operated by JMRCL.

Certain clarifications in regard to the subject case were sought from CRS/Western Circle in reference to his letter mentioned at (i) above vide this office's letter of even no. dated 26-08-2014, which were replied by CRS/Western Circle vide letter mentioned under reference (ii) and (iii) above. These are enclosed alongwith the case.

JMRCL has processed for operation of the rolling stock type mentioned in above subject at the maximum speed of 80 kmph on its SG sections on the basis of Joint Safety Certificate (Revised) No.SG-2/2014 (signed on 20-11-2014) and Interim Speed Certificate No. UTHS/18/JMRCL, Dated 12-05-2014 and its Amendment no.1 Dated 23-07-2014 issued by RDSO. **However, the CRS/Western Circle has recommended the case for a maximum speed of 60 kmph.**

Case is hereby forwarded for necessary action for INTERIM running of the above said rolling stock **at a maximum permissible operating speed of 60 (SIXTY) kmph** with the various conditions/stipulations as mentioned in CRS/Western

Shr
19/2/2015

Circle's letter no.42-5/6/717, dated 03-02-2015 as well as the following additional conditions/stipulations:-

1. It shall be ensured by the JMRCL to get all their 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. Evaluation/scrutiny and safety assessment of subject rolling stock has been done on the basis of various parameters and criterion mentioned in "Procedure for Safety Certification and Technical Clearance of Metro Systems by RDSO" issued by the Urban Transport & High Speed Directorate of RDSO in January 2013 and later on modified on several occasions, latest on 10.12.2014. This procedure order has not been approved by Railway Board. The same is required to be approved by the Railway Board and a Copy of the approval sent to the Commission.
3. Railway Board's letter no.2012/Proj./Jaipur/30/7(SoD)I dated 18-06-2013 addressed to JMRCL does not specify what has been cleared. It is not clear from the body of this letter that, what system has been approved by Railway Board to be adopted by JMRCL. Railway Board's clearcut approval detailing the traction system to be adopted on JMRCL is required as has been done in the case of approval of S&T System and Track Structure.
4. Signalling system as approved by Railway Board shall be verified and certified by ISA as well as the Executing Authorities and their clarifications shall be submitted to the Commission with the Opening Documents.
5. There is no infringement to any of the dimensions as per approved Schedule of Dimension for Standard Gauge for Jaipur Metro Standard Gauge (SG) System.

At present one Scissor Crossover 1 in 9 have been provided near Chandpole station. **This is not permitted as per the approved Schedule of Dimension. This infringement should be removed.**

6. As per Para 1.1 of annexure F-2 of "Procedure for Safety Certification and Technical Clearance of Metro Systems by RDSO" , for new Metro System, oscillation trials shall be done over the complete section before introduction of first train. Moreover, the same is required in view of RS8 coaches hitting the platform of one of the metro station during first run.
7. From the documents submitted, it is not clear what track structure including the fastening system has been approved by Railway Board for adopting on Jaipur Metro Standard Gauge Section.

Railway Board's clearcut approval detailing the track structure including the fastening system to be provided on Jaipur Metro Standard Gauge System is required and a copy of the same sent to the Commission.

8. The limits of Noise and Vibration parameters of the Metro System are within the permissible limits as per legal and statutory requirement of India.

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

संलग्नक: उपरोक्त ।

18.02.2015
(उत्तम प्रकाश)

उप रेल संरक्षा आयुक्त (यांत्रिक)
कृते मुख्य रेल संरक्षा आयुक्त

प्रतिलिपि-

रेल संरक्षा आयुक्त, पश्चिम परिमंडल, मुम्बई



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



रेल संरक्षा आयुक्त,
पश्चिम परिमंडल, २री मंजिल,
चर्चगट स्टेटो उप भवन,
एम. क. रोड, मुंबई - ४०० ०२०

Commissioner of Railway Safety,
Western Circle, 2nd floor,
Churchgate Stn. Bldg. Annex,
M. K. Road, Mumbai 400 020

No.42-5/6/717

Dated :03.02.2015

✓ Chief Commissioner of Railway Safety,
Ashok Marg,
Lucknow.

Sub: Sanction for Introduction of Standard Gauge Jaipur Metro Rail Corporation Ltd., (JMRCL) 'RS8' coaches manufactured by M/s. BEML, India with air suspension arrangement at secondary stage to BEML's Drawing Nos.555-00003AD for Driving Trailer (DT) & 555-00002AD for Driving Motor (M) coaches over Jaipur Metro Standard Gauge (SG) system.

Ref: This office letter No. No.42-5/6/607 dated 28.11.2014

The rolling stock of Jaipur Metro, ATP and signalling and interlocking system of Jaipur Metro was inspected by the undersigned on 25.01.2015 at Jaipur. Trial run of rolling stock was also conducted.

The introduction of rolling stock on Jaipur Metro system for public carriage of passengers is recommended for obtaining the Railway Board's sanction subject to following conditions/stipulations :

1. The maximum permissible speed of rolling stock is restricted to 60 Kmph. For raising the speed up to 80 Kmph performance of rolling stock should be observed for two months from the date of its introduction for public carriage of passengers. After satisfactory performance of rolling stock during the period of two months fresh application for raising the speed to 80 Kmph should be submitted to Commission along with following documents :-
 - (i) Performance report of satisfactory performance of rolling stocks during period of 2 months. This report should be submitted by Director/JMRC incharge of rolling stock.
 - (ii) Public opinion obtained under item 10.
2. JMRC should ensure proper maintenance of rolling stock, propulsion equipment, control systems, signalling and interlocking, track, OHE and structures.

3. At least 4 fire extinguishers should be provided in each coach below seat near to door. Instructions to operate fire extinguishers should be written near fixing place of extinguishers.
4. Observance of all permanent and temporary speed restriction enforced and /or those that will be enforced from time to time on various accounts.
5. Observance of all conditions laid down in RDSO's interim Speed Certificate and concomitant Track Certificate, Bridge Certificate and Joint Safety Certificate submitted by JMRC.
6. Ensuring adequate road learning and training of train operators and testing their knowledge by Director (Operations & Systems)/JMRC.
7. Ensuring adequate training of station operators and controllers in working of Metro system and testing their knowledge by Director (Operations & Systems)/JMRC.
8. Adequate training of staff who will maintain the rolling stock, signalling and interlocking installations, OHE and track and their knowledge is being tested by Director (Operations & Systems).
9. Smoke detector should be provided in all coaches on programme basis. On detection of smoke by smoke detector, automatically "Siren" should sound in affected Coach & driving cab and there should be automatic application of brakes and flasher light should lit automatically.
10. After putting new rolling stock in service, public opinion regarding various passenger amenities/facilities provided in coaches should be obtained. Public opinion may be obtained by designing and opening user friendly web page on JMRC web site or otherwise.
11. Fire fighting system in coaches is inadequate. State-of-art fire fighting system should be installed in coaches on programmed basis.
12. Emergency evacuation system provided in train set is inadequate. It was informed that in emergency fully loaded train can be evacuated in 30 minutes. This time is very high especially in case of emergency like fire. State-of-art evacuation system should be provided in train set on programme basis.


(CHETAN BAKSHI)
Commissioner of Railway Safety
Western Circle, Mumbai

DA: (i) Inspection report of Rolling stock of Jaipur Metro in 16 pages.
(ii) Abbreviations (2 pages).

**Inspection report of Chetan Bakshi CRS/WC - Inspection of
Rolling stock of Jaipur Metro on 25.01.2015 at Jaipur**

1. Unique Transportation code/Identification number.

The coaches of each train set is designated by unique identification number (e.g.Ts#03)

SN	Car Type	Drawing No.	Identification No.
1	DT1	555-29101AD, 555-00004AD, 555-00003AD	D1A03
2	M1	555-29201AD, 555-00002AD	M1A03
3	M2	555-29201AD, 555-00002AD	M1B03
4	DT2	555-29101AD, 555-00004AD, 555-00003AD	D1B03

Configuration:- DT+M+M+DT

2. Axle Load.

- i. Maximum axle load (Design) of MC = 16.0t.
- ii. Maximum axle load (Design) of DTC = 16.0t.

3. Ride Index

Ride index measured by RDSO as per Oscillation Trial report RDSO/2014/TG/MT-1327/F/Rev.0, Amendment-Nil,dt.29.04.2014 shows that Maximum value of ride index listed under para 6.2 of the said report is 2.45 (Para no. 6.2.1) for vertical riding and 2.30 (Para no. 6.2.3) for lateral riding at speed of 90 kmph in inflated condition as against the criteria of 2.75. The Maximum value of ride index listed under para 6.2 of the said report is 2.51 (Para no. 6.2.2) for vertical riding and 2.27 (Para no. 6.2.3) for lateral riding at speed of 60 kmph in deflated condition as against the criteria of 3.00.

4. Power rating.


Propulsion and control equipment has been designed for maximum service speed of 85kmph and maximum Design speed of 95kmph. The ratings of propulsion equipment are as under

(i) Traction Motor

Continuous rating: 220 kW, 113 A
Hourly rating : 240 kW, 121 A

Transformer winding	Rated capacity	Rated voltage	Rated current
Primary for overhead line	1243 kVA	25000 V	49.7 A
Secondary for Traction duty	1006 kVA	1058 V	475 AX2G
Tertiary for auxiliary	237 kVA	470 V	504 A

Transformer is designed to deliver the power to the continuous load including the emergency operation and 10% extra above the maximum load for 30 minutes.


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5. **Hauling capacity**

Each traction motor has continuous power rating of 220 kW. Therefore, power rating of 4-car Train is 220 kW*8 (no. of TM in- 4 car train) = 1760 kW at nominal OHE voltage of 22.5 kV. The maximum tractive effort of the 4 car train is 230.4 KN, which enables the starting acceleration (avg. from standstill to 30 kmph) of 0.8 m/s² on level tangent track. Fully loaded train (AW3) with one motor coach isolated (50% traction) is capable of starting on 4% gradient and clearing the section.

6. **Passenger carrying capacity coach wise (AW3:- 8 persons/m²)**

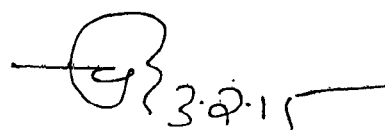
Sr.No.	Description	Seating Capacity	Standing Capacity	Total
1.	Driving Trailer 'D' coach	43	272	315
2	Motor coach	50	291	341

7. **Brake system:- Service rake, Emergency Brake & Parking Brake**

(i) **Service Brake:** - Electro pneumatic brake system is electronically controlled system provided with fault diagnosis and fault record function. Application and release of brake is achieved manually through movement of TBC (Traction Braking Control) or by Automatic Train operation (ATO) system. During the process of normal service brake, the electric regenerative braking and friction air braking are blended to meet the requirement of brake demand with preference given to electric regenerative braking. If the electro-regenerative braking cannot meet the demand brake force, pneumatic brake compensates for the demand. Brake application with jerk control function is to ensure smooth braking operation.

(ii) **Emergency Brake:-**Emergency Brake is controlled by Emergency Brake Hard-wired loop all along the train. The breakage in this loop (resulting in emergency electromagnetic valve de-energization) due to any condition, namely, application of emergency brake push button, train parting, low pneumatic pressure or by Automatic Train Protection etc. results in application of Emergency Brake in all the coaches. Emergency Brake can be applied through Dead Man Safety Device (DSD), Driver Brake Valve (DBV) and Emergency Brake Push Button (EBPB). Emergency braking distance trials were conducted by RDSO. As per para 7.0 of RDSO trial report Emergency Braking Distance (EBD) observed is 169m in empty & dry condition and 173m in loaded & dry condition , observed through application of Master Controller (EP only) at speed of 80KMPH against the requirement of 220m(max.) at speed of 85kmph under fully loaded condition . RDSO has authorized maximum operating speed of 80kmph based on oscillation trial. JMRCL clarified that braking distance at 25kmph speed is 23.88m in full service brake application and 15.33 m in emergency brake application.

(iii) **Parking Brake** – Parking brake is provided on 50 % wheels diagonally in DTC (Driving Trailer Car) and MC (Motor Car) Parking brake and is capable of holding fully loaded train on a 4% (1 in 25) grade. The parking brake is spring applied and air released. The Parking brake is failsafe and is applied automatically, if air pressure is lost for any

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reason. Parking brake is released gradually and air brake is applied when air pressure is available. Parking brake can be applied and released from occupied driver cab, when the air supply is present. Parking brake system is having provision for manual isolation in case of mal operation.

RDSO has tested efficiency of parking brake at gradient of 3.854% on run up from depot to Mansarovar station, which has maximum gradient on JMRC section. As per para 6.3 of RDSO report on Emergency Braking Distance (EBD) trial, no movement is observed during application of parking brake test for one hour.

8. Safety features (headlight, speed recorder, Auto flasher, VCD (DSD), WSP, ACP (PEAH) etc.)

Train speed is indicated on Train Integrated Management System (TIMS) screen. It is also available on Driver Machine Interface (DMI) of Automatic Train Control (ATC) system.

Flasher light, Headlights are provided. Their failure is indicated on TIMS screen. Deadman safety device (DSD) is provided for vigilance control function. Driver is required to keep DSD handle pressed, while driving.

Trains are provided with wheel slip/slide protection (WSP).

Passenger Emergency Alarm Handle (PEAH) is provided for emergency communication between passenger and driver.

Train Control and Management System screen provided in the driver's cab displays the health of various systems on the rolling stock.

9. Standard of crash worthiness including safe speed, crumble zone impact energy absorbed and in which mode.

The coaches are made from high tensile stainless steel. The car body is constructed of a welded structure which includes the under frame, side wall, end wall and roof, with a built-in positive camber, which is sustained during operating loads.

It was informed that the coaches are designed for crashworthiness feature as per EN 15227. Crashworthiness simulation has been done as per EN 15227, which the cars and the trains will be able to absorb collision forces as following:

- 1) **DT-car**
 - i. The actual structural deformation occurs at 18.0 km/hr (car to car crash) and the absorbing energy is 127.8 kJ for full car.
 - ii. The structural deformation of back of coupler pad is expected to commence over 50 kmph (car to car crash). The amount of energy absorption is 0.96 MJ. Maximum displacement is 247.8 mm.
 - iii. The deformation between body bolsters of DT-car starts at speed of 76 km/hr (car to car crash). There is no deformation between the body bolsters up to 76 kmph (car to car crash). The amount of energy absorption is 2.18 MJ. Maximum displacement is 657.5.4 mm.

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- 2) M-car
- The actual structural damage occurs at 11.0 km/hr (car to car crash) and the absorbing energy is 46.4 kJ.
 - The structural damage of back of coupler pad is expected to occur at 40 km/hr (car to car crash). The amount of energy absorption is 0.64 MJ. Maximum Displacement is 204.7 mm
 - The deformation between body bolsters of M-car commences at 52 km/hr (car to car crash). Therefore, there is no deformation between the body bolsters up to 52 kmph (car to car crash). The amount of energy absorption is 1.08 MJ. Maximum Displacement is 279.5 mm.

10. Type of suspension

Conical Rubbers are provided in primary suspension & air springs are provided in secondary suspension. Failure of air spring is displayed on Train Control and Management System screen and same was demonstrated during the inspection.

11. Type of coupling/coupler from buffer system including buffer height variation, coupler strength & buffing gear capacity.

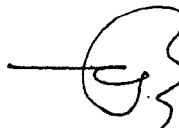
Two types of couplers are used in metro train. Semi permanent coupler is used between M and DT car forming a basic unit of a metro train. Automatic coupler is used between two such units. As per technical specification, the coupler shall sustain no permanent damage, when a fully loaded 6 car train collides with an impact speed upto 10 kmph. Maximum load on the coupler as per impact simulation study undertaken by OEM and the corresponding test parameters for coupler are as follows:

S N	Coupler/ Coupler components		Max. load as per impact Simulation	Test parameter
1	Automatic coupler	Compression	1120 KN	1500 KN (Coupler Head, Rubber cushion, bearing bracket)
		Tension	NA	1000 KN (Coupler Head, Rubber cushion, bearing bracket)
2	Semi permanent coupler	Compression	1040 KN	1200 KN (cushion rubber)
		Tension	NA	850 KN (Cushion Rubber)

Expected Maximum Tension loads:

Maximum tension load on coupler is expected when a 6 car fully loaded train is being rescued by a healthy train in Pull mode on 4% Up gradient. (Normal Rescue operation is in Push mode and not in Pull mode)

Weight of 6 car fully loaded train = 3763kN
 Load exerted on coupler on 4% gradient = 150kN


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Rolling resistance@5kg/ton	=	19kN
Assuming acceleration of 0.1 m/s ² , load	=	38 kN
Total tension load on coupler head of DT car=		207 kN

207 kN is the maximum expected Tension load during Rescue of 6 car Fully loaded train on 4% gradient. Coupler has been tested for 1000 kN. Maximum value for semi-permanent coupler is 241 kN against 850 kN (Test value).

12. MMD infringement and Minimum Ground clearance.

Kinematic envelope of Jaipur metro rolling stock is within the Kinematic Profile provided in Jaipur metro SOD approved by Railway Board.

13. Safety, emergency evacuations and functional instruction for passenger's guidance (coaches).

This mechanism can be operated by train operator in case of any emergency to evacuate the passengers from the train. Since, the passenger evacuation is under guidance of TO, the evacuation will normally be done from the end door of the car occupied by TO. However, the provision exists in end door of each car. JMRCL has issued detailed procedure for the evacuation of passengers in case of emergencies in JMRCL Safety Manual- SC-13, & chapter 6.4 of Operation Manual.

14. Crew and passenger communication system.

In order to facilitate the communication between passengers and Train Operator: Four Nos. of Passenger Emergency alarm handles are provided in each coach. The functionality was demonstrated during Inspection.

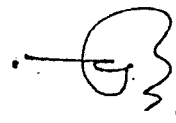
The Information System available in the train has following functions:

Public announcements by train operator to make announcements to all passengers from the driving and non-driving cab. It has Half duplex internal communication, which will make it possible for onboard personnel to speak with each other from cab to cab and between train operator and passenger, via the passenger emergency alarm handle, the (PEAH).

Passenger Information Boards: Four numbers of Passenger Information Boards (PIBs) are provided in each car where information regarding approaching station and other important messages are disseminated.

Line Route Maps (LRM): LRMs are provided over each door, giving indication of approaching stations, and information about the side on which the door will open.

Passenger Surveillance System: (CCTV) – 4 nos. CCTV cameras are provided in each car. Ten hour recording of CCTV footage is available for reference and records in case of any emergency. CCTV images are available to train operator on his display panel in his cab. In case of operation of Passenger Emergency Alarm (PEA), operator can view the person seeking attention.

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15. **Fire prevention system.**

It was informed by JMRC that fire retardant material complying to BS6853 or equivalent is used in coach construction, majority of equipments are mounted in underframe or on roof, isolated from passenger area. Only control and monitoring equipments are provided in saloon.

Short circuit/over current protection provided to eliminate incidences of fire. One fire extinguisher is provided in each cab and two fire extinguishers in passenger area in each coach. Instead of existing locking arrangement of keeping fire extinguishers in Cabinet under lock & key, it should be kept below seat near door and label shall also be provided showing the location to the passengers. In each coach at least 04 fire extinguishers should be kept.

Smoke detection system is provided in each cab to stop entry of external smoke in case of any fire outside. If, smoke or fire is reported on a train between stations, the Train Operator shall inform the Traffic Controller, drive his train to the next station and detrain passengers. JMRCL has procedure in their safety manual detailing the actions to be taken by various operation staff in case of fire.

16. **Layout of driving cab and signal visibility.**

Driving Cab layout is as per BEML drawing no 555-18000. Signal visibility from either side of the cab is good.

17. **Layout of equipment/machine room and isolation of machines room/equipment room from passenger portion of the coach.**

Traction convertor cubical, electrical control cubical and distribution cubical are housed in separate compartment. Layout of equipment/machine room provides adequate isolation of machines room from passenger portion of the coach.

18. **Availability of indication of equipment failure in the driving cab, such as electrical equipments, pneumatic springs etc.**

The status of major propulsion equipments can be seen on HMI fitted in driver desk. In case of failure of equipment / sensor or input / output feedback, TCMS detects the same and related events / messages are shown in HMI. In case of air spring deflation, failure message appeared in HMI.

19. **Maintenance system and coach fitness certificates.**

Rolling stock will be maintained as per periodical maintenance schedule laid down in O&M manual. The trains will be maintained in Mansarovar Depot. The Depot has 3 inspection lines with roof and under frame inspection facility and 2 Nos. workshop lines with crane, under floor pit jacks and mobile jack facility and 14 Nos. of stabling lines for the train stationing in depot. The necessary M & Ps like automatic washing plant, pit wheel lathe, overhead cranes etc are also available

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Following maintenance schedules are proposed by JMRC for the maintenance of rolling stock:

S.N.	Type Of Schedule	Periodicity	Duration
1	Daily	Everyday	30 min.
2	A	15 days or 6,000 km	3 hours
3	B1	45 days or 18,000 km	10 hours
4	B4	18 days or 72,000 km	16 hours
5	B8	360 days or 1,50,000 km	18 hours
6	C1	42 Months or 4,20,000 km	10 days (approx.)
7	C2	84 months or 10,40,000 km	15 days (approx.)
8	C5	210 months or 26,00,000 km	20 Days (approx.)

20. **System and procedure of coupling and de coupling of coaches during emergency:**
Possible cases of decoupling of coaches on main line and procedure to be adopted in each case is as follows:

Case – 1: Train Divided electrically between two units:

Train Divided (electric) message will pop up on TCMS (Train Control & Management System) Train Operator (TO) shall verify physically that train is complete and mechanically coupled.

Train Operator in consultation with traffic controller will isolate the BIC (bogie isolating cock) of rear unit, cut out BLCOS (brake loop cut out switch) & DPLCOS (Door Proving loop Cut Out switch) and proceed to next station following the instruction given by traffic controller at a maximum speed of 20 kmph.

The train shall be withdrawn from passenger service at the next station and worked to terminal station and shall be brought to depot in non-revenue hour.

Case – 2: Train Divided electrically & mechanically between two units:

Train Divided (Electric) and train divided message will pop up on TCMS (Train Control & Management System). Train operator shall verify physically that train uncoupling status and assess damage if any. Train operator in consultation with OCC tries to couple the rear unit with help of front unit and complete the mechanical coupling.

Train Operator in consultation with traffic controller isolate the BIC (bogie isolating cock) of rear unit, cut out BLCOS (brake loop cut out switch) & DPLCOS (Door Proving loop Cut Out switch) and proceed to next station following the instruction given by traffic controller at a maximum speed of 20 kmph.

The train shall be withdrawn from passenger service at the next station and shall be brought to depot.

Coupling of Disabled rake

Whenever a rake or train is not able to move on its own power the train operator of failed rake will request to station controller and train operator of following rake to assist in coupling. Train operator in following rake and train operator in defective train will ensure proper coupling of two trains

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21. Conditions for formation of rake with multiple units (maximum number)

Electrical Design permits formation of Train upto 6 car formation (DT-M-T-M-M-DT). However, presently it is proposed to run the rake in 4 car formations. The Configuration is DT-M-M-DT.

22. Number of members of crew

There is one Train operator in driving cab.

23. Electrical system and protective devices and Fire Prevention measures.

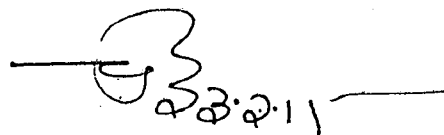
- Majority of equipment's are mounted in under frame(Static Inverter , Main Transformer ,Main Compressor ,Battery Box ,Converter /Inverter)or on roof(Air conditioner, VCB, PT), isolated from passenger area. Only control and monitoring equipment's are provided in the saloon.
- All cables and other non metallic items comply to BS 6853 or equivalent with regard to fire safety performance.
- Power & control circuits are separated and provided with adequate short circuit/over current protection for quick isolation of faulty equipment to eliminate any possible incidence of fire.
- Equipment's with major fire load e.g. Transformer & Traction motor are in the under frame.It was informed that the floor of rolling stock is designed for 30 minutes of fire rating. Further JMRCL clarified that a fully occupied train can be evacuated within 30 minutes.

24. Dimensions of Rolling Stock

The dimensions of Train set 03 as compared to the dimensions listed in the layout drawings are listed below:

DT Coach Number: D1B03

S.No	Dimension	As per schedule of Dimension	As per the layout Drawing	Actual measured at site
1.	Height of interior ceiling from the floor level	Not mentioned	2075.5 +/-2.0mm	2075 mm
2.	Height of grab railing from the floor level	Not mentioned	1910+/-1.2 mm	1910 mm
3.	Width of Coach (including doors)	Max 2900 mm	2900 mm	2900 mm
4.	Height of the seat from the floor	Not mentioned	435 +/-0.8 mm 29101AD	435 mm
5.	Length of a bank of 7 seats	Not mentioned	3150 +/-2 mm	3150 mm
6.	Opening width of door	Not mentioned	1400 +/-1.2 mm	1400 mm



7.	Length of DT Car	Max 22010 mm	21840+/-3 mm	21840 mm
8.	Distance between bogie centres.	14750 ± 350 mm	15000+/-3 mm	14798 mm
9.	Height of floor from rail top	Max 1130 mm Min 1100 mm	Nominal 1130 mm	1115 mm
10.	Height of pantograph from rail level in drop down condition	Max 4048mm	4048 mm as per SOD	4036 mm
11.	Gap between platform coping and train door in door closed condition	Max.75mm Min.70	Not mentioned	82mm in door open condition from door guide rail and platform and 74mm in door closed condition (Measured at Mansarovar station)

M Coach number: M1B03

S.No	Dimension	As Schedule of Dimensions	As per Layout Drawing	Actual measured at site
1.	Width of Coach (including doors)	Max 2900 mm	2900+/-2 mm	2900 mm
2.	Height of the seat from the floor	Not mentioned	435+/-0.8mm	435 mm
3.	Distance of door to door in the open condition	Not mentioned	1400 +/-1.2 mm	1400 mm
4.	Length of M Car (including end fairings)	Max 22010 mm	21740 mm	21740 mm
5.	Distance between bogie centres	14750±350 mm	15000 mm	15000 mm

25. Train Control and Signaling System:

The system of Operation is which is briefly described below:

- i. Continuous Automatic Train control system is provided on Mansarover-Chandpole section for movement of trains between stations and between the depot and running lines.
- ii. The Continuous Automatic Train Control system works on the principle of target

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speed with cab signals, by means of continuous transmission of data from track to train through Coded Audio Frequency Track Circuit.

- iii. Limit of movement authority and the maximum safe speed.
- iv. The continuous Automatic Train Control system provides the following modes of train operation
 - Automatic Mode (AM) for Automatic Train Operation (ATO) (In future)
 - Supervised Manual Mode (SM)/ Coded Manual Mode (ATP) Mode.
 - Restricted Manual (RM) Mode.
 - Run On Sight (ROS) Mode.

a) Automatic Mode (In future)

- i. In the Automatic Mode, the train operates without intervention by the Train Operator except closing of train doors and starting from a station stop and it shall operate under the supervision and control of Automatic Train Protection functions.
- ii. In Automatic Mode, the train control and the signalling system:-
 - accelerate and decelerate the train by applying traction power, coasting and applying and releasing brakes;
 - Automatically control speed, acceleration, and stop the train at stations;
 - Provide all indications necessary to operate the train;
 - determine continuously the maximum safe speed and limit of movement authority;
 - Prevent movement of the train in excess of the maximum safe speed and limit of movement authority
 - Open train doors on the correct side when the train is stopped if permitted by the Automatic Train Protection door release;
 - Prevent the train from starting if train doors are not detected closed;
 - train re-starting from a signal stop is automatic; and
 - Train starting or re-starting from a station stop is initiated by the Train Operator.

b) Coded Manual Mode (ATP)

- i. In Coded Manual Mode the train is driven by the Train Operator, obeying Cab Signals.
- ii. In Coded Manual Mode, the train control and signalling system-
 - provide cab signals and all other indications necessary to operate the train including current speed;
 - determine continuously the target speed and limit of movement authority;
 - prevent train operation in excess of the target speed or limit of movement authority;
 - provide audible and visual warning if the train speed exceeds the target speed or the maximum safe speed;
 - enable train doors when the train is stopped, enabling only the doors on the correct platform side of the train; and
 - Prevent the train from starting if train doors are not detected closed.

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c) **Restricted Manual Mode (RM)**

- i. The Restricted Manual Mode is the default mode of operation and is automatically initiated, when the automatic train control train borne equipment is first powered and it remains in operation until sufficient conditions have been met to allow for a transfer to Coded Manual Mode.
- ii. The Restricted Manual Mode is used-
 - to operate trains in depots;
 - following an emergency brake application on main line, and absence of cab signals;
 - for entry to and up to exit from the depot; and
 - on instructions from Traffic Controller.
- iii. In Restricted Manual Mode, the train speed is limited to a maximum of 25kmph enforced by on board Automatic Train Protection equipment.
- iv. The Train doors on the correct side will have to be operated manually by the Train Operator.

d) **Run on Sight Mode**

In Run on Sight Mode, which only operates in the absence of Automatic Train Protection signals from the track, the train is driven manually on line of sight and the speed is limited by Automatic Train Protection system to a maximum of 25 kmph. When Automatic Train Protection signals from track are received, this mode automatically changes to Coded Manual Mode.

26. **ATP Principle and details of Trackside ATP Equipments**

a. **Automatic Train Protection Principles**

- i. Line is divided into Fixed Blocks with coded Audio frequency track circuits(AFTC)
- ii. Train ahead causes a series of speed profile for the following train
- iii. Following train gets reduced target speed as it approaches the train ahead
- iv. Track side computers and beacons give accurate route map information
- v. On Board computer calculates the safe speed and distance
- vi. Train stops assured within the movement authority
- vii. When the first axle of the train occupies the track circuit, then the train detection happens and the AFTC sends continuously the telegram message to the Train. The same is picked by PUC (Pick up coils) attached on the under frame of the Train.

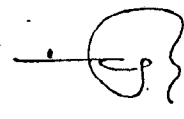
b. **Details of On – board ATP equipment**

i. **Beacon Antenna**

The beacon antenna is located on the driving trailer (DT) car bogie. The function of the beacon antenna is to ensure the data transmission between the trackside beacon and the on-board ATC cubicle.

ii. **Pick up coil**

The sensors are installed in front of the first axle (2 at each end of the train). They detect the signal transmitted in the rails by trackside Track Circuits.

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iii. **Odometer**

The odometer is located on the axle of the bogie. Its function is to acquire speed and displacement information of the train, for electronic processing by the on-board ATC Cubicle.

iv. **Cab display (DMI)**

The cab display is located on the driver desk at each extremity of the train. Its function is to display on a screen the driver's ATC information, to acquire on the integrated keyboard, the driver commands (as ROS request and acknowledgement), to generate sounds to warn the driver in different situations.

v. **On-board ATC cubicle**

The on-board ATC subsystem consists of:

- An electronic cubicle (one at each end of the train) with sockets, relays and cables ;
- An electronic rack, including its own power supply, which contains electronics boards and perform ATO and ATP functions.

c. Details of Trackside ATC EQUIPMENTS

i. **Trackside ATC cubicle**

The trackside ATC is based on 2oo3 platform. This platform architecture is based on parallelism calculation. Each channel are computing the same application in parallel and a system verifies that at least 2 channel are all right out of the three existing channels.

ii. **Beacons**

Beacons allows the on-board ATC to update its localization computation and to re-initialize the On-board ATC.

iii. **DLR (Down Link Receptor)** -The DLR beacon has only the downlink communication functionality from Train to Track for transmitting the Positive Train Identification.

27. Failures Scenarios and Degraded operations

a. **Track circuit failed**

- i. Train in ATP approaching such track; apply Emergency Brake (EB) in case the distance to stop is too tight.
- ii. TO informs the OCC that EB is triggered by ATP System and seeks Instructions from OCC.
- iii. Train Operator chooses "ROS" mode. Train is still protected and run at lower speed (25kmph). TO runs the train looking ahead for any obstructions. ATP apply EB if the speed of the train exceeds 25kmph in this case.
- iv. Train gets back to normal ATP with target speed, as soon as the train clears the failed track circuit and ahead is safe.
- v. Other trains in the line continue their movement, protected by ATP .

b. **Wayside Signal is controlled to "OFF", but LED is blank**

- i. Train in ATP still shows the target speed per availability of the track ahead and trains are protected by ATP. Train can continue to run. No impact on operations.
- ii. Only Trains in RM and ROS mode shall stop at the signal.

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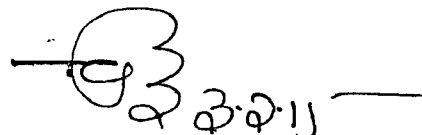
- c. **Wayside beacon is failed**
 - i. Train missing one beacon has no effect on ATP operations.
 - ii. Train gets de-localized if two consecutive beacons are failed. Then Train applies EB. TO then runs the train in ROS.
 - iii. Train gets back to normal ATP when the train passes over the next beacon.
 - iv. Other trains in the line continue their movement, protected by ATP.
- d. **Track side ATC failed**

No impact if one channel out of 3 channel fails.

 - i. If two channels are failed, then all trains in that ATC sector apply EB.
 - ii. TO runs the train in RM.
 - iii. Trains are protected by Interlocking with line side signals
 - iv. Other trains in the adjacent ATC sector continue their movement, protected by ATP.
- e. **On-board ATP failed**
 - i. Failure of single ATP (head side) cubicle has no effect on the operations. Other cubicle at Tail side is available for train to continue the movement in ATP.
 - ii. ATP will not be available in case of failure of both cubicles.
 - iii. Train can run in ATP Bypass mode. This would help the train to reach the next station with EMU monitoring the speed limit and applying EB in case of over speed.
- f. **ATS servers failed in OCC**
 - i. Failure of single sever has no effect on the operations.
 - ii. Failure of both servers can only stop the Automatic Route Setting operations. But
 - iii. Trains in ATP are still protected. Station Controllers can use the Local ATS to control the routes.
- g. **Local ATS servers failed**
 - i. Failure of single sever has no effect on the operations
 - ii. Failure of both servers can only stop the Route Setting operations
 - iii. Trains in ATP are still protected.
 - iv. Station Controllers can also use the Local VDU to control the routes.
- h. **Interlocking (CBI) failed**
 - i. Failure of single Computer Based Interlocking (CBI) cubicle has no effect on the operations. Hot stand-by system would be available.
 - ii. In case of Failure of both CBI, Train shall run in RM until at least one CBI is made available.

Signalling and Train Control System demonstrated during inspection on 25.01.2015.

- a. Inspected Automatic Train Supervision (ATS) work stations of Chief Controller, Traffic Controller, Fault Management Controller and Signalling system Video wall at OCC Theatre. Action to establish Direction of Traffic (DOT) through Traffic Controller's work station was shown.
- b. Inspected Telecom Equipment Room of OCC building.



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- c. Inspected Video wall of CCTV system in Security Controller Room :- Live video field from stations were shown.
- d. Inspected Communication System Supervisor (CSS) room. Briefed about the various Telecom Network Management System work stations commissioned. Play back of recording of Radio communication was verified.
- e. Train run was performed with TS#06 to check given below ATP tests:

Train Set	Location	Test Performed	Track Ckt No./ Mast No.	Remark
Train No. # 6	Moved towards NAMT DN P/F from MSOR	Over speed protection	TC 41F	Full Service Brake and alarm (FSB) triggered when TO over speed the train from target speed.
Train No. # 6	Moved towards NAMT DN P/F from MSOR	Safety Margin distance between two trains.	TC 45F	Train TS#1 stabled at NAMT Down Platform. Emergency Brake triggered on TS#6 on approach of NAMT by on board ATP system and it stopped approx. 30 meter before TS#1 (short of DN platform).
Train No. # 6	NAMT-VKVR	Over Speed/EB	120 to 124	On over speeding beyond the Service Brake limit, Emergency Brake (EB) triggered and train stopped. TO explained the reason of EB to Traffic Controller (TC) at OCC via train radio and moved further as per instruction from OCC.
Train No. # 6	VKVR DN P/F	Door authorisation failure	TC 57F	Doors not opened as train stopped approx. 5 meter before the Normal Stopping Point. No indication appeared on Door enabled left indicator. TO explained the reason via radio to TC and further moved it to Normal stopping Point.
Train No. # 6	VKVR DN P/F	Door authorisation when train docked in Normal stopping Point window.	TC 57F	Doors opening indication appeared, and doors opened by the TO.
Train No. # 6	VKVR - SMNR	TSR	61F - 63F	TSR of 35 Kmph implemented by Traffic Controller from OCC.

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Train Set	Location	Test Performed	Track Ckt No./ Mast No.	Remark
				On Driver Machine Interface Console (DMI) inside Cab, Target speed of 30 Kmph appeared and train was allowed to move by ATP within this speed. Beyond 30kmph, the Emergency Brake was applied.
Train No. # 6	VKVR - SMNR-RMNR	<p>1.Beacon missed (Two consecutive beacon missed) On entry to Shyam Nagar station</p> <p>2..Movement in Run on Sight (ROS) driving mode.</p> <p>3.Emergency Braking in ROS mode.</p>	TC-63F TC 69F	<p>1.When first beacon missed, nothing happened and train moved in ATP mode but got delocalised when two consecutive beacons were missed. Emergency Brake was triggered by ATP.</p> <p>2..To explain the reason via radio to TC and after exchanging private nos. with OCC, further moved in ROS by pressing ROS soft key on DMI. Target speed on DMI restricted to 25 Kmph by ATP.</p> <p>3. When TO touched the maximum speed of 25 Kmph, EB activated by ATP system and train stopped.</p>
Train No. # 6	SMNR - RMNR	On Board ATP redundancy		Train moved toward RMNR in ATP mode with local ATC cab active. It was stopped and in active ATC cubicle, "DISTANT" mode was selected i.e. rear ATC cab got active and train moved in ATP mode with rear ATC functional.
Train No. # 6	RMNR DN P/F	Correct stopping & Door authorisation	TC 17G	Door authorisation was on correct side. TO highlighted these functions to CRS.

MM	-	Millimetre
MMD	-	Maximum Moving Dimension
NA	-	Not Applicable
O&M	-	Operation and Maintenance
OCC	-	Operation Control Centre
OEM	-	Original Equipment Manufacturer
OHE	-	Over Head Equipment
POH	-	Periodic Overhauling
RDSO	-	Research Design and Standards Organization
RM	-	Restricted Mode
ROS	-	Run On Sight
SOD	-	Schedule Of Dimensions
TCMS	-	Train Control & Management System
TM	-	Traction Motor
TO	-	Train Operator
TSR	-	Temporary Speed Restriction
V	-	Volt
VCB	-	Vacuum Circuit Breaker
VCD	-	Vigilance Control Device
VDU	-	Visual Display Unit
WC	-	Western Circle

Handwritten notes:
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