Technical Standards for the Metrorail in Bangladesh

Dhaka Transport Coordination Authority (DTCA)

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Preface

The Technical Standards for Metro-Rail has been formulated with a view to developing smooth transits, increase efficiency and improve the quality of passenger service. Moreover, the Technical Standards shall apply to the Metrorail in Bangladesh while considering safety, economics, convenience, comfort and other factors of basic standard concerning Metrorail.

In exercise of the powers conferred by section 15(2) of the Metrorail Act, 2015 (1 of 2015), the Governing Council of Dhaka Transport Coordination Authority (DTCA) has approved the Technical Standards for the Metrorail in Bangladesh in its 3rd decision of the sixth Governing Council meeting dated May 28, 2015.

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I. GENERAL PROVISIONS

1. General Provisions

1.1 Objective

The intent of these technical standards (hereinafter "Standards") is to contribute to the development of Metrorail through aiming to promote smooth transits, increase efficiency and improve the quality of passenger services while considering securing safety, economics, convenience, comfort and other factors by establishing basic standards concerning Metrorail which a mass transit to be introduced in Bangladesh.

1.2 Scope of Technical Standards

This Technical Standards shall apply to the Metrorail in Bangladesh.

1.3 Prevention of Danger

Construction work shall be carried out carefully so as not to threaten lives by in the carrying out of grading, earth cutting, excavation, embankment, drilling piles and so on.

1.4 Measures to be Provided for Smooth Transport of the Elderly and the Handicapped

The passenger facility shall have facilities and equipment for elderly and the handicapped.

1.5 Implementation Standard

A Metrorail Operator shall set a standard (hereinafter referred to as "implementation standard") to implement this standard and abide by that standard.

2. Terms and definitions

1.6 Terms and definitions

In these Standards the following words or expressions shall have the meanings hereby assigned.

(1) "Main track" means the tracks on which trains are regularly operated.

(2) "Side track" means the tracks that are not classified as a main track.

(3) "Gauge" means the shortest distance between rail heads when measured within 16 mm from rail head surfaces.

(4) "Curve Incidental to Turnout" means the curve created before or after the curve within the turnout because of installation of the turnout and provision of the curve in the turnout.

(5) "Design Maximum Speed" means the maximum speed specified in the basic business plan while taking the future transportation system into consideration, and specifically means the maximum speed used as the design criterion for radius of curvature for main track, gradients and width of formation level, etc.

(6) "Cant" means the arrangement making the outer rail higher than the inner rail to prevent derailment occurring due to the centrifugal load when rolling stock pass through a curve.
(7) "Gauge Widening" means the arrangement to slightly increase the inside rail on a curve or turnout to enable rolling stock to pass through the curve as smoothly as possible.
(8) "Buffer Stop" means the device installed at the edge of tracks to prevent a train or rolling stock from overrun, or derailment.
(9) "Scotch Block" means the device installed on the side track to prevent the stopped rolling stock from moving by itself.
(10) "Station" means the place used for passengers getting on and off the vehicle
(11) "Signal station" means the place that is used exclusively to allow trains to pass each other or wait for each other.
(12) "Railway station" means station and signal station
(13) "Halt" means those without routes inside the station and starting routes in sections implementing ATC methods among stations
(14) "Rolling stock" means electric cars and special kinds of cars (which means track testing cars, electric testing cars, accident relief cars and cars with other special structures or equipment) that are used for the railways business
(15) "Train" means railway transportation equipment constituted by rolling stock for operation on tracks outside of the stations
(16) "Sheds" means places to be exclusively used for containing rolling stock
(17) "Motive power car" means rolling stock with power units
(18) "Continuous brake" means equipment that enables applying brakes on all rolling stock at once by the driver's operation through brake pipes penetrating the front part of coupled rolling stock or through wire to control brakes, and apply emergency brakes automatically when coupled rolling stock separate.
(19) "Brake axle ratio" means ratio of the number of break axles (total number of axles that brakes apply among the number of coupling axles) against the number of coupling axles (total number of axles of rolling stock made up as train) as 100
(20) "Cab signal" means signal devices that indicate signal aspects consistently within the rolling stock.
(21) "Automatic Train Control (ATC)" means equipment with functions to indicate signal aspects on cab signals and automatically lower the speed of trains or rolling stock depending on the distance between preceding trains and route conditions.
(22) "Centralized Train Control (CTC)" principally means controlling signal devices and switches in stations in a centralized manner at an operation control center, and conducting operation management of trains, etc.
(23) "Railway signals" means signals, signs and indicators.
(24) "Signal" means those that indicate conditions when operating trains or rolling stock to officials.

(25) "Sign" means the action by officials that indicates the intention of a sign giver to the counterparty.

(26) "Indicator" means those that indicate the location of things, direction, condition, etc., to the officials.

(27) "Tunnel" means underground structures which consist of underground stations and between stations.

(28) "Metrorail" means town based rail system where there shall be a dedicated right of way with underground, elevated or at grade rail track.

(29) "Dhaka Transport Coordination Authority (DTCA)" means the transport coordination authority of Dhaka.

(30) "Aptitude" means the physical and mental ability.

II. OFFICIALS IN CHARGE

2.1 To Secure Safety in Operation

When operating a train, etc., officials in charge (hereinafter "officials") shall strive to secure safety by comprehensively utilizing their knowledge, skills and operation related facilities.

2.2 To Keep Knowledge and Skills

Officials shall have sufficient knowledge and skills to operate trains or rolling stock safely.

2.3 To Supervise Officials

A Metrorail Operator shall supervise officials appropriately, such as requesting them to report or giving them instructions on matters necessary for operation before getting onboard, while operating trains and other suitable times.

2.4 Education, Training, etc. of Officials

2.4.1 Metrorail Operators shall provide the officials engaged in work directly related to the operation of trains, etc., and officials who carry out maintenance and other related work on facilities and rolling stock with education and training so that they gain knowledge and skills necessary for their work.

2.4.2 Metrorail Operators shall confirm that officials engaged in work directly related to the operation of trains, etc., have the aptitude, knowledge and skills necessary for their work.

2.4.3 Metrorail Operators shall not allow the officials to do their work when the officials engaged in work directly related to the operation of trains, etc. is recognized to be in a condition unable to fully utilize one's knowledge and skills.

2.4.4 "The officials engaged in work directly related to the operation of trains, etc.," in the above items shall have the meaning given in the following items.

(1) The officials who drive a motive power car (hereinafter "driver");

(2) The officials who conduct railway traffic operation arrangements such as changing the operating order of trains, changing the locations where trains pass each other and cancelling operations (hereinafter "traffic dispatcher");

(3) The officials boarding trains for train protection, to conduct brake operation or making signs necessary for train operation (hereinafter "conductor");

(4) The officials who control and block routes for trains, etc., handle railway signals, and also operate switches;

(5) The officials who conduct work directly related to the operation of trains due to maintenance, construction and such of railways, contact lines or train protection equipment, or the officials who direct and supervise such work

2.4.5 "The officials who carry out maintenance and other related work on facilities and rolling stock" in paragraph 1 shall mean the following. In the case where Metrorail Operators

commission "maintenance and other related work on facilities and rolling stock" to outside, officials belonging to the commissioned operators shall be included in the officials.

(1) The officials engaging in maintenance service for structures, railways and buildings;

(2) The officials engaging in maintenance service for electric equipment and train protection equipment;

(3) The officials engaging in inspection and repair work of rolling stock;

(4) The officials who directly conduct operation to open/close machinery in electric equipment.

2.5 To have a Driver Onboard, etc.

2.5.1 A driver shall be onboard a train.

2.5.2 A driver shall possess a driver's certification specified by a Metrorail Operator; provided, however, that this shall not apply in the following case.

(1) When an apprentice driver operates a motive power car under the instruction of another certificated driver onboard.

2.5.3 The drivers shall not board trains in a state in which there are concerns that they are unable to operate normally under the influence of drugs, etc.

III. CIVIL

1. General Provisions

The civil work shall conform to the design requirements set out in this standard which is the minimum prescribed.

2. Civil Structures

3.1 Design requirement for civil structure

Structures such as earthwork, bridge, and tunnel shall be able to withstand the anticipated load. They shall also be free from any impediment for the safe car operation like the deviation of structures caused by the load and impact of the train.

3.2 Design life

The design life required for civil structure shall be obtained by the use of durable, corrosion protection, resistance to or avoidance of wear etc.

3.3 Codes and standards

The civil design and construction work shall conform to the internationally recognized codes and standards. The following codes and standards shall be applicable:

(i) Design Standards for Railway Structures (issued in Japan)

(ii) AASHTO (American Association of States Highway and Transportation Officials) Specification

(iii) BS (British Standard)

(iv) IRC (Indian Railway Code)

(v) Any other internationally recognized codes and standards

3.4 Seismic design

Civil structures shall be designed for earthquake resistance. Seismic load shall be followed with "Bangladesh National Building Code (BNBC)". The seismic analysis shall be designed in accordance with the internationally recognized codes and standards.

3.5 Design loading

The structure shall be analyzed for the specified loads and effects to obtain the most severe combination of forces on every component member. The method and sequence of construction shall be clearly specified, and taken into account in the design. For the purpose of computing stresses and deformations, the following loads and consequential effects shall be taken into account as applicable:

(1) Dead loads;

(2) Super imposed dead load;
(3) Live loads;
(4) Dynamic effects;
(5) Forces due to curvature or eccentricity of track;
(6) Temperature effects;
(7) Frictional resistance of expansion bearings;
(8) Longitudinal forces;
(9) Long welded rail forces;
(10) Centrifugal forces;
(11) Wind pressure effect;
(12) Forces and effects due to earthquake;
(13) Erection forces and effects (Construction Stage Safety check);
(14) Drying shrinkage of Concrete;
(15) Concrete creep;
(16) Differential Settlement; and
(17) Other loads

3.5.1 Loading Combination

The various combinations of loads and effects to which components of the structures can be subjected are given in using design standard (refer to clause 3.3). Each component of the structure shall be designed for all applicable combinations of these loads and effects.

3.5.2 Train loading

The train loading shall be guided by the selected rolling stock parameters. In case of the design of structures for only electric-car line, the load pattern "M-16"as shown Figure 3.1 may be applied. The nominal loading for the design of members shall comply fully loaded trains with individual cars each having four axels of 16 tons and 20 m overall length. This load pattern shall be placed at the most critical position to generate maximum stress for the part of structure considered.

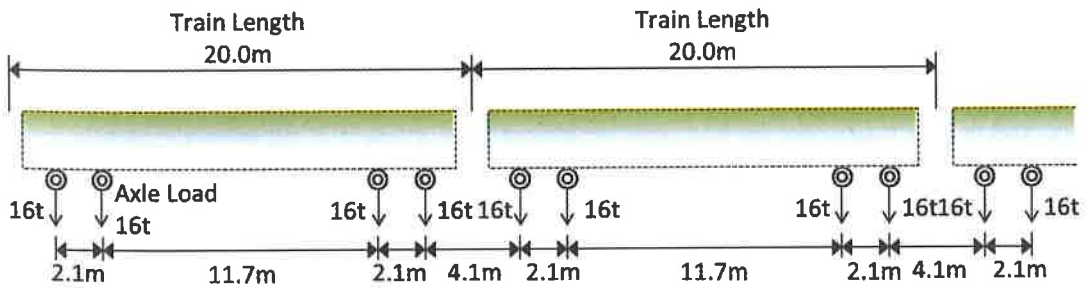


Fig.3.1Load pattern "M-16"

3.6 Bearings

Bearings shall conduct the load definitely from superstructures to substructures, and also shall have strong enough for all sorts of loadings such as dead load, live load, temperature effects, drying shrinkage, concrete creep, earthquake and wind. Durability for degradation factor by dust and storage water shall be examined and facility for construction, maintenance and repair shall be considered in the design of bearing.

3.7 Environmental consideration

The design and works of civil structures shall conform to the Bangladesh environmental standards, codes and regulations.

3.7.1 Prevention of heavy noise

A Metrorail operator shall strive to prevent heavy noise to be generated with the movement of a train. A Metrorail operator shall comply with the acts and regulations issued by the government of Bangladesh.

3.8 Cable Duct

Ducts for lying electrical, signaling and telecom cables provision shall be considered in the design of the deck.

3.9 Drainage arrangements

Properly designed drainage scheme for the elevated guide-way structure, stations and concourse and depot shall be provided. All drains shall be of adequate size as per hydraulic calculations and shall be connected to the nearest underground drainage facilities or discharge facilities.

3.10 Precautions against flooding

Mitigating measures shall be taken in areas where flooding is likely to occur. In order for the rail track structure not to be disturbed by flood water, the top of the embankment shall be above the maximum flood water elevation at Depot area and grade structure.

3.11 Facilities for the prevention of a disaster

Facilities or devices to prevent or detect any fallen or falling objects shall be installed at the cut sections where traffic on the line may be impaired as a result of an object dropping onto the track, or entrance of tunnels.

At stations and tunnels, relevant facilities or devices shall be installed to prevent immersion and also drain appropriately if needed.

3.12 Protection of the area under bridge beams

Bridges that span the busy road, guide way or rivers and could constitute a hazard to the traffic beneath them shall be equipped with the protective devices to prevent any danger to those that pass under these bridges.

If overhead bridges spanning the busy road or river are vulnerable from the impact of the automobiles and ships underneath, they shall be equipped with relevant protective devices to minimize the impact from them.

3.12.1 Vertical clearance below deck

The minimum vertical clearance available below soffit of beam structure on the road shall be 5.5 m and / or as relevant codes of traffic authorities.

3.13 Evacuation Facilities

Railway track shall be built to provide safe on foot evacuation for passengers in case of emergency. This rule, however, does not apply if adequate evacuation facilities are provided depending upon the rail structure.

3.14 Inspection and trial operation of facilities

Newly installed, reconstructed, renovated or repaired tracks and electric facilities shall not be used unless inspection and test run are completed. Test run may be omitted, however, for track and electric facilities that have been slightly reconstructed or repaired and also for side tracks that do not seem to impair the main track.

When the track and electric facilities were suspected of faulty because disaster and other operation accidents took place, and also the track and the electric facilities that have not been used for a while are to be used for train operation, the relevant track and electric facilities shall be inspected in advance and test run shall be conducted wherever and whenever necessary.

3.15 Patrol inspection and monitoring of main track

Patrol inspection shall be conducted for the main track and overhead contact line installed over the main track, according to the situation of the section block and traffic conditions of trains. When a possibility of disasters that can interfere with the safe train operation on the main track is found, the relevant track shall be carefully monitored.

3.16 Periodic Inspection of civil structures

Periodic Inspection shall be enforced every period as shown Table 3.1.

Table 3.1 Period of inspection

Structures	Period of Inspection
Elevated structure	2 years
Building for operation	2 years

3.17 Irregular inspection

In case of check the damage of civil structures by the weather disaster, car crash or the like, irregular inspection shall be enforced.

3.18 Records

All the records of inspections, conversions, renovations and repairs of the civil facilities shall be kept for the pre-determined period of time. Also, all the records of the deformations of bridges, tunnels, and other structures shall be kept in such manner that the history of such deformations can be understood.

IV. TRACK

1. Alignment and Basic Structure of Track

4.1 Gauge

The standard gauge (1,435mm gauge) shall be used.

4.2 Track Alignment

The curve radius (excluding curve incidental to turnout) and the gradient of the main track shall be determined so as to attain the maximum design speed, in consideration of the performance of the rolling stock and other factors. This does not apply, however, to those cases where there are unavoidable circumstances due to topographical conditions or other restricting factors.

4.3 Radius of Curvature

4.3.1 Radius of curve shall be able to ensure the safe running of trains, in consideration of the characteristic of the rolling stock, such as curve passing performance, running speed, and the other relevant factors.

4.3.2 The minimum curve radius on the main track (excluding curve incidental to turnout) shall be 400m in response to the design maximum speed of 110 km/h.

4.3.3 Regardless of the provision in the preceding article, the minimum curve radius of the main track may be 160 m, in cases where there are unavoidable circumstances due to topographical conditions or other restricting factors.

4.3.4 The minimum radius of the curve incidental to turnout on the main track shall be 160m. However, in cases where there are unavoidable circumstances due to topographical conditions or other restricting factors, the minimum radius of curvature may be set to100m.

4.3.5 Radius of curvature along a platform on the main track shall be set to 400 m or greater.

4.4 Length of Straight Line between Curves

4.4.1 The minimum straight line between two transition curves on the main track shall be set greater than the largest vehicle length.

4.4.2 Regardless of the provision in the preceding article, in case that the straight line cannot be set as specified by unavoidable circumstances due to topographical conditions or other restricting factors, any of the following measures may be taken.

(1) Direct connection of the two transition curves

(2) Curve diminishing of cant on two transition curves

4.5 Length of Circular Curve

(1) The length of the circular curve shall be set greater than the largest vehicle length. This does not apply, however, to curves inside a turnout.

(2) In cases where the circular curve cannot be set as specified by unavoidable circumstances due to topographical conditions or other restricting factors, the provision in article 4.4.2 shall apply mutatis mutandis.

4.6 Cant (Super elevation)

4.6.1 Cant provided to the circular curve shall be determined in consideration of the centrifugal force exerted on the rolling stock during traveling. The value calculated by following formula shall be set as a standard. This does not apply, however, to the curve incidental to turnout or the like where there is no danger of the train overturning due to speed restricting.

$$C_0 = 11.3\frac{{V_0}^2}{R}$$

Where, C_0, V_0 and R represent the following values.

C_0: Actual Cant (mm)

V_0: Average speed of the train passing through the relevant curve (km/h)

R: Curve radius (m)

Maximum cant value shall be less than the value calculated by following formula.

$$C_m = \frac{G^2}{6H}$$

Where, C_m, G and H represent the following values.

C_m: Maximum cant value (mm)

G: Gauge (mm)

H: Height between surface of rail and vehicle gravity (mm)

Allowance cant deficiency shall be determined in response to curve passing speed. The value calculated by following formula shall be set as standard.

$$C_d = 11.3\frac{V^2}{R} - C_0$$

Where, C_d, V, R and C_0 represent the following values.

Cd: Allowance cant deficiency (mm)

V: Speed of the train passing through the curve (km/h)

R: Curve radius (m)

C_0: Actual cant (mm)

4.6.2 In cases where a transition curve is provided, the cant shall be stepped down along the whole length of the transition curve. In cases where no transition curves are provided (excluding the case where two circular curves in the same direction are connected), the cant shall be stepped down in the adjacent tangent section with a length over 300 times the cant.

Further, when the curve diminishing of cant is taken, the cant degression slope shall not exceed 1/300.

4.6.3 In cases where two curves in the same direction connect without intermediate transition curve, the cant difference between two curves shall be stepped down in the larger radius curve section. The length of cant degression shall be set at least 400 times of the cant difference.

4.7 Gauge Widening (Increasing of the distance between rails)

Gauge widening shall be determined as following descriptions, in consideration of curve radius, wheelbase, the number of axles and other such factors of the rolling stock traveling on said curve section.

4.7.1 Gauge widening shall not exceed the value calculated by following formula.

$S_{max} = 1000(B^2/(2R)) - \eta$

Where, S_{max}, B, R and η represent the following values.

S_{max}: Maximum value of Gauge Widening (mm)

B: Maximum wheel base of the rolling stock traveling on the said curve (m)

R: Curve radius (m)

η: Movable allowance between wheel and rail (mm)

Regardless of the above provision, the maximum value of gauge widening shall be 25 mm.

4.7.2 Gauge widening shall be gradually decreased in accordance with the following criteria

(1) In case where a transition curve is provided, gradual decreasing shall be carried out along its entire length.

(2) In case where the transition curve is not provided, gauge widening shall be gradually decreased in the adjacent section, of which the distance from the beginning or the end of the circular curve is equal to or greater than the maximum wheelbase of the rolling stock traveling on said curve. This does not apply, however, to curves inside turnout.

4.8 Transition Curve

Transition curve shall be provided between straight line and circular curve or between two circular curves to secure the safe train operation. This does not apply, however, to curves incidental to turnouts, circular curves with small cant, and other cases where preventive measures, such as speed restriction, are taken.

The length of transition curve shall not be less than the value calculated by the following formula.

$L = 0.4\ C_m$

Where, Land C_m, represent the following values.

L: Transition curve length (m)

C_m: Actual cant (difference between two actual cants when the transition curve is provided between two circular curves: mm)

When curve diminishing of cant is taken, the length of the transition curve shall be so determined that the maximum cant degression slope is 1/300.

4.9 Gradient

The maximum gradient of the track in traveling areas and stopping areas (including parking areas and areas for coupling and decoupling the rolling stock) shall be determined in consideration of the performance of motive device, braking device, operation speed and other such factors of the rolling stock.

4.9.1 The maximum gradient in the traveling areas for trains shall be 35/1,000

4.9.2 The maximum gradient in the stopping areas shall be 5/1,000. However, it may be 10/1,000 in the areas not used for parking or coupling/decoupling of the rolling stock, but only if there is no possibility of interference with train departure and arrival.

4.10 Vertical Curve

4.10.1 Vertical curve shall be provided wherever a gradient changes to secure the safe train operation, in consideration of operation speed and structure of the rolling stock. The radius of a vertical curve shall not be less than 2,000m (3,000m when the horizontal curve radius is not greater than 600m). However, where the change of gradient is smaller than 10/1,000, vertical curves may be omitted.

4.10.2 The combined use of a vertical curve and a transition curve shall be avoided as far as possible.

4.11 Structure Gauge

Metrorail Operator shall specify a structure gauge and make sure not to build buildings or other structures within it. Fig. 4.1 shows a standard drawing of structure gauge for tangent track.

4.11.1 Clearance in widthwise, between structure gauge and basic rolling stock gauge at the sides of the windows in tangent track, shall be greater than 400mm (200 mm is limited to rolling stock having a structure that prevents a passenger from extending his/her body out of the windows). In platform section, clearance between structure gauge and rolling stock gauge at upward and the side of the platform shall be greater than 50mm.

4.11.2 Even within the basic structure gauge, certain constructions can be built if they are necessary for the train operation or the maintenance of railway facilities and if there is no possibility of impeding the safe running of trains. In such a case, this shall be stipulated in the structure gauge provisions.

4.11.3 Structure gauge at a curve (including the structure gauge for platforms along curves) shall be increased, according to the deviation of the rolling stock, by adding the values calculated by the following formula to both sides of the structure gauge at a tangent track, and shall be slanted corresponding to the cant. However, if the amount of deviation due to the curve radius is substantially smaller than the clearance between the structure gauge and the

basic rolling stock gauge, the increase of the structure gauge at a curve according to the deviation may be omitted, with the exception of the platform.

(1) Deviation towards the inside of curve W_1

$$W_1=R-\sqrt{\{(R-d)^2-(L_1/2)^2\}}$$

$$d=R-\sqrt{\{(R)^2-(L_0/2)^2\}}$$

(2) Deviation towards the outside of curve W_2

$$W_2=\sqrt{\{(R+B/2-W_1)^2+(L_2/2)^2\}}-R-B/2$$

Where, L_0, L_1, L_2, B, R, W_1 and W_2 represent the following values respectively.

L_0: Wheelbase (m)

L_1: Distance of fixed axles of bogie (m)

L_2: Length of rolling stock (m)

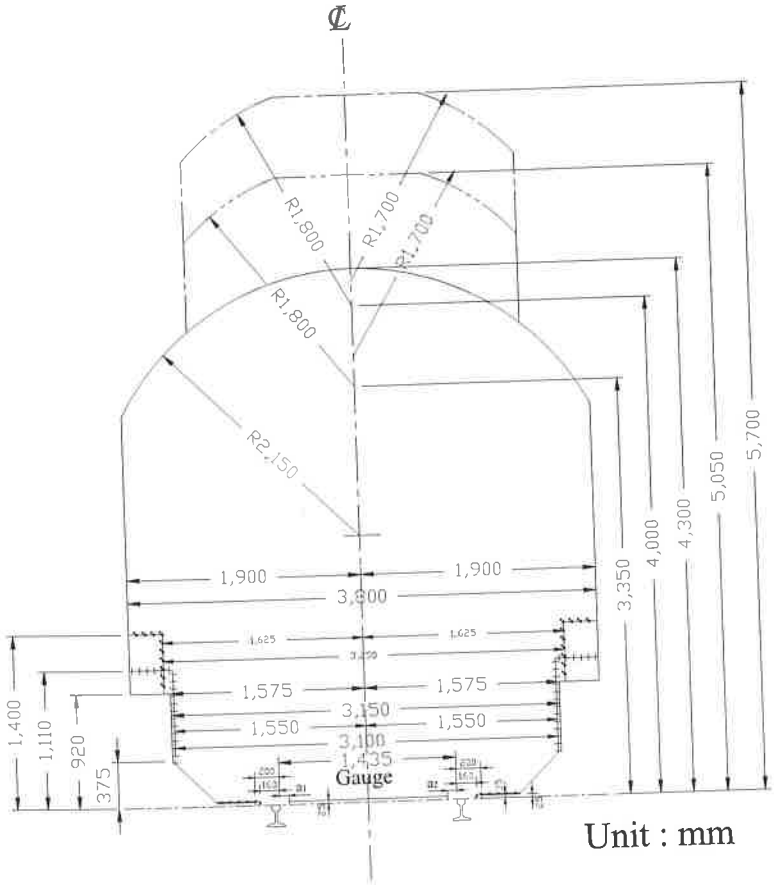
B: Width of rolling stock (m)

R: Curve radius (m)

W_1: Deviation toward the inside of the curve (m)

W_2: Deviation toward the outside of the curve (m)

4.11.4 Structure gauge on the section from the end of a circular curve (where two transition curves are connected directly, the point of the connection, hereafter the same) to a point outside the end of the transition curve (where there is no transition curve, the end of said circular curve) for the length of the longest rolling stock traveling on said line, shall be determined by gradually decreasing the value, calculated by the provision in preceding article, that should be added at the end of relevant circular curve, and adding it to both sides of the structure gauge at a tangent track.



Basic structure gauge

Structure gauge for those other than overhead contact lines, their suspension equipment, and insulated reinforcing materials on railway tracks operated with DC electric power supplied through contact lines.

Structure gauge required for those other than overhead contact lines, their suspension equipment and insulated reinforcing materials in tunnels, bridges, over bridges, and platform roofing as wellas the sections before and after those structures on railway tracks operated with DC electric power supplied through overhead contact lines.

Structure gauge for platform

Structure gauge for signals, markers, signs, and special tunnels and bridges

Structure gauge for run-over type turnouts

Structure gauge for shunt and crossing

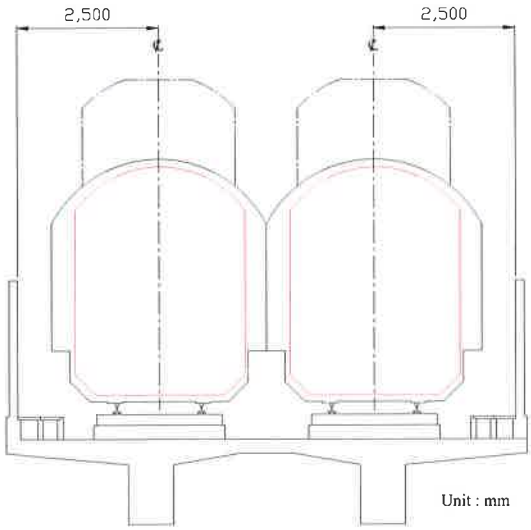
Fig. 4.1 The standard drawing of structure gauge for straight lines

4.12 Width of Formation Level

4.12.1 Formation width is the distance from the center of the track to the outer edge of formation level. Formation width shall be appropriately set to maintain the function as a railway track in response to the track structure. Also it shall be able to provide enough space for crew to take shelter when a train is approaching. Formation width at tangent track shall be 2.50 m or greater. However, this can be reduced if there is no hindrance in consideration of the track structure, sheltering area, and other factors.

4.12.2 Formation width at curve section shall be widened the width of tangent track specified the provision in preceding article, according to the deviation of rolling stock and the amount of cant.

4.12.3 In the sections of ballast-less bridges, tunnels, or other fields where it is difficult to provide sufficient formation width for the crew to take shelter, sheltering bays shall be provided in consideration of the traveling speed of the train and other factors. The sheltering bays shall be set every 50 m.



Unit: mm

Fig. 4.2 Example of the Formation width

4.13 Distance between Track Centers

4.13.1 Distance between track centers at a tangent track of the main track shall not be less than the maximum width of the basic rolling stock gauge plus 600 mm. However, the said distance shall not be less than the maximum width of the basic rolling stock gauge plus 400 mm on lines where vehicle for train operation is limited to the vehicle having a structure that prevents passengers from extending any part of their bodies from the windows. In addition, in case that sheltering area is provided between the tracks, the distance specified in the above shall be increased by 700 mm or grater.

4.13.2 Distance between track centers at a curve section shall be increased by the value corresponding to the deviation of rolling stock to the distance specified by the provision in preceding article.

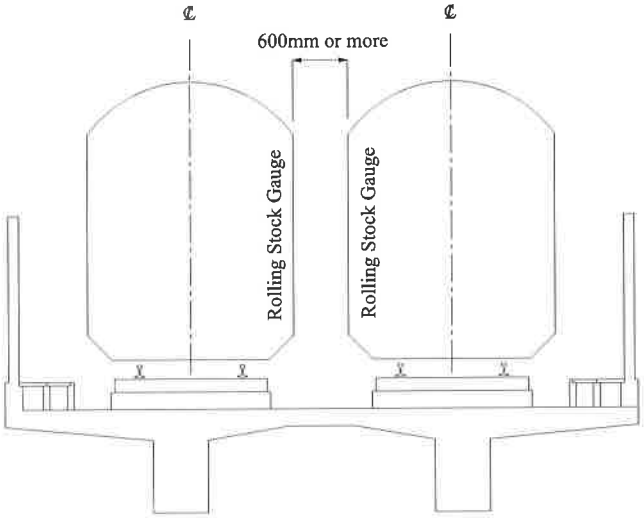


Fig. 4.3 Example of Distance between Track Centers

4.14 Structure of Track

4.14.1 Railway track shall conform to the structure of a rolling stock and shall be able to guide the train to a specified direction. Also railway track shall withstand the anticipated load.

4.14.2 Several types of permanent deformation are generated in various parts in railway track, such as irregularity of gauge, irregularity of cross level, longitudinal level irregularity, alignment irregularity and twist fault, because the train load is applied repetitively. However, railway track shall not deform to jeopardize the safe train running.

4.14.3 Railway track shall not impede the maintenance of railway.

4.14.4 The weight of the rail used for the main track shall be 50kg/m or more.

4.15 Structure of Turnout

4.15.1 Turnout shall not impede the safe train running.

4.15.2 Turnout shall not be installed on transition curve or vertical curve section.

4.15.3 Turnout shall not be installed on a ballast-less bridge.

4.15.4 Turnout shall not be installed behind the abutment of a bridge. This does not apply however, to cases where there are topographical restrictions and when additional measures of reinforcing the roadbed have been taken.

2. Safety Equipment

4.16 Guardrail

Protective devices shall be installed to prevent derailment or to minimize the consequence of derailment, at those critical areas where derailment could be a possibility and/or the damage of derailment could be detrimental.

4.17 Prevention of Rolling Stock Overrun, etc.

Protection devices as following descriptions shall be provided at locations where there is a risk of rolling stock overrun or a train leading to dangerous situation.

4.17.1

At a point where the main tracks or important side tracks intersect with each other at the same ground level or branch from each other, and there is a possibility of them interfering with each other, a refuge siding shall be provided. This does not apply, however if equipment that can automatically stop a train in conjunction with a signal indication of the main signal at the starting end of the line section concerned is provided, or if any of the following cases is applicable.

(1) If a warning signal are provided with another main signal on the outer side of the main signal at the starting end of said line section

(2) If the length of the track from the main signal (or from the train stop indicator in case where a train stop indicator is provided) at the starting end of said line section to the clearance post of the track or the tongue rail of the facing turnout (excluding turnouts for the refuge siding) is at least 100m

4.17.2 The facilities, as following descriptions, shall be provided at the end of the track.

(1) At the end of a refuge siding or a track where there is a risk of a serious damage occurring, a car stop made of heaped gravel or other car stop that has a cushioning effect that is at least as good as that of heaped gravel shall be provided according to the estimated approach speed of a train and its weight.

(2) At the end of a track line other than the lines mentioned in preceding paragraph (1), a car stop for stopping rolling stock at its body or coupler shall be provided.

(3) At a location on a side track where two lines are connected together or intersect each other, a derailing switch or a stop block shall be provided.

4.18 No trespassing to Guide Way and Protection of Guide Way

4.18.1 To those areas where there is a possibility of trespassing, if needed, adequate preventive devices shall be installed or "danger" sign shall be displayed.

4.18.2 Facilities or devices to prevent or detect any fallen or falling objects shall be installed at the cut sections where traffic on the line may be impaired as a result of an object dropping onto the track, or entrance of tunnels.

4.19 Evacuation Facilities, etc.

Railway track shall be built to provide safe on foot evacuation for passengers in case of emergency. This does not apply, however, if adequate evacuation facilities are provided depending upon the rail structure.

4.20 Crossing another Railway

Train level crossing shall be avoided. This does not apply, however, to the station yard where the appropriate protective devices are provided.

4.21 Intersection with Road

Railway shall not intersect with roads at grade (Roads here mean the roads used by the general public traffic. The same definition shall apply hereinafter.). This does not apply, however, to the line where traffic volume at rail crossing is small or where it is difficult to make a separate crossing due to topographical conditions.

4.22 Level Crossing

Level crossing roads shall be provided with appropriated consideration for the safe and smooth passage of people and automobiles (hereinafter referred to as "level crossing road passengers, etc."). Level crossing roads shall conform to the following criteria.

4.22.1 The angle of intersection between the railway and the road must be at least 45 degrees.

4.22.2 A warning sign and crossing gate shall be provided.

A warning device shall be provided, in cases where the number of train operation and road traffic are extremely small or where it is extremely difficult to construct the crossing gate due to technical aspects.

3. Sign Posts

4.23 Wayside Posts

The following wayside posts shall be provided on a main track in order to ensure that tracks are appropriately maintained and trains can run safely.

(1) Clearance post
(2) Distance post
(3) Curve post
(4) Grade post

4. Maintenance of the Railway Facilities

4.24 Maintenance of the Railway Facilities

(1) Rail track shall be maintained in an appropriate condition to provide a safe train operation at the designated speed.

(2) In case the main track is not in the condition described in the preceding paragraph temporarily, necessary measures including speed restriction shall be taken to maintain a safe train operation. Those sections that need special attention shall be carefully monitored.

4.25 Inspection and Test operation for Newly-built facilities

(1) Newly installed, reconstructed, renovated or repaired tracks shall not be used unless inspection and test run are completed. Test run may be omitted, however, for track that have been slightly reconstructed or repaired and also for side tracks that do not seem to impair the main track.

(2) When the track facilities were suspected of faulty because disaster and other operation accidents took place, and also the track facilities that have not been used for a while are to be used for train operation, the relevant track facilities shall be inspected in advance and test run shall be conducted wherever and whenever necessary.

4.26 Track patrol and watched for Main line

(1) Patrol inspection shall be conducted for the main track, according to the situation of the section block and traffic conditions of trains.

(2) When a possibility of disasters that can interfere with the safe train operation on the main track is found, the relevant track shall be carefully monitored.

4.27 Periodic Inspection of Facilities

A pertinent cycle, item and method of periodic inspection for main track facilities shall be determined according to their types, structure and usage, in advance. Periodic inspection shall be carried out within every 1 year.

V. ARCHITECTURE

1. General Provisions

5.1 Architectural buildings

Architectural buildings including station facilities and access for passengers shall withstand the anticipated load and shall not impair the safe train operation and safe utilization by passengers.

5.2 Design standards

Bangladesh's existing standards regarding the buildings with station facilities and including fire extinguishing facilities shall be applied, if it can be useful.

5.3 Station facilities

Station facilities shall include platforms, facilities for passenger flow (passageways, concourses, stairs, passenger's overpasses, lifts, escalators, etc.), facilities for serving passengers (ticket offices, gates), queue facilities (ticket offices, waiting rooms), business facilities (station office), toilets, lighting facilities, information facilities (guidance signs, location signs, information signs, regulation signs, etc.) and so on.

2. Platform facilities

5.4 Platform facilities

5.4.1 Distance between the edge of the platform and pillars on the platform must be 1.0m or greater.

5.4.2 Distance between the platform edge and the entrance of passenger's overpasses, underground passages, waiting shelters, etc. on the platform must be 1.5m or greater.

5.4.3 The provisions in preceding articles 5.4.1 and 5.4.2 does not apply to a platform provided with platform screen doors or other facilities for adequately protecting passengers from other trains (hereinafter called "platform screen doors, etc.").

5.4.4 In the case of a platform provided with platform screen doors, etc., the distance from the entrance to an overbridge, the entrance to an underpass, the waiting room, etc., on the platform, to the platform door etc. shall be at least 1.2 m (or at least 0.9 m at a location where there is no likelihood of interference to the boarding and alighting of passengers).

5.4.5 The surface of the platform and the surface of the floor part of the rolling stock where passengers board and alight shall be as flat as possible.

5.4.6 The clearance between the edge of the platform and the edge of the floor surface of the rolling stock shall be as small as possible within the range where the running of the rolling

stock is not impeded. Note, however, that if this clearance is unavoidably large due to structural considerations, facilities for warning passengers to this effect shall be provided.
5.4.7 At the end of the platform other than the track side, a fence shall be erected to prevent passengers from falling. Note, however, that the above does not apply if the end concerned is a stairway, and there is no danger of general passengers falling.
5.4.8 The surface of the platform shall be finished so that passengers cannot readily slip on it.
5.4.9 Facilities for warning passengers of the approach of a train using text, etc., and also audible warning facilities shall be provided on the platform.
5.4.10 Copestones on the edge of the platform shall be of a non-slip finish.

3. Access for Passengers

5.5 Access for Passengers
The width of accesses for passengers and stairs for passengers shall conform to the following criteria in order to prevent any impediment to the smooth flow of passengers, and also to prevent passengers from falling off stairs for passengers.
The Bangladesh's existing standards regarding the Access for Passengers shall be applied, if it can be useful.
5.5.1 The width of accesses for passengers and stairs for passengers shall be at least 1.5 m.
5.5.2 Stairs for passengers shall have one landing every 3 m or so of height.
5.5.3 Stairs for passengers shall have handrails.

4. Barrier－free facilities

5.6 Barrier－free facilities
The architectural buildings shall conform to the following criteria in order to promote aged and disabled persons make easily accessible transportation mobility with convenience and safety.

5.6.1 One or more channels that connect station entrance and platform where the level difference is eliminated by lift or ramp shall be provided.

5.6.2 Dotted blocks shall be installed on the edge of the platform in order to prevent visually impaired persons from falling. This does not apply, however, to a platform provided with platform screen doors, etc.
5.6.3 Lighting facilities shall be provided at passageway and platform.
5.6.4 The lift car shall be provided with s structure that wheelchair can easily change the direction and turn at the place.
5.6.5 Equipment for notifying with sound that the doors of the destination floor and the car itself, and that of shaft will close shall be provided inside the lift car. And equipment for

notifying the direction in which the car is moving with sound shall be provided in the lift lobby.

5.6.6 Passageways and the other facilities that constitute channels between station entrance and platform shall be provided with guidance blocks for visually impaired persons.

5.6.7 Dotted blocks shall be installed on passageways next to the end of staircases, ramps and escalators.

5. Station in a Building

5.7 Station in a Building

In case of a building which has Metrorail station with own land, station facilities and access for passengers shall conform as follows,

5.7.1 Design standards of its building shall be applied the Bangladesh's existing standards. Note, in cases which the railway loading may affect, the effects of railway loading shall be considered in reference to 'Design loading' specified in Clause 3.5 of this standard.

VI. STATIONS

1. Station Facilities

6.1 Track Layouts in Stations

6.1.1 Track layout at station and halt shall conform to the train operation.

6.1.2 The effective length of main track to be provided as passing track at station and halt shall be long enough to accommodate the longest train.

6.1.3 Main tracks must not be branched away outside of the station.

6.2 Platform

Platform shall conform to the following criteria in order to secure passengers, depending upon the train speed, frequency and operational patterns.

6.2.1 The effective length of a platform shall be at least the maximum length from the front-most passenger car to the rear-most passenger car of a train that arrives at, and/or departs from, said platform, and in addition, shall not impede the safe and smooth boarding and alighting of passengers.

6.2.2 Platform width shall not impede smooth boarding and alighting of passengers. The width of the platform shall be at least 3 m at the center part and at least 2 m at the end parts in the case where both sides of the platform are used, and at least 2 m at the center part and least 1.5 m at the end parts in the case where only one side is used.

VII. ELECTRIC FACILITIES

1. Electric line facilities

7.1 Contact Lines and Other Facilities

Catenary line, feeder line and their accessories including apparatus, wire and protection equipment shall be installed not to cause electric shock and fire, according to the location, insta11ation method and standard voltage.

7.1.1 Overhead Catenary system

(1) Catenary system shall be simple catenary system or feeder messenger catenary system.

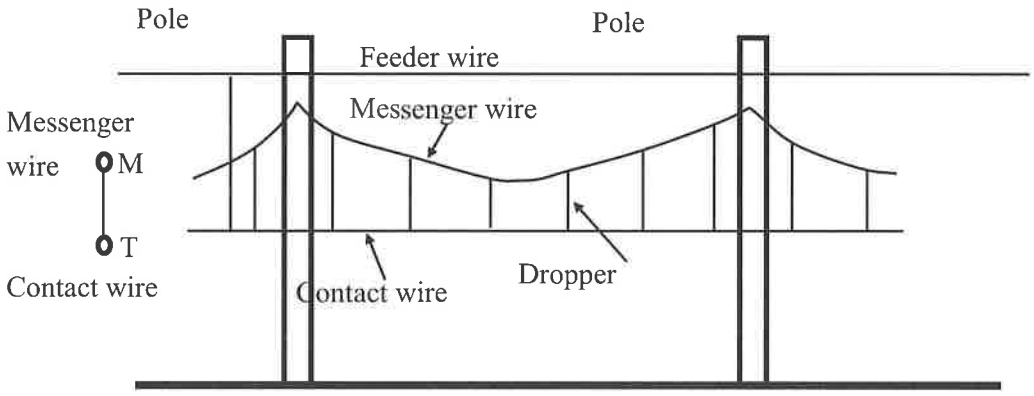


Fig. 7.1 Simple Catenary system

(2) The deflection of single overhead contact lines shall be within 250 mm from the center plane of the track perpendicular to the rail surface in sections using pantographs as current collectors.

(3) The inclination of single overhead contact lines with respect to the rail surface shall be 5/1,000 in the case of suspension of an overhead

7.1.2 Overhead contact 1ine and feeder line shall be installed at an appropriate height depending upon the location, installation method and standard voltage to make them free from of the risk of electric shock or other impediment to train traffic. The height above the rail top of a single overhead contact line on an ordinary railway shall be 5 m as standard, not less as 4.4 m for DC, and not less than 4.8 m in the case of installation at level crossing. Additionally, each height shall be not less than the value obtained by adding 400 mm to the maximum height of all traveling vehicles with the current collector folded.

In tunnel section, the height above the rail top of rigid conductor shall be reduced to the numerical values specified. In the cases of (1) and (2) below, values of 400 millimeters in the item 7.1.2 may be shortened 250 millimeters (150millimeters in the case of procedures to avoid cutting off the load current through pantographs on DC overhead contact wires)

(1) A device enabling communication with respect to a substation or power control center from any train or vehicle.

(2) An interlinked breaking device provided on the feeding side of a substation to stop the feed of electric power from the substation to the area to be fed.

7.1.3 Contact line shall be withstood the predictable maximum wind pressure load, tension of electric wire, etc. and also shall be installed appropriately to collect electricity without any impediment according to the train speed and feeder system.
7.1.4 Contact line and feeder line shall be installed in such a manner as to prevent failures caused by an inadvertent contact or confusion with other contact line or feeder line that differs in standard voltage, frequency and so on.
7.1.5 The voltage of contact line shall be maintained at sufficient level to guarantee adequate train operations. The voltage of contact line shall be 1,500V as standard, maximum voltage shall be 1,800V and minimum voltage shall be 900V as standard.

7.2 Proximity or Crossing of Overhead Electric Lines, etc.
In case the voltage applied part of the overhead contact line, or feeder, line is in proximity of or crossing other contact lines, manmade works, or vegetation, it shall be installed with caution to be free from chance of damaging any of the above and causing electric mixture, shock or fire.

7.3 Division of Insulation of Contact Lines
In order to avoid breakage or electric shock a contact line shall not be sectionalized in the area where electric locomotives or electric trains usually make stops, This rule does not apply, however, when an appropriate measure is taken to either prevent any electric locomotive or train from approaching the sectionalized area, or install proper measure to prevent any trouble from happening when an electric locomotive or a train has stopped at the sectionalized area.

7.4 Prevention of Troubles at over bridge, etc.
For such cases when overhead contact, as well as feeder lines are to be installed underneath an over bridge a building over platform, a bridge or any other similar facility, and are likely to cause some harm to people, etc., preventive measures or facilities shall be installed.

7.5 Installation of Return Current Rail
Rail for return current shall be installed in such a manner as to configure the sufficient electric circuit for return current and also to minimize the leakage current from the rail to the ground.
7.5.1 Return circuit rails shall be electrically connected at joints using bonding or similar,
7.5.2 The joints of return circuit rails for DC overhead contact lines shall have not more than 5 m of electrical resistance (value converted into rail length)

7.6 Transmission and Distribution Line Routes

Transmission and distribution lines (except those installed outside the exclusive right of way. the same shall apply hereinafter.) shall be strong enough to withstand both the anticipated maximum wind load and the tensile load of electric wires, and at the same time, need to be installed in such a manner as to be free from current mixture, electric shock and fire, depending upon the location, installation method and voltage.

7.6.1 0verhead transmission line and overhead distribution line shall be installed at an appropriate height to eliminate the possibility of electrocution and other impediment to traffic. The height of overhead transmission/distribution lines shall be as follows.

(1) In the case of spanning a railway or track, the height shall be not less than 6 m above the rail top.

(2) In the case of spanning a road (excluding level crossings), the height shall be not less than 6 m above the road surface.

(3) In the case of spanning a level crossing, the height shall be not less than 6 m above the level crossing surface.

7.6.2 Transmission line and distribution line that are located in the proximity of, or cross over other electric lines, structures or vegetation shall be installed in the manner not to damage those electric lines or structures and to be free from the danger of electrocution and fire.

7.7 Measures to Prevent Lightning Damages, etc.

Protective measures and equipment against lightning damages shall be installed to those vulnerable locations deemed necessary from the security standpoint, such as at contact line and feeder line together with their accessories, as well as overhead transmission and distribution lines. This rule does not apply, to the area that are less susceptible of lightning damages.

7.8 Prevention of Induction Damage

When contact line, feeder line, transmission line and distribution line are installed, distance among each other shall be increased, or protective devices shall be installed in order to seclude the influence of inductive interference from them.

2. Substation and Other Facilities

7.9 Equipment at Substations, etc.

Substation, distributing station and switching station (hereinafter referred to as "substation, etc.") shall be constructed in the manner to exclude unauthorized persons.

7.9.1 Substations, etc., shall be equipped with appropriate devices and fire extinguishers to protect equipment, contact lines and other facilities at a time of emergency. It is not necessary, however, to install any fire extinguisher at substation, etc., where there is no risk for fire.

7.9.2 The capacity for transformers to be used for train operation shall be sufficient to withstand the anticipated load.
7.9.3 Monitored substations (meaning automated, remotely controlled and monitored substations, and portable substations without stationary operators) and switching stations shall be provided with a control post with the surveillance and control equipment, and shall be able to deal with any accident, disaster and failure.

3. Electrical Equipment and Other Facilities

7.10 Electrical Equipment, Power Distribution Board and Others
Electric equipment, power distribution board and other relevant equipment shall be installed to be free from the risk of electric shock and fire.

7.11 Lead and Distribution Line, etc.
Lead line (excluding the line to be installed outside the exclusive right of way) and distributing line shall be installed in the manner to be free from electric shock and fire, impediment to other traffic and damage to other structures, depending upon the location and type of installation, and the voltage.
7.11.1 Appropriate devices shall be installed to the critical locations from the safety and security need, to protect the electric line and equipment from grounding or short circuit faults.
7.11.2 Overhead ground wires to be installed to the contact line as protection for lightning or for other purposes shall have the strength to withstand the anticipated maximum wind load and the tensile strength of the electric line.

4. Miscellaneous Provision

7.12 Insulation of Electric Route etc.
Insulating performance of the electric line and equipment shall be able to withstand the danger from the insulation damage, taking the abnormal voltage at the time of fault into consideration.
7.13 Grounding of Electric Facilities
At critical locations of electric facilities, effective grounding shall be provided to prevent electrocution and fire caused by the abnormal elevation of electric power and invasion of high voltage, etc.

VIII OPERATION SAFETY FACILITIES

1. Railway Signaling Facilities

8.1 Devices to Ensure Block, etc.

Devices to ensure a block shall be capable of providing the signal aspect that comply with the condition of the block sections on the route or assuring the block.

8.1.1 The devices to ensure the interval between trains shall be capable of retarding or stopping the speed of the relevant train, by continuously controlling it according to the intervals with other trains/cars and track conditions on the route.

8.2 Railway signal devices etc.

Structure providing method and installation of railway signals shall be free from the chance of misrecognition.

8.2.1 Signal device shall be appropriately installed to let the train/car decelerate or stop according to the speed instructed by its aspect before it comes to the front end of the section to be protected by the signal

8.2.2 To secure safe train/car operation signal indication devices shall be installed at intersections or junctions or other vulnerable locations that could cause collision or derailment.

8.3 Apparatus to Interlock Signals, etc.

At intersections or junctions or other vulnerable locations that are susceptible to collisions or derailment, interlocking apparatuses shall be installed to coordinate signals, turnouts on the route and other comparable facilities, in order to prevent collision and to secure safe train operation.

8.3.1 The remote control device to the aforementioned apparatus shall be able to display necessary information to secure safe train operations, including but not limited to where trains are located and whether the route is open or not.

8.4 Apparatus to Automatically Decelerate or Stop Trains

In the case when trains are operated by the block system, apparatus to automatically decelerate or stop trams depending upon signal aspects and line conditions shall be installed, This does not apply, however, to those cases where safe train operation will not be jeopardized from the standpoint of operational and route conditions.

8.5 Devices for automatic operation

Apparatus for automatic train operation to be installed for an unmanned train (without a driver) unit shall comply with the following standards.

8.5.1 A train shall not be able to be departed until after confirming the safety of all passengers getting on and off the train.

8.5.2 A target speed shall be set below the operating speed indicated by the control information from the apparatus that are ensuring train intervals and the train speed shall be controlled smoothly.
8.5.3 A train shall be stopped smoothly at the location which would not interfere with passengers getting on and off

8.6 Apparatus to Detect Trains, etc.
Apparatus to detect trains (limited to those needed from a safety standpoint) shall be able to detect trains without failure, by preventing an impediment caused by inductive interference, etc.
8.6.1 If the boundary is set for the area to be detected by the aforementioned apparatus to detect, the boundary shall be drawn at the location where there is no danger for trains to collide.

2. Safety Communication Facilities

8.7 Safety Communication Facilities
In order to communicate or exchange information quickly to each other or among themselves, safety communication facilities shall be installed at station and halt, power substations, and traffic control centers ,electric power dispatching stations and other location deemed necessary from the safety and train operational standpoints.
8.7.1 Safety communication facilities to be located between power dispatch and traffic control center, between electric power dispatch and substations, between traffic control center and stations and between stations that handle blocks or hold preliminary discussions on the direction of train operation shall have dedicated lines.

8.8 Installation of Overhead Communication Line
Overhead communication lines shall be installed with an appropriate height so as not to impair with other transportation movement.
8.8.1 Overhead communication lines shall be installed properly not to pose hazard to people and other equipment, and at the same time to prevent the damages caused by electric mixture and lightening hazard.
The height of overhead communication lines shall meet the following requirements:
(1) In the case of spanning a railway or a track, the height shall be not less than 6 m above the rail top.
(2) In the case of spanning a road, the height shall be more than 5.5 m above the road surface.

3. Level Crossing Protection Facilities

8.9 Level Crossing Protection Facilities

Level crossing safety facilities shall be able to warn the danger of approaching train to people going across level crossings, and to block the street traffic into the crossing to secure the safety for both train and people. However, for those exceptional cases where the traffic volumes at the crossing is minimal or where it is extremely difficult from the technological standpoint to install the device to shut the street traffic, warning device fan approaching train suffices as protection.

8.9.1 Level crossing safety facilities shall take into consideration the train speed traffic volume of both rail and road, the type of vehicles that go across the crossing and so on, if necessary safety facilities shall include the device to let relevant trains etc., be informed of any automobile interfering with the crossing.

4. Miscellaneous Provision

8.10 Securing Safety When in Troubles

Those facilities to secure safe train operation shall be equipped with the function, according the performance characteristics of its electric equipment and circuit not to interfere with safe train operations even at the time of failure.

5. Other Facilities

8.11 Devices for recording the operating condition of trains

For trains operation control centers or other necessary places, event recorders to record train operation shall be installed.

8.11.1 The "Device for recording the operating condition of trains" shall be capable of recording the fo11owing items. However, this does not apply when the maximum train operating speed is 40 km/h or less or when the recording of the necessary information is difficult due to structure.

(1) Basic information relating to train operation

1) Time

2) Position (including when calculated from speed and time)

(2) Recording of communications between operating dispatch center and driver, etc.

1) Voice

2) Time

8.11.2 The recording of 1.1 shall be capable of recording the amount for the most recent one day or more.

IX. ROLLING STOCK

1. Rolling Stock Structure

9.1 Rolling Stock Gauge

9.1.1 A Metrorail Operator shall comply with the rolling stock gauge on a straight track as shown in Figure 9.1. The rolling stock shall not exceed that rolling stock gauge.

9.1.2 The "rolling stock shall not exceed the rolling stock gauge" in 9.1.1 means the rolling stock shall not exceed the rolling stock gauge in the following conditions.

(1) On a flat, straight track, the rolling stock (including with the wheels, etc. worn), is in the stopped state with the center line of the car body and bogies align with the center line of the track.

(2) The load condition is between the empty condition and the maximum load condition.

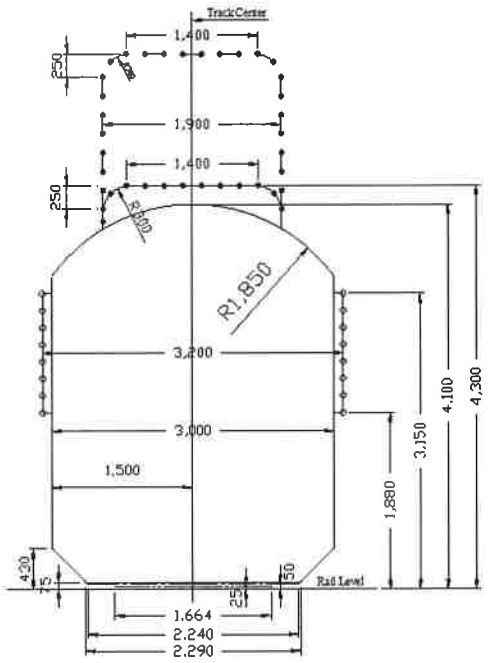
(3) The car body and bogies are not tilting due to passengers or loaded material.

9.1.3 The relevant devices in the following table may, within the range of the various conditions, exceed the rolling stock gauge.

Table 9.1

Device	Conditions
Wheels, track lubricator	When parts are within the structure gauge
Obstacle deflector	When movable parts are within the structure gauge
Doors	When open
Track measuring wheels, rail inspecting equipment, rail grinding equipment and structure gauge measuring equipment	When in use within structure gauge

9.1.4 The rolling stock gauge on a curve shall have the relative values corresponding to the displacement of the rolling stock added to each side of the rolling stock gauge presented in 9.1.1.



Basic

Gauge in relation to parts that do not move vertically due to action of

Gauge in relation to sanding pipe, obstacle deflector, brake shoe and other parts that do not exceed the rim

Gauge when current collector

Gauge in relation to top of roof when current collector is operated.

Gauge in relation to signs, marker lamps, car side lamps.

Unit : mm

Gauge	Height	Width	Note
Basic Gauge ———	4100mm	3000 mm (over 430 mm in height)	Depend on figure

Fig. 9.1 Rolling Stock Gauge

9.2 Weight of Rolling Stock

Rolling stock shall not impose the impact that exceeds the capacity of track and structure. The rolling stock weight per one pair of wheel shall be maximum 16t in the stopped and loaded state. The conditions to calculate loaded state shall be decided by Metrorail Operator.

9.3 Car-body material

The aluminum alloy or stainless steel shall be used as a main material of rolling stock car body structure.

9.4 Stability

9.4.1 Rolling stock shall be capable of ensuring stable travel even under the conditions indicated below.

(1) Passenger loading conditions, etc. (From empty car to maximum load capacity)

(2) Travel conditions (Travel speed, acceleration, deceleration, etc.)

(3) Wheel wear, etc.

(4) Atmospheric conditions, such as wind, rain, etc. (however, does not include times of disaster)

9.4.2 The rolling stock, when stopped on a curved track, shall not be tipped over by forces acting on the inside of the curved track. Moreover, the rolling stock, when passing through a curve at high speed, shall not be tipped over by forces acting on the outside of the curved track.

9.5 Wheel load balancing of rolling stock

The appropriate ratio of wheel load balance of rolling stock (the ratio which divided the wheel load acquired by one-half the axle load, when the car is empty) shall be determined and the rolling stock shall be managed by this ratio. In addition, the rolling stock shall have a structure by which adjustment of the ratio of wheel load balance can be easily performed. For example, the target of the ratio of wheel load balance at the same axle shall be within 15%.

9.6 Running Gear of Rolling Stock, etc.

Running gear, etc., shall comply with the following standards:

9.6.1 The wheels of a running rolling stock shall not damage the track;

9.6.2 The axles shall be arranged appropriately without imposing any problem for a train to negotiate the curve of the minimum radius of the line on which it is supposed to run;

9.6.3 The suspension devices shall have sufficient capacity and stability against shock from the track and when a suspension device with air springs is used, it shall be as follows:

(1) Air reservoirs with sufficient capacity shall be provided;

(2) The car body shall be safely supported even if an air leak of significantly affecting spring characteristics were to occur;

9.6.4 The front part of the leading car of a train shall be equipped with the device to remove any obstacle left on the top of the rails;

9.6.5 In addition to the paragraphs prescribed above, the running gear, etc., shall be made robust with sufficient strength and shall be able to secure safe and stable vehicle operations.

9.7 Traction Power Generation and Related Equipment

9.7.1 The traction power generation and related equipment shall conform to the facilities and shall have a structure that is capable of generating and transmitting sufficient power to satisfy operating conditions. In this case, the "traction power generation system" shall include all of the following devices:

(1) Devices that generate the power for running (in case they have electric braking device including electric braking force);

(2) Devices that transmit the power that has been generated;

(3) Devices that directly control the extent of the power to be generated;

(4) Current collection devices;

(5) Auxiliary power supply devices necessary for the generation of main power, such as auxiliary power supply equipment and auxiliary rotating equipment, etc.;
(6) Equipment electrically or mechanically connecting the above-referred devices.
9.7.2 The electrical circuits for the electric facilities for the rolling stock shall be as indicated below.
(1) The function and structure of the electric facilities (including electric wires) shall be as shown below:
1) There shall be no risk of electrical shock or fire due to the breakdown of insulation, etc.
2) There shall be no risk of being easily touched by persons other than the operator;
3) Electric wires shall be as shown below;
(a) Sections that may be damaged by sliding, vibration, etc., shall be protected.
(b) There shall be no risk of rain water entering into the service inlet ports and service outlet ports for protective piping and equipment.
(c) Wires with different voltages shall not be inserted into the same protective piping. However, this does not apply to the wiring in the said protective piping when the wires being used have an insulating effect that is equal to or better than the standard for the insulated wire with the highest one of the voltages being applied to the said wires.
4) There shall be no risk of other electric circuits being affected by induction effect (limited to facilities provided for use by a Metrorail Operator and items provided on the rolling stock).
5) The pantograph shall have the tracking performance for the contact line on the section of the electric railway where it will be used, and shall be as shown below:
(a) On electric cars comprising a train, the pantograph shall be capable of being completely lowered all together by an operation from the crew cabin;
(b) The mounting part for the pantograph on passenger trains operating on sections of track electrified by direct current shall have double insulation;
(c) The pantograph on rolling stock shall be capable of being raised by mechanical force, such as by springs. Here, mechanical force includes that generated by pneumatic pressure;
(2) The following devices shall be provided on the main circuit:
1) An automatic circuit breaker and a manually operated cut-off switch capable of maintaining the circuit in the open position shall be provided near the current collector device. However, this does not apply to rolling stock receiving its power supply by way of the said circuit from another car having a circuit provided with the automatic circuit breaker and cut-off switch.
2) Electric railcars, etc., equipped with pantographs shall be provided with an arrestor at a location near the pantograph;
(3) The following devices shall be provided on the power supply side of electric circuits other than the main circuit:
1) Fuses (including non-fused circuit breakers, etc., having equal or greater performance.) However, this excludes rolling stock receiving its power supply by way of the said circuit from another car having a circuit equipped a fuse;

2) Switches on power supply circuits for electric conversion devices such as electric generators, static inverters, etc., and motors for pneumatic compressors, etc. However, excluding the power supply circuits for electric motors, etc., of air compressors receiving their power supply from electric power conversion devices equipped with switches.

9.8 Brake Devices

9.8.1 Rolling stock shall be equipped with the brake devices that comply with the following items:

(1) Shall be able to decelerate or stop the rolling stock without failure;

(2) Shall be applied to all the consisted cars in conjunction with the control from the crew cabin;

(3) Shall be free from failure caused by vibration, impact and other factors;

(4) Shall be able to apply braking force continuously;

(5) Shall be applied automatically at the time when consisted vehicles are separated;

(6) Shall be able to bring a train to a rapid stop;

(7) Shall be able to prevent the train from departing when the braking effort would be adversely affected without securing the braking power supply source;

9.8.2 In addition to the aforementioned devices, rolling stock shall also be equipped with the braking devices that comply with the following items:

(1) Shall be capable of preventing rolling of the parked vehicles from moving and complying with the previous item 9.8.1. (3). This does not apply, however, for those cases when a rolling stock is prevented from rolling by being fixedly coupled to other rolling stock;

(2) Shall be equipped with independent braking capability that can be utilized when the brake devices mentioned in the previous paragraph would fail and can also satisfy the standards of the item 9.8.1 (1), (3) and (4) of the previous paragraph;

9.8.3 The types of rolling stock brake devices are as shown below and brake device corresponding to the type of rolling stock as shown in the following table 9.2 shall be provided.

(1) "Service brake device" is the brake device usually used for braking the rolling stock during operation and it has a function that enables the rapid stopping of the rolling stock during operation.

(2) "Parking brake device" is the brake device for preventing the parked rolling stock from rolling.

(3) "Security brake device" is the brake device used for braking the rolling stock during operation when the service brake device has failed.

Table 9.2

Type of Rolling Stock		Type of Brake device To be Necessarily Provided		
		Service	Parking	Security
Electric Cars	Without cab	✔		✔
	With cab	✔	✔	✔

Note : When the security brake can prevent the parked rolling stock from rolling, the parking brake can be eliminated.

9.8.4 There shall be no risk that vibration, shock, etc., will impede the operation of the equipment, piping and braking function of the brake device on the rolling stock.

9.8.5 The function and performance, etc., of the service brake shall be as shown below:

(1)The service brake shall be capable of decelerating the traveling rolling stock, stopping it and maintaining it in the stopped condition.;

(2) There shall be a function that applies braking force to all wheels of the rolling stock.

(3) The braking force shall be according to the brake ratio and the loaded car brake ratio (the ratio of total force acting on the brake shoes to the weight of the loaded cars) shall be 70/100 or more.

(4) When the air is used as the source of operating power, the following shall apply:

1) The air tank shall have the capacity for storing sufficient pressure for braking;

2) When there is the risk that a reduction in pressure in the main air reservoir or a reduction in pressure in the brake piping will impede the braking effect, there shall be the mechanism that will not enable departure.

3) The equipment and air piping (except being installed in the interior, hereinafter the same) in the section from the final air tank (including the check valve on the main air reservoir side, hereinafter the same) used to supply braking force to the brake cylinders shall be arranged within the width of the bogie (including the bolster anchor and other main parts provided on the bogie). However, this does not apply when the equipment and air piping is protected by some means having suitable strength;

4) On the rolling stock having a driving cab (of the crew cabins, this is defined as the cabin stationed by the person who drives the motive power vehicle and performs the control of powering, braking, etc. Hereinafter the same.), the equipment and brake piping in the section from the final air tank, serving as the supply for braking force for the cab that will become the front part of the leading car of a train, to the brake cylinder shall be arranged to the inside of the front end of the underframe. However, this does not apply when the equipment and air piping is protected by some means having suitable strength.

(5) When the hydraulic pressure is used as the source of operating power, the following shall apply:

1) The accumulator shall have the capacity for storing sufficient pressure for braking;

2) When there is the risk that a reduction in pressure will impede the braking effect, there shall be a structure that will not enable departure;

3) In the driving cab, it shall be possible to confirm that the supply source for the braking force of rolling stock is normal;

4) The equipment and hydraulic piping (except being installed in the interior. Here in after the same.) in the section from the final accumulator used to supply braking force to the brake cylinders shall be arranged within the width of the bogie (including the bolster anchor and

other main parts provided on the bogie). However, this does not apply when the equipment and air piping is protected by some means having suitable strength;

5) On the rolling stock having a driving cab, the equipment and brake piping in the section from the final accumulator serving as the supply for braking force for the cab that will become the front part of the leading vehicle of a train to the brake cylinder shall be arranged to the inside of the front end of the underframe. However, this does not apply when the equipment and air piping is protected by some means having suitable strength.

9.8.6 The function and performance, etc., of the parking brake device shall be as shown below:

(1) "Parking brake device" shall have performance that is equal to or higher than the manual brake device, car side brake device and others that are used for preventing the parked rolling stock from rolling;

(2) The braking force shall be according to the brake ratio and shall satisfy the values in the following table that correspond to the type of brake.

Table 9.3

Type of brake	Empty vehicle brake ratio	Calculation conditions
Hand brake device	20／100	The force for operating the handle shall be 294 N for a handle operated by one hand and 441 N for handle operated by both hands. Braking leverage shall be 1200 or less.

Note : The empty vehicle brake ratio means the ratio of total force acting on the brake shoes to the weight of the empty vehicle.

9.8.7 The function and performance, etc., of the security brake device shall be as shown below:

(1) The security brake device shall stop the traveling rolling stock when the service brake device has failed and shall be capable of maintaining the stopped condition for the necessary period;

(2) The security brake device shall automatically activate when the service brake device has failed. However, this does not apply when the driver and conductor can operate this device from the driving cab and conductor's cabin (this means a crew cabin other than the driving cab for 9.8.5. (4). 4). Hereinafter the same.);

(3) The braking force shall correspond to the empty vehicle brake ratio of 70/100 or more;

(4) When the air is used as the source of operating power, the following shall apply;

1) The air tank shall have the capacity for storing sufficient pressure for braking;

2) The equipment and air piping in the section from the final air tank serving as the supply source for braking force to the brake cylinder shall, as far as possible, be independent from other equipment and air piping;

3) The equipment and air piping in the section from the final air tank serving as the supply source for braking force to the brake cylinder shall be arranged to the inside of the width of the bogie frame. However, this does not apply when the equipment and air piping is protected by some means having suitable strength;

4) On the rolling stock having a driving cab, the equipment and brake piping in the section from the final air tank serving as the supply for braking force for the cab that will become the front part of the leading car of a train to the brake cylinder shall be arranged to the inside of the front end of the underframe. However, this does not apply when the equipment and air piping is protected by some means having suitable strength.

(5) When the hydraulic pressure is used as the source of operating power, the following shall apply;

1) The accumulator shall have the capacity for storing sufficient pressure for braking;

2) The equipment and hydraulic piping in the section from the final accumulator serving as the supply source for braking force to the brake cylinder shall, as far as possible, be independent from other equipment and air piping;

3) The equipment and brake piping in the section from the final accumulator serving as the supply for braking force to the brake cylinder shall be arranged to the inside of the width of the underframe. However, this does not apply when the equipment and air piping is protected by some means having suitable strength;

4) On the rolling stock having a cab, the equipment and brake piping in the section from the final accumulator as the supply for braking force for the cab that will become the front part of the leading vehicle of a train to the brake cylinder shall be arranged to the inside of the front end of the underframe. However, this does not apply when the equipment and air piping is protected by some means having suitable strength.

9.8.8 A continuous brake for rolling stock shall be provided on the brake device for coupled and operated rolling stock and its functions shall be as shown below:

(1) The continuous brake shall act with being interlocked by operation from a crew cabin in the consisted rolling stock;

(2) The brake shall act automatically when the consisted rolling stock is separated;

(3) When coupling the rolling stock provided with brake devices, there shall be coupling of the main air tank piping (when there is no main air tank piping, the brake pipe). However, this does not apply if it is possible to confirm in the driving cab that the pressure in the main air reservoir of all the rolling stock in the consisted train is normal.

9.8.9 The brake functions for rolling stock operated with a single vehicle that has driving cabs at both ends shall be as shown below:

(1) The brake device for passenger electric vehicles and for passenger internal combustion vehicles that have driving cabs on both ends and travel as a single vehicle shall have one of the following mechanisms in addition to the stipulations in 9.8.1 through 9.8.8

1) Two sets of independent brake systems shall be provided for the section from the air tank supplying the source of the braking force for the air brakes for the service brake device and the security brake device to the brake cylinder;
2) There shall be dual air tanks and check valves for the security brake device, and by arranging the check valves so that they are on the right and left of the rolling stock it shall be possible to ensure the brake function of either the front or rear bogie;
3) By using some method such as rail brakes other than air brakes, it shall be possible to ensure performance of 35/100 or more at the empty vehicle brake ratio when the service and security brakes have failed, and it shall be possible to maintain the rolling stock in the stopped condition.

9.9 Structure of Car Body

9.9.1 Rolling stock car body shall be made sturdy with enough strength and be capable of withstanding train operation.

9.9.2 Facilities to prevent passengers on the platform from falling into the gap between coupled cars shall be provided at the coupling portion (limited to portions coupled at all times) of railway rolling stock. However, this shall not apply to cases where facilities are in place on the platform to prevent passengers from falling into the gap.

9.10 Structure of Driver's Cabin

9.10.1 Driver's cabin shall be separated from passengers in order for the driver not to be disturbed, and shall be provided with exclusive entrance and exit as the train operation is not interfered with.

9.10.2 Window of a driver's cabin shall be able to provide the view necessary for driving. The front window shall also have sufficient strength to protect a driver from gravel, wind pressure and other objects.

9.10.3 Driver's Cabin structure shall be as shown below.

(1) The driver's cabin shall be partitioned from the passenger room.

(2) Notwithstanding (1), cabs that may not be staffed by a crew member shall have a structure that provides a door, etc., partition so that passengers cannot easily contact the equipment provided in the cab, or shall have a structure whereby the same devices, etc., that can be mechanically or electrically locked.

(3) The exterior entrance/exit for the driver's cabin shall be as shown below.

1) An exterior entrance/exit for the crew shall be provided. However, this shall not apply to rolling stock that enables the crew to easily enter/exit through the passenger room, etc.

2) The door of an entrance/exit on the side of the rolling stock shall be an inward-opening hinged door or a sliding door. However, when the door only opens to the cab, and when a device is provided to indicate this, an outward-opening door may be used. When an outward-opening door is used, a gap of 75 mm or more shall be maintained between the opened door and the structure gauge.

(4) On passenger cars having a driver's cab, an entrance/exit with a sliding door or hinged door structure shall be provided between the driver's cab and passenger room, etc. In this case, when a hinged door is to be used for evacuation in the event of emergency, it shall open into the driver's cab, or be capable of opening in both directions.

9.10.4 Driver's cabin windows shall be as shown below.

(1) A window having the necessary visibility for operation shall be provided on the front surface of the cab and a wiper device, etc., shall be provided to ensure visibility during rain, etc.

(2) Glass, or other material having equal or better performance, that can withstand the wind pressure from the operating travel speeds and climatic conditions, that can ensure operator visibility even when damaged by a small stone, bird or other flying objects, and that cannot be easily penetrated, shall be installed in this window. In this case, JIS R 3213 safety glass, are examples of conforming glass that cannot be easily penetrated.

(3) Windows necessary for operation shall be provided on both sides of driver's cabin. In this case, the windows on both side surfaces (when the conductor room is provided on one side of the rolling stock, which side) that are to be used by the conductor shall be capable of being opened and closed.

9.11 Structure of Passenger Car

9.11.1 Passenger room structure shall be as shown below.

(1) Windows shall be as shown below.

1) Shall not be capable of opening to the outside.

2) The height of the bottom border of the opening section (the section that passengers and staff can open, hereafter the same) from the floor surface shall be as follows.

(a) Window at the side surface of seat or behind a seat: 800 mm or more.

(b) Window facing an aisle: 1200 mm or more.

3) Dimensions of opening section (dimension between upper border and lower border) are as shown in the table below.

Table 9.4

	Height from Floor surface	Dimensions of openings		
		General rolling stock	Rolling stock operated on sections where the space between the centerlines of the tracks is narrow. (Note 1)	Rolling stock operated on sections where the space between the structure clearance and rolling stock clearance is small. (Note 2)
Window contacting the side surface of seat or behind a seat	800 mm or more 1200 mm or less	No limit	200 mm or less. However, no limit when there are protective bars, etc., on the window. (Note 3)	150 mm or less However, 250 mm or less when there are protective bars, etc., on the window. (Note 4)
	1200 mm or more	No limit	No limit	No limit
Windows contacting accommodations for standing passengers or an aisle	1200 mm or more 1400mm or less	No limit	200 mm or less. However, no limit when there are protective bars, etc., on the window. (Note 3)	150 mm or less. However, 250 mm or less when there are protective bars, etc., on the window. (Note 4)
	1400mm or more	No limit	No limit	No limit

Note 1: When the maximum width of the rolling stock operating on track sections where the distance between track centers of the main line exceeds the maximum width of the basic limits for the rolling stock gauge by less than 600 mm (excluding signs), excluding rolling stock where the maximum wide has been reduced to 600 mm or less than the distance between track centers of the main track.

Note 2: Rolling stock operated on sections where the space between the structure clearance and basic limits of the rolling stock gauge at the side section is less than 400 mm.

Note 3: Protective bars on the window (including alternative facilities to these, hereafter the same) shall be mounted on the outside of the window and the space between the center of this mounting and the bottom border of the opening shall be in a range from 150 mm to 200 mm.

Note 4: Protective bars on the window shall be mounted on the outside of the window and the space between the center of this mounting and the bottom border of the opening shall be in a range from 100 mm to 150 mm.

4) Window glass shall be safety glass or have performance that is equal to or better than it. In this case, examples of "safety glass" is safety glass in compliance with JIS R 3205 laminated glass, JIS R 3206 reinforced glass or JIS R 3213 safety glass.

(2) One or more wheelchair spaces shall be provided in each passenger train.

9.11.2 Passenger room interior ventilation shall be as shown below.

Table 9.5

<table>
<tr><th></th><th>When natural ventilation is used</th><th>When forced air ventilation is provided</th></tr>
<tr><td>Normal operation</td><td rowspan="2">The total area of the opening for the windows, etc., in the passenger room during normal times shall be 1/20 or more that of the floor area of the passenger room of said rolling stock (Note 1).</td><td>The forced ventilation device shall have the performance capacity that has been calculated using two times the rated passenger capacity, based on a ventilation volume of $13m^3$ per person per hour. (Note 1)</td></tr>
<tr><td>One of the following shall apply in the event of the main power supply being interrupted.</td><td>One of the following shall apply in the event of the main power supply being interrupted.
[1] Be capable of maintaining the function of the forced ventilation device for a fixed period.
[2] In addition to the windows in the passenger room, the total area of the openings added for side doors, etc., shall be 1/20 that of the floor area of the passenger room of said rolling stock. (Note 2)</td></tr>
</table>

Note 1: When natural ventilation alone or forced ventilation alone cannot satisfy the conditions, it is acceptable to satisfy the conditions by adding/combining each respective capacity.

Note 2: Measures shall be taken at these doors to prevent falling, etc. In addition, limited to when the rolling stock consist is fixed, when the area of the opening for the side sliding doors is added, the total of the surface area of the opening at the gangway connecting adjacent rolling stock may be added to the total for the surface area of openings in said rolling stock, to make [the total surface area of the openings] 1/20 that of the floor area of the passenger room of said Rolling stock. However, in this case, the total of openings for the all rolling stock in the fixed consist shall be 1/20 that of the floor area of the passenger room of the entire consist for said rolling stock.

9.11.3 Lighting shall be as shown below.

(1) Appropriate lighting devices shall be provided.

(2) Auxiliary lighting devices that will automatically come on in the event of the main power supply being interrupted shall be provided. However, this shall not apply to lighting devices that do not go out even when the main power supply is interrupted.

(3) When an auxiliary lighting device (including lighting devices that do not go out even when the main power supply is interrupted) is provided, illumination equal to or exceeding the level that enables the positions of doors or door cocks, etc., to be identified shall be maintained. (The reference standard shall be the brightness of two or more 10-watt incandescent bulbs for each 10 m length of the car.)

9.11.4 Accommodations for standing passengers shall be as shown below.

(1) Accommodations for standing passengers may be provided [when] limited to the floor space other than the floor space provided for use by dedicated seating.

For example, the standing capacity shall be calculated by dividing the floor area where the effective width not less than 550mm and the effective height not less than 1900mm are secured from which the seat areas and the area of 250mm from the front end of the seats are excluded in the passenger cabin floor area, by the area occupied by a passenger. The calculated value shall be an integer by rounding number after the decimal point. The area occupied by a passenger shall be 0.3 m^2.

(2) Hand straps, hand rails and other facilities to ensure the safety of passengers shall be provide.

9.11.5 Seats shall be as shown below.

The passenger car shall be provided with the appropriate number of passenger seats by taking into consideration the application of the rolling stock, the section of track it will use, etc.

For example, the seating capacity shall be calculated by dividing the seat width by the length occupied by a passenger. The calculated value shall be an integer by rounding numbers after the decimal point. The length occupied by a passenger shall be 430mm or more.

9.12 Structure of Passenger Entrance and Exit

9.12.1 Entrance/exits for passenger getting on and off shall be provided on both sides of passenger cars.

9.12.2 The function and structure of entrance/exit for passenger shall be as shown below.

(1) The effective width of the entrance/exit for passenger getting on and off shall be 1300 mm or more and the effective height shall be 1800 mm or more. However, the effective width for entrance/exits wheelchairs shall be 800 mm or more.

(2) Entrance/exit for passenger shall have sliding doors or slide-type plug doors.

(3) The gap between the floor surface of the entrance/exit for passenger and the border of the platform shall be as small as possible within the range that there is no danger of rolling stock travel being impeded.

(4) The height of the floor surface of the entrance/exit for passenger and the height of the edge of the platform shall be as even as possible.

(5) The floor surface of the entry and exits shall have a patterned-indented surface or the material, etc., used for the surface shall be slip resistant.

(6) Facilities shall be provided for audio notification of the side where the door of the passenger entrance/exit is opened and closed.

(7) The step height in rolling stock shall be easily identifiable by means of a large difference in brightness between the color of the edge of the step and that of the surrounding portion, etc.

9.12.3 An automatic door operating device shall be provided for the entrance/exit for passenger getting on and off doors.

9.12.4 The function and construction of the door operating device provided on entrance/exit for passenger getting on and off doors shall be as shown below.

(1) The crew shall be able to perform unified opening or closing operations and confirmation of the open or closed state of the doors.

(2) The operating device shall be capable of being electrically or mechanically locked.

(3) The doors shall have a structure that will not enable them to open even if the lock in (2) is released during travel and the door operating device is set to the release position.

(4) There shall be lamp provided that automatically illuminates when the entrance/exit door for passenger is opened, and this lamp shall be as follows.

1) It shall be provided at the top part on both of the side surfaces of the rolling stock.

2) It shall be red.

3) It shall be easily recognizable from among other lamps.

(5) A device that enables the doors to be manually operated during an emergency shall be provided on the inside and outside of the rolling stock. In this case, the device on the inside shall be capable of being easily operated by passengers. However, this shall not apply to the following rolling stock.

1) In dedicated underground structures, rolling stock traveling on sections of track where the space between the structure gauge and the rolling stock gauge is small.

Note 1: Excluding rolling stock traveling on sections where evacuating from the side of the train is possible.

Note 2: "In . . . underground structure, rolling stock traveling on sections of track where the space between the structure gauge and the rolling stock gauge is small" means that of the passenger cars of an underground railway, these are the rolling stock that travel on section of track where the space between the structure gauge and the basic limit of the rolling stock gauge at the side section less than 400 mm.

(6) For the device in (5) (limited to devices that are installed on the inside of the rolling stock), the location, operating instructions and precautions of the operating device shall be displayed so as to be easily visible by passengers. However, this shall not be displayed in the rolling stock indicated in (5) 1).

9.12.5 Doors at entrance/exits for passengers shall have a structure whereby it is not possible to depart until after the doors are closed.

9.12.6 Doors at entrance/exits for passengers shall take the safety of the passengers into consideration, such as by a structure that reduces the speed of the doors just prior to them closing.

9.13 Structure of Gangway Entrance and Gangways

9.13.1 The dimensions of passageway and gangway facilities shall be as indicated in the following table.

Table 9.6

Type of rolling stock	Required number of passenger ways	Required number of gangways	Effective width of passenger ways and gangways	Effective height of passenger ways and gangways
Passenger cars operating one dedicated car (Of passenger cars used in subways, etc., excluding rolling stock operated on sections where the space between the structure clearance and basic limits of the rolling stock clearance at the side section is less than 400 mm and rolling stock operated on sections of track with third rails.)	0	0		
Passenger car	2	2	600 mm or more	1800 mm or more
Rolling stock that serve as the front-most or rear-most part of the train. Rolling stock with special measures taken (Note)	1	1		
Rolling stock travelling on sections where the space between the structure clearance and basic limits of the rolling stock clearance at the side section is less than 400 mm.	2	2		
Rolling stock or more operating as dedicated single car	2	0		
Rolling stock that serve as the front-most or rear-most part of the train.	2	1		

Note: "Rolling stock with special measures taken" means when any one of the following measures has been taken for the rolling stock of the coupled sections when the rolling stock on a passenger train is comprised of coupled consists of two or more cars.

(a) When there is a crew member (hereafter, the security crew member) in each of the coupled trains that can provide guidance and evacuate passengers in the event of an emergency.

(b) When there is a security crew member in either of the coupled trains, and there is a function provided on the emergency communication devices in all rolling stock forming said passenger train that enables communication between passengers and the security crew member.

9.13.2 Passage way and gangway structure shall be as shown below.

(1) The following door that is capable of being securely closed during normal times shall be provided at the passageway at the front end that will serve as the front-most part of the train or at the rear end that will serve as the rear-most part of the train.

1) When this is a hinged door, it shall be capable of maintaining the released condition when it is on the coupled side.

2) If it can be easily touched by passengers, it shall have a construction that will not cause a dangerous condition when inadvertently operated by a passenger.

(2) Other than when the door indicated in 9.13.2 (1) is provided, this shall be a sliding door.

(3) A diaphragm and gang plank, etc., shall be provided at a gangway free of substantial differences in height, etc., that would impede passage so as to enable safe passage.

9.14 Couple Device

9.14.1 The couple device for the rolling stock (except connecting bogies and structures similar to that) shall be as indicated below.

(1) Shall be rugged and have sufficient strength to withstand operation.

(2) It shall not release due to vibration and impact.

(3) It shall automatically couple by the tight contact of rolling stock to rolling stock. However, this shall not apply to coupling devices provided on fixed-coupled rolling stock and coupling device for rescue, etc.

(4) It shall have a shock absorbing function. However, this shall not apply to coupling devices provided on fixed-coupled rolling stock and coupling device for rescue, etc.

9.14.2 The air piping coupling device shall not be caused to leak air due to vibration [and/or] impact.

9.14.3The electric wiring coupling device shall prevent mixed contacts or short circuits due to the ingress of water, vibration [and/or] impact.

9.15 Equipment of a Driver's Cabin

9.15.1 A driver's cabin or crew's cabin shall be provided with the facilities shown in the following table. Moreover, these facilities shall be capable of being easily operated or confirmed by the crew.

Table 9.7

Type of Crew Room	Facilities Provided	
1 Driver's Cab	(1)	Operating devices for control facilities
	(2)	Operating devices for service brake devices
	(3)	Transmitting devices and receiving devices for sign devices and communication devices (limited to rolling stock provided with said equipment)
	(4)	Speedometer
	(5)	Aspect facilities of onboard signal equipment (limited to rolling stock operating on sections of track using onboard signal equipment)
	(6)	Operating device for raising and lowering the pantograph (limited to rolling stock provided with pantograph)
	(7)	Transmitting devices and receiving devices for security communication devices (limited to the said devices provided on the rolling stock)
	(8)	Warning generating devices and transmitting devices for alarm signal facilities
	(9)	Whistle activation device
	(10)	Pressure gauge indicating pressure of main air tank piping
	(11)	Operating devices for front marker lamps
	(12)	Receiving devices for emergency communication devices or device indicating the operating status of an emergency stop device (Limited to rolling stock provided with emergency alarm device or emergency stop device)
	(13)	Door closed confirmation device for entrance/exit for passengers
2 Conductor's room	(14)	Operating devices for service brake devices (Limited to those items for rapidly stopping the rolling stock)
	(15)	Sign devices or transmission devices and receiving devices for communication devices (Limited to rolling stock provided with sign devices or communication devices)
	(16)	Transmission device for onboard public address device
	(17)	Operating device automatic door closing device for entrance/exit for passengers
	(18)	Receiving devices for emergency communication devices or device indicating the operating status of an emergency stop device (Limited to rolling stock provided with emergency alarm device or emergency stop device)

9.15.2 In addition to the above, the following devices shall be provided in the cab.

(1) A device shall be provided that automatically and rapidly stops the rolling stock when the staff person operating the propulsion car become sick, etc. (hereafter, operator abnormality train stop device). However, this shall not apply to rolling stock operated on sections of underground or elevated track with automatic train operation device, automatic brake device or automatic train stop device (limited to devices where there is no danger of the normal speed limited being exceeded).

(2) The operator abnormality train stop device shall not be capable of easily releasing the function manually.

9.15.3 The speedometer shown as table 9.7.(4) in the table in 9.15.1 shall comply with the standard "JIS E 4603 Electric Measuring Speedometers for Railway Rolling Stock" or have performance equal to or better than it.

9.15.4 The transmitting device for the warning signal facility shown as table 9.7 (8) in the table in 1 shall automatically switch to a power supply from a separate electrical source even when the main electric power supply and electrical power supply from the storage battery shown in the Interpretive Criteria relating to Article 9.20 have been interrupted. However, this shall not apply to the following.

(1) When the power supply from storage battery shown in the Interpretive Criteria relating to Article 9.20 is automatically supplied by a separate circuit from the power supply circuit from the main electric power supply and there is no danger of the electrical power supply being interrupted by a collision.

(2) When the storage battery shown in the Interpretive Criteria relating to Article 9.20 is installed inside and there is no danger of the power supply being interrupted by a train collision, etc.

(3) When used in combination with a device that can be used even when the supply from the main electrical power supply and the storage battery shown in the Interpretive Criteria relating to Article 9.20 have been interrupted.

9.15.5 The pressure gauge shown as table 9.7 (10) shall display the regulator inflow pressure and the release pressure. However, this shall also include digital pressure gauges using a different display method when below the inflow pressure and when above the release pressure (meaning a pressure gauge that displays respective pressures intermittently for a preset interval)

9.15.6 The following shall apply to rolling stock traveling on sections of track provided with automatic train stop device, automatic train brake device and automatic train operation device.

(1) Indicator device indicating the operating status of said device and an operating device shall be provided in the cab that is being used for operation.

(2) A release switch for the onboard facilities shall be provided.

(3) The release switch shall not be capable of being operated while the staff member is in the normal operating position, or said switch shall be covered by a switch cover, etc.

9.16 Internal Pressure Vessels and Other Pressure Supply Sources and Other Accessories

9.16.1 The following shall apply for the pressurized vessels and its attached device.

(1) A safety valve shall be provided at the main air tank or at a location near to where the air piping connects to the said air tank.

(2) The main air tank shall be provided with a drain cock (this shall include a drain plug on the main air tank that receives its air supply from a compressor provided with a desiccant filter unit) or an automatic drain device. In addition, of the drain cocks indicated above, a protective device shall be provided on those for which there is the danger of damage due to impact from a foreign object during operation.

(3) The pressurized vessels and its piping shall be mounted so as to be protected from damage due to vibration or shock.

(4) Pressurized vessels shall be provided in a place where it is easy to inspect.

9.16.2 Rolling stock equipped with an air compressor shall be provided with a regulator. However, when two or more air compressors are installed on a train and they are connected by air piping, it is acceptable not to provide a regulator with each compressor.

9.16.3 The following shall apply for the accumulator and its attached device.

(1) A safety valve shall be provided at the accumulator or at a location near to where the hydraulic piping connects to the said accumulator.

(2) The accumulator and its piping shall be mounted so as to be protected from damage due to vibration or shock.

(3) Accumulators shall be provided in a place where it is easy to inspect.

9.16.4 A hydraulic pump shall be provided with a regulator.

9.17 Rolling stock Accessory Devices

9.17.1 Rolling stock shall be equipped with the following attached devices.

(1) Sign device:

(2) Communication device:

(3) Whistle device:

(4) Public address system:

(5) Emergency alarm Device:

(6) Emergency stopping device:

(7) Marker light:

(8)Onboard guidance equipment

(9) Destination guidance devices

9.17.2 The following shall apply the sign device.

(1) A sign device shall be provided on rolling stock on which the departure sign is performed by the conductor.

(2) Transmission and receiving shall only be performed reciprocally among crew members.

(3) It shall have a structure in which the function cannot be easily cancelled by the decision of the receiver.

9.17.3 The following shall apply the communication device.

(1) A communication device (including a portable communication device) shall be provided on passenger trains. However, this does not apply to rolling stock operated as a single car.

(2) Transmission and receiving shall only be performed reciprocally among crew members. However, this does not apply when it has a function that gives priority to reciprocal communication among crew members and will not impede crew member communication.

(3) It shall have a structure in which the function cannot be easily cancelled by the decision of the receiver.

9.17.4 At the front part of the first car of trains shall be provided a whistle device that has sufficient volume capable of warning danger.

9.17.5 An onboard public address device shall be provided that enables guidance information to all rooms on passenger cars.

9.17.6 The following shall apply the emergency alarm device.

(1) An emergency alarm device shall be provided on passenger cars. However, this does not apply to the rolling stock provided with an emergency stop device.

(2) The transmission device of the said device shall be provided in the room of passenger cars provided with an emergency alarm device.

(3) The location and operating instructions shall be displayed at the emergency alarm device or near to it so as to be easily visible by passengers.

(4) It shall not be possible to manually cancel the function.

(5) On passenger cars provided with an emergency alarm device, a lamp shall be provided that automatically lights on when the said device is operated. However, this does not apply when the location of the emergency alarm device that has been operated can be confirmed by the crew in the driver's cab and conductor's room.

(6) The lamp in (5) shall be provided at the top part on both of the side surfaces of the rolling stock and shall be easily distinguished from other lamps (except lamps that automatically light on when the emergency exit is opened and when emergency stopping device are operated).

9.17.7 The following shall apply the emergency stopping device.

(1) The operating device for the emergency stopping device shall be provided in the room of passenger cars provided with an emergency stopping device.

(2) The location and operating instructions shall be displayed at the emergency stopping device or near to it so as to be easily visible by passengers.

(3) It shall not be possible to manually cancel the function.

(4) On passenger cars provided with an emergency alarm device, a lamp shall be provided that automatically lights on when the said device is operated. However, this does not apply when the location of the emergency stop device that has been operated can be confirmed by the crew in the driver's cab and conductor's room.

(5) The lamp in (4) shall be provided at the top part on both of the side surfaces of the rolling stock and shall be easily distinguished from other lamps (excluding lamps that automatically

light on when the emergency exit is opened and when an emergency communication device is operated).

9.17.8 The following shall apply for marker lights.

(1) White-color front marker lights shall be provided at a symmetrical position to the center surface of the rolling stock on the front surface of rolling stock having a driver's cab. Furthermore, at night, it shall be possible to confirm that the lights are on from the front of the rolling stock, and shall be possible to reduce the light intensity or changing the direction of the light beams downward.

(2) Rear markers shall be provided on the rear surface of the rolling stock of the rear end part of the last car of a train. The rear markers should be red lamps and shall be capable of shining from the rear of the rolling stock at night.

(3) The rear marker lights on the front surface of the rolling stock and front marker light on the rear surface of the rolling stock shall not provide confusing lamp lights.

9.17.9 In the passenger car, Equipment for displaying by characters, etc., and equipment for audibly providing the name of the next station the train is going to stop at and other information relating to the operation of the train must be provided.

9.17.10 The destination and type of service of the train must be clearly displayed on the side of the car body. However, this shall not apply when the destination and type of service are clearly known.

9.18 Rolling Stock Indication

9.18.1 Rolling stock shall have indication necessary to be properly identified. The indication for rolling stock shall be as shown below.

(1) Rolling stock shall have the indication such as code, number, etc., in order to identify individual rolling stock.

9.19 Countermeasures against Rolling Stock Fire

9.19.1 The countermeasures against rolling stock fire shall be as shown below.

(1) The countermeasures of wiring, equipment, etc., against rolling stock fire shall be as shown below.

Table 9.8

Wiring	Items near to or connected to equipment for which there is the danger of arcs or heat being generated.	Cover with extremely flame retardant material (including incombustible material, hereinafter the same.)
	Other than the above	Cover with extremely flame retardant material (including incombustible material, hereinafter the same.). However, this does not apply to items for which there is no danger of mixed contact or shorting.
Electrical Equipment	Equipment for which there is the risk of arcs or heat being generated.	Shall isolate from, walls, etc., and as necessary provide insulation and incombustible heat-resistant plate between them.

(2) The countermeasures against rolling stock fire for passenger cars shall be as shown in the following table

Table 9.9

Part		General Passenger Cars
Roof	Roof (Note 1)	Metal or equal to or better than the incombustibility of metal(Note 2)
	Roof top surface	Shall be covered with a flame retardant insulating material (limited to passenger trains that travel on sections of track with electrified overhead contact line)(except extremely high voltage contact lines)
	Equipment and hardware mounted to the roof	The mounted part shall be insulated from the car body or shall be covered with a flame retardant insulating material (limited to passenger trains that trains that travel on sections of track with electrified overhead contact line)(except extremely high voltage contact lines)
External sheeting	End section	Incombustible Shall use incombustible material for the surface paint (Note 4)
	Other than end section	Incombustible Shall use incombustible material for the surface(Note 4)
Passenger room	Ceiling	Incombustible Shall have resistance to burning due to radiant heat, and shall have resistance to melting and dripping (Note 3) Shall use incombustible for the surface paint (Note 4)
	Inside panel	Incombustible Shall use incombustible material for the surface paint (Note 4)
Heat insulation and Noise insulation		Incombustible
Floor	Floor	Structure where there is little risk of smoke and fire flowing
	Floor covering	Flame retardant
	Filler material under floor covering (Note 5)	Extremely flame retardant
	Floor panel	Metal floor sheeting or equal to or better than the incombustibility of metal (Note 2)
	Underfloor surface ((Note 6)	Shall be incombustible or surface covered with metal and shall use incombustible material for the surface paint (Note 4)
Underfloor equipment box (Note 7)		Incombustible. However, flame retardant when the need for insulation is unavoidable
Seat	Fabric	Flame retardant
	Filler	Flame retardant

	When electric heater is provided under the seat	Provide incombustible heat-resistant plate in between heating element and seat
Window shade	Window shade	Flame retardant
Gangway bellows	Gangway bellows	Flame retardant

Note 1: "Roof" means the section above the rain trough or rain gutter of the upper structure of the car body, but when the rain trough or rain gutter is located inward of one-third the maximum car body width as measured from the centerline of the car body, "roof" shall mean the section up to one-third the maximum width of the car body respectively as measured from the centerline of the car body. However, when part of the roof is in integral part of the external sheeting of end section, the said section shall be the "end section" of the "external sheeting" shown in (2) of the table.

Note 2: The expression "equal to or better than the incombustibility " for "roof" and "floor" means that the non-combustion performance is equal to or better than the metal used on the existing roof and floor sheeting, which is different from the stipulation for incombustible in the combustibility standards for materials used in railway rolling stock.

Note 3: The material for ". . . have resistance to burning due to radiant heat, and shall have resistance to melting and dripping . . ." shall, in addition to ceiling materials, include main facilities for air conditioning outlets, etc., installed in upper section of passenger rooms. However, excluding small items, etc., that will not affect the spreading of the fire.

Note 4: "Surface paint" means the most outer coat of paint when there are multiple coats.

Note 5: "Filler material under floor covering" means the filler for floors with keystone construction, and the hardboard, water-resistant veneer, etc., that are sandwiched between metals or between metal and flooring material are included in the stipulations for filler material.

Note 6: When a metal sheet is affixed under the underfloor surface so that hot air from equipment installed underfloor will not affect the underfloor surface, the said metal sheet shall be deemed the "underfloor surface."

Note 7: The covers for relays, etc., are not included in "underfloor equipment box."

(3) Non-combustible, extremely flame retardant and flame retardant are used in the tables in (1) and (2) are according to the standards in the following table which are based on the following Test Method I for Non-Metallic Materials for Use on Railways.

Table 9.10 Combustibility Standards for Materials for Use on Railways

Classification	During Burning of Alcohol				After Burning of Alcohol			
	Ignition	Flame	Smoke	Flame Condition	Residual Flam	Residual Ash	Carbonization	Deformation
Non-combustible	None	None	Negligible	☒	☒	☒	100mm or less discoloration	100mm or less surface deformation
Extremely flame retardant	None	None	Little	☒	☒	☒	Does not reach top edge of test piece	150mm or less deformation
	Yes	Yes	Little	Weak	None	None	30mm or less	
Flame retardant	Yes	Yes	Normal	Flame does not exceed top edge of test piece	None	None	Reaches top edge of test piece	Deformation that reaches edge, localized penetrating holes

Note: Dimensions of carbonization and deformation are shown on major axis.
Items that burn abnormally shall have one rank lower classification.
Determinations shall be according to the following test methods.

Test Method I

In the Test Method I for Non-Metallic Materials for Use on Railways a B5-size (182 x 257 mm) test material is held at a 45 degree angle as shown in the figure and the center of the bottom of the fuel container is placed on wood platform, such as cork, having a low heat conduction ratio so that it will be positioned 25.4 mm (1 inch) perpendicularly below the center of the bottom plane of the test piece. The fuel container is filled with 0.5 cc of pure ethyl alcohol, which is ignited and allowed to burn until consumed.

The determination of combustibility is classified into during burning and after burning, with ignition, flame, smoke condition and flame condition, etc., of the test material being observed during burning and residual flame, residual ash, carbonization and deformation being investigated after burning.

In regards to the pre-test treatment of the specimen, when the material has absorption characteristics, it shall be finished to the prescribed dimensions and left in the ventilated rooms for 5 days above 1 m or more apart from the floor surface avoiding the direct sunshine. The conditions in the test room shall be as follows, without any flow of air.
Temperature: 15 to 30 degrees Celsius, Humidity: 60% to 75%

General Sketch of Test Method

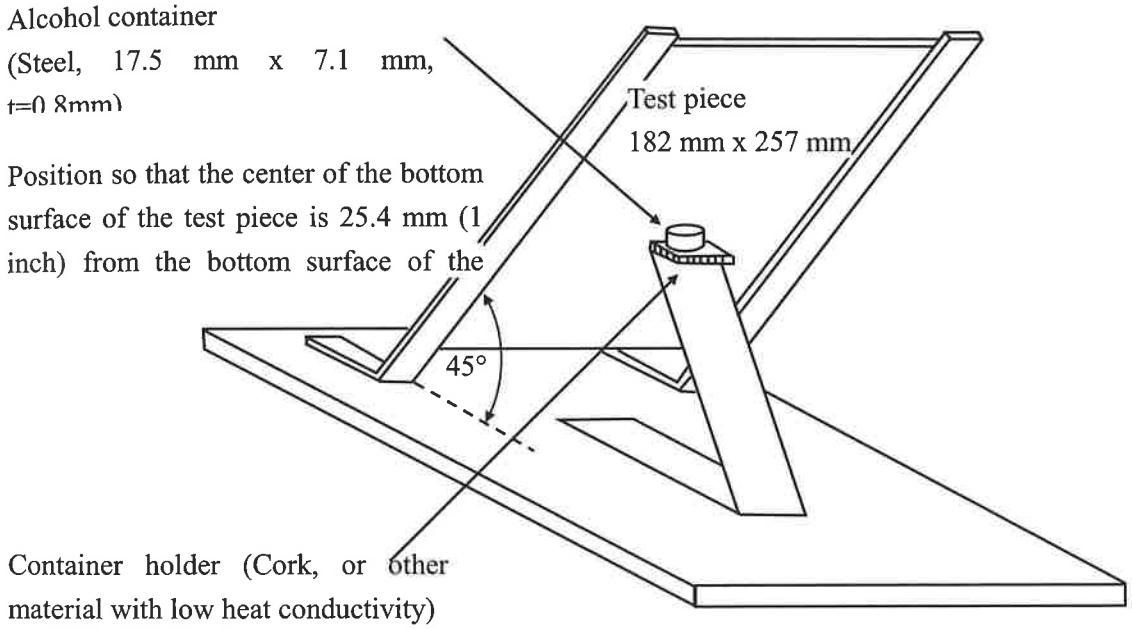


Fig. 9.2General Sketch of Test Method

(4)" . . . shall have resistance to melting and dripping . . ." used in the table in (2) means that the surface of the material shall maintain its smoothness after the alcohol in the Test Method I for Non-Metallic Materials for Use on Railways has been burned .
(5)"Resistance to burning" in the table in (2) shall be according to the following standard which is based on the Test Method II for Non-Metallic Materials for Use on Railways.

Table 9.11

Overall heat value(MJ/m2)	Ignition time (Sec)	Maximum heating speed (kW/m2)
8 or less	☒	300 or less
Exceeding 8 and 30 or less	60 or more	

Test Method II

Test Method II for Non-Metallic Materials for Use on Railways applies ISO 5660-1: 2002 as shown in figure, where a square test specimen having a smooth surface and width and length of 100mm and thickness of up to 50 mm is exposed to a radiant heat of 50 kW/m2 for 10 minutes.

This test verifies whether the difference between the average value of the maximum heating speed of three test specimens and the maximum heating speed of each test specimen is less than 10%, and if less than 10%, the data of the said three test specimens will be adopted. In the event that the difference was 10% or more, the tests shall be conducted on another three test specimens, and among the six test specimen sheets, the data of the four test specimens of which the maximum value and the minimum value of the maximum heating speed are excluded shall be used. The combustion determination shall be based on the total heating value (MJ/ m2) and the maximum heating speed (kW/ m2) and ignition time (seconds) during the test.

The ignition time (seconds) shall be the time from the start of the test until the initial ignition is confirmed. The initial ignition is deemed to be the case that the flame has existed for 10 seconds or more.

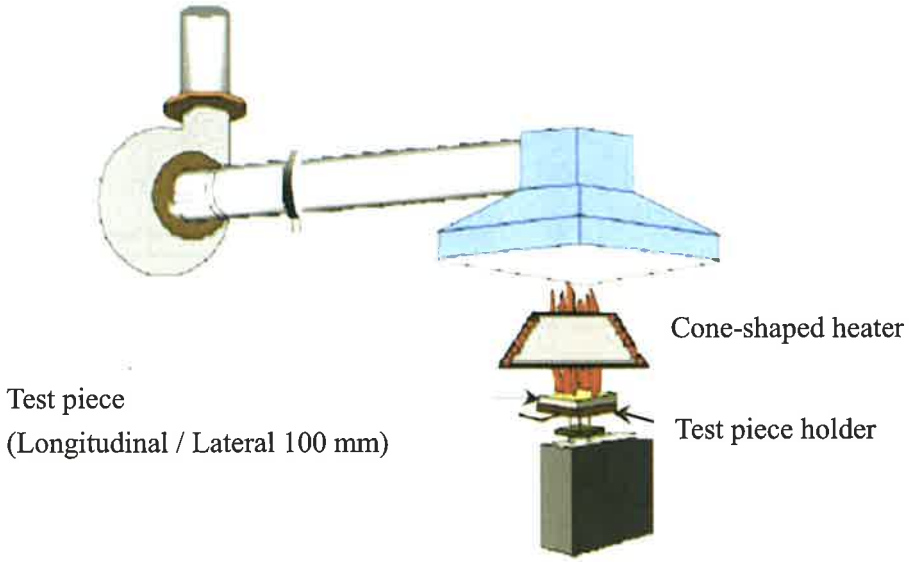


Fig. 9.3 General Sketch of Test Method II

(6) The appropriate fire extinguisher shall be provided for passenger cars. Furthermore, the location of the fire extinguisher shall be shown in a position that can be easily seen by passengers. However, this does not apply when the fire extinguisher can be easily seen by passengers.

9.19.2 A gangway door, etc., having a function to close it during normal operation, shall be provided on rolling stock with connecting rooms on passenger cars. However, if the

connecting section is the crew room, it is acceptable that the door for the gangway entrance be one that is easily closed.

9.20 Function of Devices at Power Failure

9.20.1 The devices or equipment needed to secure the safety of both train operation and passengers shall be able to function for a fixed period of time even after the main power supplies source is interrupted.

9.20.2 When the devices, etc., indicated in the following table are provided, their functions shall be ensured for a fixed period of time by a storage battery even when the power supply from the contact line has been interrupted or when the failure of a generator, etc., causes a state of interrupted power supply.

Table 9.12

Item	Device, etc.
Brake devices	☒ When electric circuits are used for brake operation.
Passenger room construction	☒ Ventilation for rolling stock provided with force-air ventilation (When appropriate to [Normal operation] of Approved Model Specifications relating to Article 9.11.2.table 9.5) ☒ Lighting devices or auxiliary lighting devices.
Construction of entrance/exits for getting on and off of passengers	☒ Automatic door closing device ☒ Door open indicator lamps for entrance/exits for getting on and off of passengers. ☒ Indicator of location and operating method of the door opening device (limited to when this device is provided on the inside of the rolling stock) that enables doors to be opened manually in case of emergency.
Construction of emergency exits	☒ Indicator of location and operating method for emergency exits. ☒ Door open indicator lamps for emergency exits.
Crew room facilities	☒ Aspect facilities for onboard signal equipment ☒ Train stop device in case of driver's abnormality ☒ Cut-out switch for onboard facilities, devices indicating operating status of automatic train stop device, automatic train control device and automatic train operation device. ☒ Device indicating door-opening/closing status of emergency exit. ☒ Door closed confirmation device for entrance/exit for getting on and off of passengers.
Devices attached to rolling stock	☒ Sign device ☒ Whistle ☒ Communication device ☒ Public address device ☒ Lamps that light on for indicating the functions of the emergency alarm device/emergency stop device, the location and operating method indicators, and

	lamps that light on when the emergency alarm device/emergency stop device are operated. ☒Rear marker lights
Rolling stock facilities for trains, etc., stationed by a single driver	☒Onboard facilities for safety communication facilities
Other facilities	☒Operating condition recording device

9.21 Rolling Stock Facilities for One Man Operation

9.21.1 The train stationed by a single staff member who drives the motive power car shall not only abide by the rules stipulated in the previous Article 9.1 through the 9.20, but also comply with the following standards.

(1) A passenger car that runs in the underground structure or other sections that make a quick evacuation of passengers difficult at the time of emergency shall be equipped with appropriate measures to maintain passengers' safety in case of emergency, including the installation of automatic notification system to inform to stations or control centers that the device under paragraph 6 to of Article9.17 has been triggered.

(2) A crew that operates a motive power car shall be able to communicate without difficulty with station or operation control center at the regular operating position when needed safety.

(3) As for a passenger car, a crew that operates a motive power car shall be able to manipulate the passenger doors and make necessary announcement easily from the regular operating position.

(4) A train without a crew to operate the motive power car shall abide by the rules or standards covered from the Article 9.1 through the preceding Article. Further, safety device that enables passengers in a passenger car to communicate with operation control centers and other security measures to maintain passengers' safety shall be installed. This rule does not apply, however, to the case when crew onboard can secure the safety in case of emergency.

9.21.2 The following shall apply to trains stationed by a single staff member who drives the motive power car.

(1) Rolling stock for trains stationed by a single staff member who drives the motive power car shall be according to the Approved Model Specifications relating to Article 9.1 through to the preceding article 9.20. However, the facilities that should be installed in the conductor's room shown in the table for Item 1table 9.7 of the Basic Items of Approved Model Specifications relating to Article 9.15, Basic Item 3 and Items 5, 6(1) of the Basic Items of Approved Model Specifications relating to Article 9.15 does not apply.

(2) Shall be provided with an onboard public address device that enables guidance information to all rooms in passenger cars.

(3) An emergency alarm device shall be provided on passenger cars. However, this does not apply to the rolling stock provided with an emergency stop device and the rolling stock operated as one) car.

(4) On passenger cars, a device for operating the onboard public address device and the automatic door operating device for entry/exits for the getting on and off of passengers shall be provided in the driver's cab of rolling stock serving as the front section of the first car of a passenger train.
(5) The device for operating the onboard public address device and the automatic door closing device for entry/exit for the getting on and off) of passengers shall be capable of being easily operated when the crew member is in his/her regular operating position.
(6) The operating device for the automatic door operator shall be in position that enables easy confirmation of the condition of the passengers at the station through the use of car-side mirrors, etc. However, when the condition of the passengers is confirmed by a window provided on the side surface, it shall be the position where the crew confirms the getting on and off of the passengers.
(7) On the rolling stock operated on sections where the space between the structure gauge and rolling stock gauge is small, shall display the method for opening the said gangway door near the gangway entrance that serves as the rear part of the last car of a train.
(8) The rolling stock that do not indicate the location, etc., of the device for enabling the door to be manually opened inside of the car, shall be provided with a function that enables communication to the train dispatcher, etc., and that enables onboard announcements to the passenger room from the train dispatcher, etc., in case that notification from the passenger room to the crew cannot be ensured.
(9) The following devices shall be provided in the driver's cab.
1) Train stopping device in case of driver's abnormality shall be provided in the cab. However, this does not apply to the rolling stock operated by automatic train operation device on sections of track with underground construction or elevated construction and also the rolling stock without passengers onboard being operated on sections of track with underground construction or elevated construction by automatic train brake device or automatic train stop device (limited to devices where all the time there is no danger of the limited speed being exceeded).
2) When a device in 1) is provided on passenger cars for subways, etc., a device shall be provided to automatically notify a station or an operation dispatch center when a device in 1) operates.
3) A device in 1) shall not be capable of easily releasing the function manually.
4) On the rolling stock operated on sections where the space between the structure gauge and rolling stock gauge is small, the doors between passenger rooms adjoining to the crew room at the rear section of the train (limited to crew rooms provided with a gangway exit) shall have a function that enables the door locks to be released from the driver's cab.
(10) The following onboard facilities for safety communication facilities shall be provided in the driver's cab.
1) On the rolling stock serving as the front part of the train, shall be provided onboard security communication facilities that enable transmission and receiving between a station and an

operating dispatch center. However, this does not apply when communication is performed by communication facilities provided at wayside.

2) Onboard facilities for the safety communication facilities shall not be capable of easily releasing the function manually and shall not be combined with onboard public address system and emergency alarm device.

9.21.3 For trains without a staff to drive the motive power car, the following shall apply in addition to the Approved Model Specifications relating to Article 9.1 through the preceding article.

(1) Trains without a staff onboard shall comply the following standards.

1) Passenger rooms shall be provided with onboard communication facilities that enable transmission and receiving with the operating dispatch center.

2) On railways with underground construction and other railways where the track cannot be used as an evacuation route, if a passenger attempts to open a getting on/off door, etc., on a running train, the said train shall automatically be stopped.

3) On railways with underground construction and other railways where the track cannot be used as an evacuation route, it shall not be easy for a passenger to open/close the train doors for getting on/off

4) On railways with underground construction and other railways where the track cannot be used as an evacuation route, it shall be possible for the train dispatch center to stop the rolling stock.

5) It shall be possible to confirm the abnormalities of rolling stock from the train dispatch center.

(2) The following standards shall apply to the trains stationed by a single staff member other than the driver.

1) In the crew room, shall be provided onboard facilities for the safety communication facilities that enable transmission and receiving with the train dispatch center.

2) When the staff member cannot perform stopping operations at the time of emergency, it shall be possible for the train dispatch center to stop the rolling stock.

3) Shall be according to the stipulations of Items 9.19.2 (7) to (8) and (9) 4).

9.22 Devices to Record the Train Operation

9.22.1 For trains shall be installed. The "Device for recording the operating condition of trains" shall be capable of recording the following items.

(1) Basic information relating to train operation

1) Time

2) Speed

3) Position (including when calculated from speed and time)

(2) Basic information relating to driver operation

1) Status of operating devices for control facilities

2) Status of operating devices for service brake devices

(3) Operation of automatic train stopping device and automatic train control device.
9.22.2 The recording of 1 shall be capable of recording the amount for the most recent one day or more.

2. Maintenance of Rolling Stock

9.23 Maintenance of Rolling Stock
9.23.1 Rolling stock shall not be used unless they are maintained to function accurately and to be safely operated.

9.24 Inspection and Field Test of Newly Manufactured Rolling Stock, etc.
9.24.1 Newly made or purchased and remodeled or repaired rolling stock shall not be used until after inspection and test run have been conducted. Test run may be omitted, however, when only a minor remodeling or repair was done.
9.24.2 Rolling stock that is suspected of failure because of derailment and other operation accidents and also that has not been used for a while shall be inspected in advance, or shall be put for test run if needed before it is put to operation.
9.24.3 When the modifications, etc. have done which may influence the static wheel load, the ratio of wheel load unbalance shall be confirmed to be appropriate by directly measuring the wheel load.

9.25 Inspection of Train
9.25.1 Main component of a rolling stock shall be inspected according to the type and traffic condition of trains.
9.25.2 A Metrorail Operator shall carry out the inspection of trains pursuant to the pre-determined content of the inspection at the pre-determined timing in consideration of the usage of the rolling stock, design method, the management method applied to them, and the traffic condition of the trains

9.26 Periodic Inspection of Rolling Stock
9.26.1 Inspection of the rolling stock shall be carried out periodically within the respective period specified in the table pursuant to the pre-determined items and methods according to their type, structure and usage. However, this does not apply to the parts of rolling stock having characteristics of anti-wear and durability, and the functions of such parts are assured to be maintained for a longer period than the period specified in the table.

Table 9.13

Kind of Rolling Stock	Period		
	Inspection of Condition And Function	Inspection of important and Critical Part	Overall Inspection
Passenger	3 months	4 years, or the period of traveled mileage of the rolling stock being not exceeding 600 thousand km, of which shorter period is selected.	8 years

9.27 Exceptions

9.27.1 In case of the rolling stock whose operation is suspended (limited to when certain measures to prevent corrosion, deformation, degradation of electric insulation, etc., possible to occur during such suspended period have been applied to such rolling stock if they are the rolling stock other than those of trackless electric car), such suspended period shall not be counted in the calculation of the period for the inspection interval stipulated in Article 9.26. However, such period not to be counted in the calculation of the period of inspection interval shall not exceed the period corresponding to the kind of inspection as specified below:

(1) Inspection of condition and function: two (2) months

(2) Inspection of important and critical parts: two (2) years

(3) Overall inspection: four (4) years

9.27.2 In case of the rolling stock whose usage for operation is then suspended, and the facility or the rolling stock such that any inspection is unable to be implemented due to a certain special reason, inspections required by the provisions of Article 9.24 to 9.26 as stated above can be postponed until such situation or reason shall cease.

9.28Records

9.28.1 Records shall be made and kept for all of the inspections, rebuilding, remodeling or repair carried out for facilities and rolling stock, according to the Article 9.24to9.26.

9.29 Workshop and Depot

9.29.1 Train workshop or/and depot shall have sufficient capacity to accommodate relevant rolling stock.

9.29.2 Rolling stock inspection facilities shall be equipped with sufficient and adequate capabilities to accommodate full inspection and repairs.

X. AUTOMATIC FARE COLLECTION (AFC)

10.1 Introduction of Automatic Fare Collection (AFC) System

10.1.1 The Metrorail operator shall introduce the AFC system in order to ensure collecting fare from passengers.

10.1.2 The ticket for the AFC system shall be contact-less IC card. But contact-less IC token can be used as the single journey ticket (hereafter, "contactless IC card" includes "contact-less IC token".)

10.1.3 In the introduction of the AFC system for the Metrorail, mutual availability with the contact-less IC cards which are used or planned to be used for the other public transport systems in Dhaka shall be secured.

10.1.4 In the introduction of the AFC system for the Metrorail, potential services such as E-cash service and Park-and-ride service shall be considered.

10.1.5 In the introduction of the AFC system, the climate conditions shall be considered.

10.1.6 The AFC system shall be designed considering passengers' safety and convenience, especially the aged, children, expected mothers, and the handicapped.

10.2 Services provided by the AFC system

10.2.1 This AFC system shall manage at least, but not limited to, these following railway services.

(1) Single journey ticket service;

(2) Day ticket service

(3) Commuter pass service

(4) Stored fare card service.

10.2.2 Personalized card service shall be taken into consideration for the commuter pass card and the stored fare card in system design.

10.2.3 All types of ticket which are anonymous shall be reusable.

10.3 Main Components of the System

10.3.1 The main components of the AFC system shall be, but not limited to:

(1) Contact-less IC cards; and

(2) Contact-less IC card handling system (including staff-pass issuing system).

(3) Ticket vending machine;

(4) Passenger gate;

(5) Ticket office machine

(6) Central server;

(7) Network facilities;

(8) Cash handling equipment;

10.4 The number of AFC Machines Provided at Stations

10.4.1 The adequate number of AFC machines at stations shall be installed corresponding to the capacity of machines and the number of passengers.

10.4.2 Layout of passenger gate shall consider separating the flow of passengers.

10.4.3 There shall be passenger gate for wheelchairs, at least one each for entering and exiting of every station.

10.5 Applicable Standards for AFC system

10.5.1 The AFC system shall follow the standards below.

(1) ISO/IEC 15408 for card security certificate

(2) ISO/IEC 18092 or ISO/IEC 14443 for data transmission between card and antenna.

10.6 Unique Card Identification Number

10.6.1 Every card shall be numbered uniquely for system identification and card stock management.

10.6.2 This unique card identification number shall be able to be inscribed on the card, as to be easily defined in case of card damage.

10.6.3 This unique card identification number shall include information of:

(1) Issue date;

(2) Issue operator code;

(3) Issue machine number; and

(4) Serial number.

10.7 Confirmation of card information

10.7.1 Information within the card shall be able to be confirmed at ticket vending machine and ticket office machine.

10.8 Monitoring

10.8.1 The AFC system shall have the system that can monitor real-time status of the AFC equipment.

10.9 Emergency mode

10.9.1 Means shall be provided to place all passenger gates in emergency mode. In an emergency mode, gates shall be opened for passengers to exit without tickets.

10.9.2 There shall be an alternative means, provided mechanically, to set all gates opened as emergency mode regardless the availability of the central server, the station server, network connection, and the power supply. Measures against fraud shall also be considered for this means.

10.10 Data Transmission

10.10.1 The Security for all data transmission shall be considered. Especially data transmission related to revenue data shall employ high-security encryption such as SSH File Transfer Protocol in order to avoid data modification.

10.10.2 The Secure measures against data loss shall be considered.

10.11 Data retain

10.11.1 The AFC system shall consider measures against any damage or loss of data. The measures shall be considered from the point of view of both software and hardware.

10.11.2 The AFC system shall consider measures against power failure or trouble.

10.11.3 The AFC system shall consider measures against network failure.

10.11.4 The AFC system shall retain backup data for 7 days or more. Targeted machine shall include, but not limited to:

(1) Ticket vending machine;

(2) Ticket office machine;

(3) Passenger gate;

10.11.5 The Central server shall retain backup data for 1 year or more.

10.12 Hardware requirements

10.12.1 Hardware design of AFC machines shall consider:

(1) Measures against vandalism (including wrenched open or damage touch-panels);

(2) Measures against fraud; and

(3) Measures against dust.

(4) Measures against leakage of water

(5) Measures against dew formation and

(6) Measures against electric leakage

10.13 Bills and coins

10.13.1 The ticket vending machine shall accept bills and coins of Bangladesh.

10.13.2 The ticket vending machine shall detect and reject fake or unacceptable bills and coins.

10.13.3 The ticket vending machine shall have escrow function.

10.13.4 The ticket vending machine shall be able to give change back to the passengers.

10.13.5 Machines such as ticket vending machine shall be designed so that station staffs do not need to touch money, unless troubles such as jamming occur.

10.14 Contact-less IC Cards

9.14.1 Shape of contact-less IC card shall be credit-card size (85.60mm×53.98mm). But the size of contact-less IC token is not limited to this size.

10.14.2 Base material of the card shall be plastic.

10.14.3 Contact-less IC Card shall be powered by a modulated radio frequency signal transmitted from read / write units of each AFC machine. Contact-less IC card shall not have battery inside.

10.14.4 Data retention period shall be at least 10 years in normal use.

10.14.5 Data transfer rate shall be at least 212kbps.

10.14.6 Data retention shall be such that even when power supply to the card is interrupted while writing the card, the card shall assure data integrity by logically retaining the previous data

10.15 High security card

10.15.1 High security card shall be applied to;

(1) Day ticket

(2) Commuter Pass

(3) Stored fare card;

10.15.2 Contact-less IC card for high security card shall be with contact-less IC chip which is certificated as at least EAL4+ of ISO/IEC 15408.

10.15.3 Access to the secure access area of the card before and after encoding (1st issue) shall be protected by encrypted authentication or other secured measures.

10.15.4 Able to handle plural, non-adjoining memory blocks as 1 file. Data reading and writing shall be handled by this file.

10.15.5 More than 2 keys shall be able to be set to each memory files.

10.15.6 Data hierarchy shall be more than 4 levels.

10.15.7 Access rights shall be created by files. Access rights shall be flexible enough to accommodate, considering the increase of other companies or operators.

10.15.8 Able to open (open means authenticate and release security) the specified files. Multiple files shall be opened by 1 authentication process.

10.15.9 File type shall be 3 or more, which include, but not limited to:

(1) Sequential access type, which is ring-buffered;

(2) Random access type; and

(3) Amount calculating type, which allows full access, deduct-only access, or add-only access with limited maximum value.

Each file type can be set to have read-only access. Each access method of each file type shall have at least 2 types of file access, secure and non-secure.

10.15.10 Command sets shall include, but not limited to:

(1) Identifying file types;

(2) Issue (format, access control, etc.); and

(3) Authenticate.

10.15.11 Data transfer shall be encrypted when secure access is required.

10.15.12 Rewriting durability shall be at least 100 thousand times.

10.15.13 Minimum data capacity shall be 2560 bytes.

10.15.14 Reading data shall be handled by file, which enables to read separate and non-adjoining blocks of data by 1 read command.

10.15.15 Writing data shall be able to be handled by file, which enables to write separate and non-adjoining blocks of data by 1 write command. Data writing shall assure data integrity by logically retaining the previous data.

10.15.16 Time required for transaction between card and read/write unit of each AFC machine shall be equal or less than 100msec. Time required does not include transaction between AFC equipment and read / write unit, nor data processing time within AFC equipment. Time required shall be calculated under following conditions:

(1) Opening multiple files;

(2) Encrypting data transmission; and

(3) Reading 240 bytes and writing 208 bytes.

10.16 Moderate security card (and token)

10.16.1 Moderate security card (or token) shall be applied to single journey ticket, in order to reduce deposit amount of the single journey ticket.

10.16.2 Security is required to avoid being copied or forged, at least to have a function that read / write units of each AFC machine can detect a copied or forged card using mutual authentication.

10.16.3 Rewriting durability shall be at least 50 thousand times.

10.16.4 Minimum data capacity shall be 240 bytes.

10.16.5 Data read at once shall be at least 64 bytes. Data written at once shall be at least 16 bytes. Data writing shall assure data integrity by logically retaining the previous data.

10.16.6 Time required for transaction between a card and read / write unit of each AFC machine shall be equal or less than 100ms. Time required does not include transaction between AFC equipment and read / write unit, nor data processing time within AFC equipment.

10.17 Ticket Vending Machine

10.17.1 The ticket vending machine must have at least following functions for passengers:

(1) Issue stored fare card, day ticket, single journey ticket, etc.

(2) Collect deposit

(3) Top-up stored fare card

(4) Show the data inside the card.

10.17.2 The ticket vending machine shall issue receipts on passenger's demand.
10.17.3 The ticket vending machine shall be able to handle at least four (4) passengers per minutes.

10.18 Passenger Gate
10.18.1 Two types of passenger gate shall be considered.
(1) Normal-width
(2) Wide-width
10.18.2 Wide-width gate shall be able to be used by wheelchairs.
10.18.3 The passenger gate shall pass at least sixty (60) passengers per minute.
10.18.4 Passenger gate shall be with horizontally swinging flap-door barriers.
10.18.5 Measures shall be taken to prevent an unauthorized person.
10.18.6 The gate status shall be indicated to passengers.

10.19 Ticket Office Machine
10.19.1 Ticket office machine shall be able to request card information to the central server.

10.20 Central Server
10.20.1 Central server shall collect and analyze information received from AFC machines.
10.20.2 Central server shall include assist terminal. Assist terminal shall show availability of following machines in each station including:
(1) Ticket vending machine;
(2) Passenger gate;
(3) Ticket office machine:
10.20.3 Central server shall be able to handle expected number of passengers.

XI. TRAIN OPERATION

1. Train Formation

11.1 Train operation plan

Metrorail Operators shall design the train operation plan which considered convenience, comfort enough in consideration for assumed passenger transportation demand, devises the suitable train working time that there is not of the problem in safety track condition, operating performance of rolling stock.

11.2 Maximum Number of Cars to be Coupled

Maximum number of cars to be coupled shall not exceed the length of the platform.

11.3 Train Brakes

A train shall be in a state in which a continuous brake works on all the axles. This rule does not apply, however, in the following listed cases and when any risk of interfering with the safe operation of the train is found.

(1) A train for which the continuous brakes do not work on some of its rolling stock due to breakdowns, etc., but coupled with such rolling stock at the middle of train and use the brakes in the foremost and the rearmost rolling stock.

(2) A train which has a broken rolling stock for which a continuous brake does not work coupled to the front or the rear of the train and supervising officials has boarded the rolling stock or taken measures so that the rolling stock should not be separated.

11.4 Train Brake Test

The driver shall confirm that the action of brakes is accurate in the following cases.

(1) When a driver boarded a train or a rolling stock (except at times when boarded by driver change at the operating position where it has been confirmed that the action of brakes is accurate);

(2) When the operating position of a train or a rolling stock has been changed;

(3) When coupling a rolling stock to a train or a rolling stock

11.5 Train Braking Force

11.5.1 Train braking force shall be sufficient in accordance with the track gradient and running speed.

11.5.2 If the shortage in break axle ratio occurs during the operation of a train, one shall notify it to the traffic dispatcher and shall receive instructions.

11.6 Operation on Main Track outside Station

Rolling stock shall not be operated on the main track outside of a station (including halts), unless they form as a train, provided, however, that this shall not apply at the time of shunting rolling stock.

11.7 Station Boundaries

Station boundaries shall be indicated as follows.

(1) As for the approaching direction of a train, outmost home indicator;

(2) As for the departing direction of a train, outmost home indicator on the opposite track.

11.8 Train Operating Position

The drivers shall operate the train at the front head of the forefront rolling stock, provided, however, that this shall not apply in the following cases.

(1) When conducting pushing operation;

(2) When conducting backward operation

11.9 Handling when Unable to Operate at Forefront Rolling Stock

When unable to operate at the forefront of a train due to breakdown, etc., the driver shall report the situation to the traffic dispatcher and shall receive instructions for the subsequent operation method.

11.10 Backward Operation of Trains

No train shall perform backward operation except for the following cases.

(1) When the track is defective;

(2) When there is a breakdown in rolling stock;

(3) When operating a train for construction;

(4) When operating a relief train;

(5) When operating to test facilities or rolling stock, etc.

11.11 Pushing Operation of Trains

No train shall perform push operation, except for the following cases.

(1) When there is a breakdown in rolling stock;

(2) When operating a relief train

11.12 Train Operation Time

Trains shall be operated based on departure time, passing time and arrival time at a specified station

11.13 Train Departure

The driver shall confirm the following when a train departs from a station

(1) A signal that instructs proceed is indicated;

(2) That it is the departure time;

(3) Door-pilot lamp of rolling stock are lit

11.14 Operating Direction between Stations

The operating direction between the stations in the double track sections shall be left-side operation, provided, however, that this shall not apply in the following cases.

(1) When conducting backward operation;

(2) When operating a relief train;

(3) When operating a train to test facilities or rolling stock, etc.

3. Track Possession

11.15 Track Possession

The following constructions or work shall be implemented only after the track possessions.

(1) Construction that obstructs or might obstruct train or rolling stock operation;

(2) Work that obstructs or might obstruct train or rolling stock operation;

(3) Use of maintenance cars.

11.16 Indication of Stop Signal during Track Possession

When conducting construction that requires track possession, using maintenance cars or conducting construction that requires power shutdown, the track shall be closed by indicating a stop signal on the route located outside the concerned section until the construction, work or the use is complete.

4. Shunting of Rolling Stock

11.17 Shunting

Shunting of rolling stock shall be carried out using one of the following methods (including shunting of trains).

(1) Method using signals;

(2) Method using signs;

(3) Method using indicators;

11.18 Shunting that Extend Outside Station

Shunting of rolling stock that extend outside of the stations shall not be conducted, provided, however, that shunting of rolling stock that extend outside of the stations can be conducted in cases when it is inevitable and the following conditions are satisfied.

(1) When there are no trains proceeding into the direction of shunting;
(2) When arrangements are made not to enable departure of a train from the adjacent station;
(3) When having received instructions from the traffic dispatcher.

11.19 Types and Indication Method of Shunting Signal

Shunting signal indicates a signal for rolling stock of shunting operation, types and indication methods show as per the following table, provided, however, that, these are specified it by need separately and shall be able to use it.

Table 11.1 Types and Indication Method of Shunting Signal

Type of signal			Stop	Proceed
Indication method	Two-position	Position light		

11.20 Indication Method of Shunting Signal Appendix (Route Indicator)

The indication method of the shunting signal appendix (route indicator) shall be as per the following (1) and (2), provided, however, that, these are specified it by need separately and shall be able to use it.

(1) Three-route indicator

Table 11.2 Three-route indicator

Direction of route		Route clear leftward	Route clear to the center	Route clear rightward
Indication method	Position light			

(2) Multi-route indicator

Table 11.3 Multi-route indicator

Direction of route		Route clear in the direction indicated by the alphanumeric figure
Method of indication	Position light	

Note: The figure indicates that the route is clear to the track No. 4.

11.21 Shunting Speed

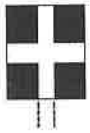
The speed of shunting rolling stock shall be as follows, provided, however, that this shall not apply at the time of shunting by using ATC system.

(1) 25km/h or less;

(2) 45km/h or less in case of shunting in accordance with shunting signals and operating at the front head of the forefront rolling stock using continuous brakes.

11.22 Indication of Car- Stop Indicator

"In cases when a shunting signal is not installed at the end of section where shunting in accordance with a shunting signal is to be conducted, the car-stop indicator shall indicate the limit of the section where the rolling stock shall be stopped when necessary, and indication method, color and form shows as per the following figure, provided, however, that, these are specified it by need separately and shall be able to use it.



Remarks: Use lamps or a reflective material

Fig. 10.1 Car-Stop Indicator

5. Storing of Rolling Stock

11.23 Prevention of Rolling of Rolling Stock

When storing rolling stock, the hand-scotch should be applied when necessary in addition to locking the brakes.

11.24 Storing of Motive Power Cars

When storing a rolling stock with motive power, necessary measures shall be taken to prevent them from self-moving, such as pulling out the key from the brake controller in addition to conducting arrangements mentioned in the preceding article.

6. Safety Assurance between Trains

11.25 Train Operation Method

11.25.1 Train shall be operated by the following methods.

(1) Method using ATC system

Method using ATC system is a method to secure the safety between trains by using ATC to control train speed in accordance with the interval with the preceding train and the route conditions.

(2) Method using substitute block system

Method using the substitute block system is a method to secure the safety between trains by using blocks as a substitute for the ATC system when it is unable to implement the system.

(3) Method using driver's attentiveness

Method using driver's attentiveness is a method to be applied based on the instruction of the traffic dispatcher to secure the safety between trains by operating trains at a speed in which the driver can stop the train within the visible distance forward when it is unable to implement the ATC system or a substitute block system.

11.25.2 When unable to apply the preceding items, it shall apply the messenger system depending on the situation.

11.26 Regular Method of Train Operation

Train shall be operated under the ATC system.

11.27 Substitute Block System

11.27.1 Substitute block system shall be used when the ATC system cannot be used due to breakdown or other reasons.

11.27.2 A substitute block system when the ATC system is unable to be implemented shall be the command-type method.

11.28 Command-type Method

11.28.1 Command-type method shall be implemented when double track operation is possible in double-track sections but unable to implement the ATC system on the up and down tracks or in either one of the tracks.

11.28.2 When implementing a command-type method, the CTC traffic dispatcher shall confirm that there is not a train or a rolling stock between stations using a device displaying the condition of train operation and the train radio.

In this case, he or she shall notify the station masters of relevant stations that the section clear status has been confirmed.

11.28.3 When dispatching a train in a section under the command-type method, the CTC traffic dispatcher shall give instructions to dispatch the train to the driver after having done the following.

(1) Confirm there are no trains or rolling stock in the relevant block section.

(2) When another train was operated under the command-type method before the train, reception of notice that the other train has arrived at the station on the other side.

11.28.4 When a train has arrived at the station on the other side in a section under the command-type method, the driver shall so notify the CTC traffic dispatcher.

11.29 Implementation of Messenger System

The messenger system shall be implemented in the following cases.

(1) In case of operating a relief train to the section due to being required from a train that stopped due to a breakdown or other reasons at a midpoint between stations (including the premises of halts. Same applies in this Article).

(2) In case of operating another train for construction to the section where a train for construction is stopping that was operated to urgently repair a breakdown of tracks between stations.

7. Running Speed

11.30 Train Running Speed

The train running speed shall be less than a maximum of 110km/h, provided, however, that it shall be on respective stipulation in the following cases.

(1) 25km/h or less; under pushing operation;

(2) 25km/h or less; under backward operation;

(3) 25km/h or less; under driver's attentiveness operation;

11.31 Speed Limit in Curves, etc.

Metrorail Operators shall establish a necessary speed limit for safety based on the physical conditions such as curve, down gradient and kind of turnout.

XII. RAILWAY SIGNALS

1. Relationship between railway signals and operation

12.1 Train Operation in Accordance with Railway Signals

Train, etc. shall be operated in accordance with the conditions shown or indicated by railway signals.

12.2 Type of Railway Signals

The types of railway signals are as follows.

(1) Signals mean those which indicate conditions for train operation in a certain section to the driver of the train, etc. by means of shapes, colors, sounds, etc.

(2) Signs mean the action among officials that indicates the intention of the sign giver to the counterparty by means of shapes, colors, sounds, etc.

(3) Indicators mean those that indicate location of things, direction, condition, etc., by mean of shapes, colors, etc.

12.3 Daytime and Nighttime Signal Aspects or Methods of Indication of Railway Signals

Railway signals having different signal aspects or methods of indication during daytime and nighttime shall be as per the following specifications (1) to (3).

(1) Daytime system from sunrise to sunset

(2) Nighttime system when it is difficult to recognize the signal aspects or indications by the daytime system in tunnels or snow shelters or due to climatic conditions.

(3) Nighttime system from sunset to sunrise

2. Cab Signal

12.4 Indication Method of Cab Signal

Types of signals and indication method of signals by cab signal (which indicate signals in the driver's cab of a train, etc.) shall be as shown in the following table.

Table 12.1 Indication Method of Cab Signal

Type of signal	Indication method
Stop signal	Light or red light with a drawing of code or letter(s) that represent stop
Proceed signal	Color light other than red light with an indication of code or figures (except 0) that represent speed

12.5 Home Indicator and Starting Indicator

The following indicators shall be displayed for the track in which a train is operated under the ATC system.

(1) Track for a train to enter the station; home indicator

(2) Track for a train to leave the station; starting indicator

12.6 Starting Route End Indicator

The starting route end indicator shall be installed to indicate the end of the outmost starting route.

12.7 Procedure when Stop Signal Aspect

In case the train has stopped due to the stop signal aspect(✖ or ⊛ signals) by the cab signal or the brakdown of the ATC system at a midpoint of stations in sections that implement ATC, the driver shall so notify the traffic dispatcher immediately and receive instructions for train operation thereafter.

12.8 Procedure after Stopping due to Stop Signal Aspect

When a train, etc. stops due to the previous Article, it shall not restart progression before following are indicated or instructed.

(1) When a proceed signal is indicated; or

(2) When being instructed to proceed; or

(3) When operating under a shunting sign; or

(4) When instructed for driver's attentiveness operation

3. Temporary Signals

12.9 Types of Temporary Signals

A temporary signal shall be installed temporarily to indicate signals in case a train, etc. is unable to run at a prescribed speed due to a breakdown of tracks or some other reason. Types of temporary signals and their indication methods shall be as shown in the following.

(1) Types of temporary signals

1) Slow-speed signal; Indicates a slow-speed signal to a train or rolling stock entering a section that requires driving at a reduced speed;

2) Slow-speed warning signal: Subordinates to a slow-speed signal and indicates a warning signal of slow-speed to a train or rolling stock;

3) Slow-speed release signal: Indicates a slow-speed release signal to a train or rolling stock which leaves a section requiring driving at a reduced speed.

(2) In cases of making trains, etc. drive at a reduced speed with the slow-speed signal, the speed shall be indicated.

(3) Temporary signals shall be used only after fixing their indication systems.

4. Hand Signals

12.10 Use of Hand Signals

Hand signals shall indicate signals with flags or lights when a cab signal is unable to be used or it is particularly necessary to indicate the signals.

12.11 Types of Hand Signals

Types of hand signals shall be as shown in the following table.

Table 12.2 Types ofHand Signals

Substitute hand signal	For use as a substitute when cab signal (limited to those which are used for trains entering or leaving a station) is unable to be used
Temporary hand signal	To be used when it is particularly necessary to indicate hand signals other than by using substitute hand signals

12.12 Indication Method of Hand Signals

The indication method of hand signals shall be as shown in the following table.

(1)Substitute hand signal

Table 12.3 Indication Method of Hand Signals (Substitute hand signal)

Type of signal	Indication method	
	Daytime	Nighttime
Stop signal	Red flag	Red light
Proceed signal	Green flag	Green light

(2) Temporary hand signal

Table 12.4 Indication Method of Hand Signals (Temporary hand signal)

Type of signal	Indication method	
	Daytime	Nighttime
Stop signal	A red flag or red light. If neither a red flag nor a red light is available, however, an object other than a green flag shall be waved around in a circle by an arm raised high.	Red light. If a red light is not available, however, any light other than a green light shall be waved around in a circle.
Slow-speed signal	Cross furled red flag and green flag held high above the head. If flags are not available, however, extend arms to right and left and move them up and down slowly.	Flashing green light
Proceed signal	A green flag or a green light. If neither a green flag nor green light is available, raise an arm high.	Green light

12.13 Identifiable Distance of Substitute Hand Signals

A flag or a light used for hand signals shall be indicated so they are identifiable from a distance of at least 400m.

5. Special Signals

12.14 Special signals

A special signal shall indicate signals when the need of stopping a train arises in an unexpected place. Special signals shall have the following types and indication methods.

Table 12.5 Special signals

Type of special signal	Type of signal	Indication method
Fusee signal	Stop signal	Red flame from a fusee
Flash signal	Stop signal	Flashing red light
Audible signal	Stop signal	Warning sound via radio communication

12.15 Stop Arrangement Due to Special Signals

The driver shall conduct the stop arrangement of the train immediately when recognizing the stop signal being indicated with a special signal.

6. Signs

12.16 Indication of Departing Sign by Conductor

12.16.1 The conductor shall indicate a departing sign when the train departs from the station.

12.16.2 The conductor shall confirm one of the following before indicating a departure sign.

(1) A proceed signal is indicated at the starting route.

(2) A proceed hand signal is indicated.

(3) The repeater of departure signal is turned on.

(4) A departure instruction sign is indicated.

(5) A departure was instructed from a CTC traffic dispatcher

12.17 Starting Operation of Train without Depending on Departure Sign

When operating a train for which the departure sign will not be given from the conductor, the driver shall start operation of the train after confirming that conditions for departure have been satisfied.

12.18 Whistle Sign

Trains, etc. shall give a whistle sign for the following purposes

(1) When warning against danger;

(2) When there is a need to urge alert;

(3) When there is a need to inform the approach of a train;
(4) When an emergency accident occurred

7. Indicators

12.19 Train Indicator
12.19.1 Each train shall display a train indicator.
12.19.2 Types of train indicators shall be head indicator and tail indicator.

12.20 Method of Display
Train indicators shall be displayed using the following methods
(1) Head indicator; One or more white lights shall be indicated on the front of the foremost rolling stock of the train. However, it can be skipped during the daytime.
(2) Tail indicator; Two red lights shall be indicated on the back of the rearmost rolling stock of the train.

12.21 Displaying Contact Wire Terminal Indicator
A contact wire terminal indicator shall be installed at places where it is necessary to indicate a termination of an overhead contact line.

12.22 Car- Stop Marker
The car-stop marker shall indicate the car-stop on the stub station of a main line, sidetrack where shunting is frequently conducted, etc., and indication method, color and form shows as per the following figure, provided, however, that, these are specified it by need separately and shall be able to use it.

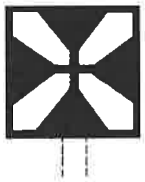


Fig. 12.1 Car-Stop Indicator

XIII. UNDERGROUND STRUCTURES AND FACILITIES

1. General Provisions

13.1 Underground Structures

Underground structures including tunnels shall be able to withstand the anticipated load. They shall also be free from any impediment for the safe car operation like the deviation of structures caused by the load and impact of the train.

13.2 Design Standards

Design standards for underground structures shall conform as follows,

13.2.1 Design Standards for Railway Structures and Commentary (Cut and Cover Tunnel)

13.2.2 Design Standards for Railway Structures and Commentary (Shield Tunnel)

13.2.3 Appropriate International Standards except above Design Standards shall be able to adopt.

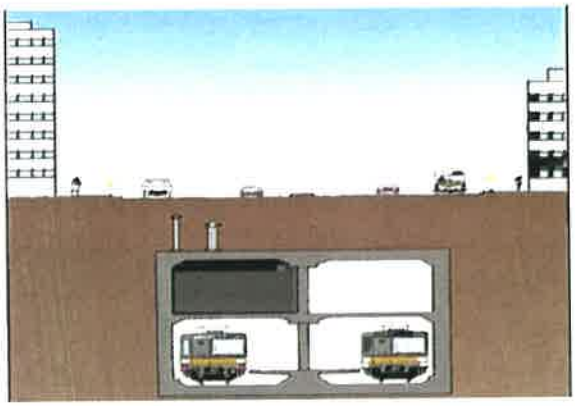


Fig.13.1 Underground Station by cut and cover

Fig. 13.2 Shield Tunnel between Stations by TBM

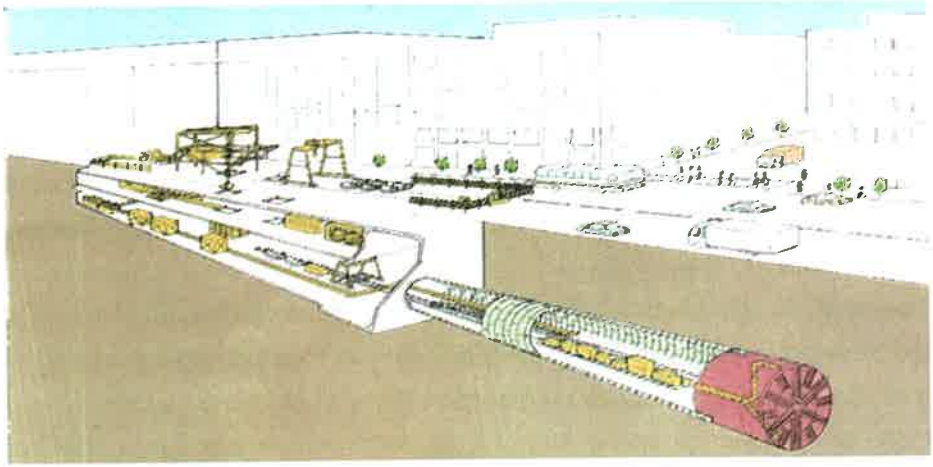


Fig. 13.3 TBM (Tunnel Boring Machine) construction method between stations

13.3 Design for measures against flooding

13.3.1 Following Structures shall be designed above critical highest flood level.

(1) Station Entrances

(2) Air Holes of Ventilation Shafts

(3) U type structure as approach between Elevated and Underground structures

13.3.2 In case of emergency, flood protection boards in front of lifts shall be equipped, because entrance of lifts are installed no higher than passage level for wheelchair users.

2. Underground Station Facilities

13.4 Station Facilities in general

13.4.1 Tunnels shall be equipped with ventilators of adequate ventilating capability. This does not apply, however, to those cases that are accessible to sufficient natural ventilation.

13.4.2 Tunnels shall be equipped with fire extinguishers, evacuation facilities and other necessary fire-prevention equipment, depending upon the structure and facility.

13.4.3 Relevant facilities or devices in tunnels shall be installed to prevent immersion and also drain appropriately.

13.5 Smoke exhaust facilities

13.5.1 Facilities that can effectively remove smoke as necessary to ensure that passengers can evacuate safely shall be provided at railway stations and between stations.

(1) The required capacity of smoke exhaust facilities shall be determined according to the appropriate International Standards such as Japanese Ministerial Ordinance Article 29.

(2) It is permissible to combine the mechanical ventilating facilities with smoke exhaust facilities

(3) If, based upon the vertical alignment of the tunnel, it can be expected that the smoke in a tunnel can be adequately exhausted by the natural ventilation openings, it is permissible not to install smoke exhaust facilities.

(4) Smoke exhaust facilities that require an electric power supply shall be provided with an emergency power source.

13.5.2 At a railway station, hanging barriers or the like shall be installed as necessary between the platform and the track, at stairways, escalators, and other locations, in order to block off the flow of smoke.

In this case, facilities that block off the flow of smoke shall mean hanging barriers protruding downward from the ceiling, or other barriers that have at least the equivalent effectiveness in blocking of the flow of smoke (including barriers that descend when activated by a detector, and can also be operated by remote control from the disaster prevention control center), and shall be made of, or covered with, non-flammable material.

13.6 Evacuation guidance facilities at station

Railway station shall be provided with the following facilities.

13.6.1 At least two different evacuation passageways from the platform to the ground level

(1) A different evacuation passageway here shall mean an evacuation passageway that does not coincide with that of another evacuation passageway.

(2) In this case, the evacuation passageway (stairways shall be limited to those of a non-spiral structure) shall enable passengers to be safely evacuated to the ground level, and the distance to the ground level shall be as short as possible.

(3) Also, as a general rule, it shall be possible to reach the ground level only by ascending from the platform.

(4) The distance between the end of the platform to the entrance or exit of the nearest evacuation passageway shall be as short as possible.

13.6.2 Lighting facilities

Lighting facilities that can instantaneously and automatically turn on the lights under emergency power in the event of a power outage, and ensure an illumination intensity of at least 1 lux at the main parts of the floor surface

13.6.3 Evacuation exit guide lights and passageway guide lights

If the distance from the end of the platform to the entrance or exit of the nearest evacuation passageway is long, passageway guide lights shall be installed on the floor, along the lower part of the walls, and at other necessary locations.

13.7 Evacuation guidance facilities at tunnel between stations

Tunnel between stations shall be provided with the following facilities.

13.7.1 Lighting facilities

Lighting facilities that can promptly power the lights by emergency power in the event of a power outage, and maintain an illumination intensity of at least 1 lux at the main parts of the floor surface of the passageway used for evacuation

13.7.2 Indicators

Indicators installed near lighting facilities powered by an emergency power source, which indicate the distance to and the direction of the railway station exit or tunnel exit.

Indicators shall be installed at a height of no more than 1.5 meters above the floor of the passageway used for evacuation, at intervals of within 100 meters, in such a way that they are adequately recognizable.

13.8 Fire extinguishing facilities

The following fire extinguishing facilities shall be provided at a railway station.

13.8.1 Fire extinguishers

Fire extinguishers shall be provided at the locations in a railway station deemed necessary for fire extinguishing activities.

13.8.2 Indoor fire hydrants

Indoor fire hydrants shall be provided at the locations in a railway station deemed necessary for fire extinguishing activities, and shall be provided with an emergency power source.

13.8.3 Internal piping for distributing water for spraying equipment or sprinkler equipment

Habitable rooms (excluding rooms relating to train operation safety) shall be provided with internal piping for distributing water for spraying equipment or sprinkler equipment that have water supply ports.

A convenience store type kiosk shall be provided with sprinkler equipment that has a water supply port.

13.8.4 Internal piping for distributing water for fire fighting

Outlets for internal piping for distributing water for firefighting at a railway station shall be provided at the locations deemed necessary for fire extinguishing activities on platforms, concourses and in passageways.

However, this does not apply in the case where indoor fire hydrants equipped with water supply ports are installed, and in addition it is deemed that they are effective for performing fire extinguishing activities.

If the distance between the outlets of internal piping for distributing water for firefighting on the platforms of adjacent railway stations exceeds 500 meters, internal piping for distributing water for firefighting shall be installed in tunnel between adjacent railway stations as well.

The distance between the outlets of internal piping for distributing water for firefighting shall be so determined as to be necessary for performing fire extinguishing activities.

13.9 Fireproofing of structures

Structures shall be made fireproof according to the following stipulations.

13.9.1 Structural items and interior dressings (including substrata) shall use non-flammable materials (hereinafter called "non-flammable materials"). However, the interior finish of the floors and walls (limited to finished sections to a height of no more than 1.2 meters from the floor) of habitable rooms of the offices such as the operation command center, the electric power command center, the signal handling center, and the disaster prevention control center (hereinafter called "habitable rooms) shall be fireproof as far as possible.

13.9.2 As far as possible, furnishings such as desks and lockers shall not be made of flammable materials.

13.9.3 Substations, distribution stations and machine rooms shall be partitioned from other areas by floors and walls having a fire-resistant construction and also fire doors.

Also, if cables and the like pass through these partitions, the penetrations of the partitions shall be filled with non-flammable material.

Fire doors shall be provided with automatic closing devices such as door closers and similar equipment.

13.9.4 Structural materials, interior dressings, bookshelves and other parts of kiosks (limited to simple ones) shall be made of non-flammable.

13.10 Disaster prevention control center

13.10.1 A railway station shall have a permanently manned disaster prevention control center that collects information, conveys notifications and commands, makes announcements for passengers, and also monitors and controls fire shutters and other facilities.

In this case, it is desirable that the disaster prevention control center be a shared facility with the station office.

13.10.2 The disaster prevention control center shall be provided with lighting facilities that are powered by emergency power in the event of a power outage.

13.11 Alarm facilities

13.11.1 A railway station shall be provided with automatic fire alarm facilities and the disaster prevention control center shall be provided with a receiver for the alarm facilities.

13.11.2 Detectors for the automatic fire alarm facilities shall be provided in habitable rooms, kiosks, substations, distribution stations, machine rooms, and other such locations. Automatic fire alarm facilities shall be provided with emergency power sources.

13.12 Notification facilities

13.12.1 A railway station shall be provided with communication facilities such that the disaster prevention control center shall be capable of communicating with the fire brigade, the police, the operation command center, the electric power command center, various parts of the station (habitable rooms, both ends of the platform and places that are important from the viewpoint of communication within the area that is controlled by the station) and also with related adjacent buildings.

13.12.2 A railway station shall also be provided with broadcasting facilities that can be controlled from the disaster prevention control center. (The range over which announcements can be made from the disaster prevention control center shall include the platforms, concourse, passageways and other areas controlled by the station.)

13.12.3 Communication facilities and broadcasting facilities shall be provided with emergency power sources.

13.13 Auxiliary wireless communication facilities

13.13.1 Communication facilities to enable communication from a train or the inside of a tunnel to the operation command center shall be provided in a tunnel between stations.

13.13.2 In this case, the communication facilities that permit communication from the inside of a tunnel to the operation command center shall be provided at intervals of no more than 250 meters inside the tunnel.

13.14 Fire doors

13.14.1 Connecting underground passages between one railway station and other station of another line (excluding cases where the same platform is used) and between the railway station and underground shopping malls etc., shall be provided with fire doors and the like (fire doors provided with hinged or sliding doors and the fire shutter).

13.14.2 Fire doors and the like shall be provided at evacuation stairways of the platform and also at other necessary locations to enable passengers to evacuate safely.

13.14.3 In this case, the fire shutters shall lower when activated by a detector down to a height of 2 meters above the floor and shall also be capable of being lowered by remote control from the disaster prevention control center.

In addition, said fire shutters shall be of a 2-stage closing construction whereby they are closed completely by an attendant at the locations where they are installed. It shall be possible to verify the lowering and closure of the fire shutter from the disaster prevention control center.

13.15 Flooding prevention equipment

13.15.1 Measures against flooding water coming into tunnels with critical highest flood level shall be required at station entrances, lift entrances, air holes of ventilation shafts and U type structure as approach between elevated and underground structures.

13.15.2 Against for worst case of flooding water coming into tunnels, protection gate at U type structure shall be considered without affected Metrorail all route.

13.16 Drainage equipment

Drainages and pumps shall be equipped for adequate capacities after calculation with leaking water from structures and flowing from station rooms and others.

13.17 Indicators

Indicators shall be provided at railway stations to inform passengers of the following items.

13.17.1 In principle, if a fire breaks out in a train that is traveling through a tunnel, the train will continue traveling to the next station and then evacuate the passengers.

13.17.2 It is possible to evacuate from the front and the rear of the train.

13.17.3 Necessary information, including an evacuation route map that will enable passengers to safely evacuate in an emergency.

13.18 Other facilities

13.18.1 Self-contained-compressed air breathing apparatus shall be provided at railway stations. In this case the number of units breathing apparatus permanently provided shall be at least the number of staff engaged in work such as helping passengers, guiding officers engaged in fire extinguishing and fire prevention activities and other such work.

13.18.2 In principle, dedicated ventilating facilities shall be installed at a substation.

13.18.3 A kiosk shall not be located at the places where it impedes the evacuation of passengers or between the end of the platform and the nearest entrance or exit of an evacuation passageway.

13.18.4 A convenience store type kiosk shall be compartmented to protect it from fire and smoke.

13.18.5 The distance from each part of a habitable room to the evacuation exit at a railway station shall be no more than 100 meters.

13.18.6 A passageway in tunnels between stations that is used to evacuate passengers shall be of a construction that does not impede evacuation.

13.19 Manual

At each railway station, a manual stipulating the following items relating to the action to be taken by the staff in charge in the event that a fire breaks out, education and training and also collaboration with a fire fighting organization shall be prepared.

In this case, the contents of the manual shall be determined after adequate consultation with the firefighting organization.

(1) Items relating to action to be taken by the staff in charge in the event of a fire

(2) Implementation method etc., of education and training for the staff in charge (this training mainly refers to training in initial fire extinguishing activities, evacuation guidance, etc.)

(3) Providing effective information concerning firefighting activities to the firefighting organization

XIV. FALL PREVENTION FACILITY

14.1 Introduction of Fall Prevention Facility

14.1.1 The railway operator can introduce the safety facility (hereafter "Fall Prevention Facility"), such as Platform Screen Door, which prevents that a passenger falls from the platform or a passenger contacts with the running train in each station, when it is judged to be required, in order to ensure the passenger's safety. When the railway operator operates the train with single driving staff or without driving staff, the introduction of Fall Prevention Facility shall be obligated.

14.2 Construction gauge corresponding to Fall Prevention Facility

14.2.1 The railway operator shall define the construction gauge corresponding to Fall Prevention Facility when the facility is decided to be introduced.

14.3 Strength of Fall Prevention Facility

14.3.1 The Fall Prevention Facility shall have sufficient strength which can withstand passenger's leaning force against the facility and a strong wind.

14.4 Ensuring the safety of Fall Prevention Facility

14.4.1 The Fall Prevention Facility shall be introduced taking into fully consideration about the measures for the following risks so that the passenger does not get injured with this facility. In addition, other risks caused by the installation of this facility shall be examined carefully and counter measures shall be taken for the envisaged risks.

(1) Contact to the train by putting long things, such as a bamboo pole, against Fall Prevention Facility

(2) Contact to the train by a passenger leaning out from Fall Prevention Facility

(3) Contact to the Fall Prevention Facility by a passenger leaning out from the window of the train

(4) Falling a foreign substance by a passenger placing a can etc. on Fall Prevention Facility

(5) The dangerous foreign substance (thin string etc.) stuck to the door in Fall Prevention Facility

(6) Leaving a passenger between Fall Prevention Facility and the train

14.5 Correspondence to the case a train stops at inappropriate position

14.5.1 The Fall Prevention Facility shall have the system that passengers can escape from a train to the platform even when the train stops at inappropriate position.

14.6 Correspondence to the electric power failure

14.6.1 The Fall Prevention Facility shall have the system that passengers can escape from a train to the platform even when the electric power is down.

14.7 Measures against difference of electrical potential

14.7.1 The Fall Prevention Facility shall have the measures so that a passenger does not receive an electric shock caused by the difference of electrical potential between the facility and the train.

14.8 Reliability

14.8.1 The Fall Prevention Facility shall have sufficient reliability so that the train operation may not be affected.

XV. MEASURES AGAINST ACCIDENTS, ETC.

15.1 Cautions in Abnormal Meteorological Conditions

15.1.1 When there is a risk of a disaster due to rainfall, earthquakes, etc. or when meteorological information thereon has been received, those who engage in train or rolling stock operation or maintenance of tracks, etc. shall pay special attention to train or rolling stock operation and make heightened precautions thereto.

15.1.2 Handling of such as detailed operation control shall be established for precautions to or patrol of tracks and restrictions on running speed at the time of rainfall, earthquakes, etc.

15.2 Stop Arrangement for Train Protection

When the need to urgently stop a train arises due to track breakdowns and such, arrangements to stop a train immediately shall be conducted.

(1) Ground officials

(a) Indicate a stop signal using radio communication

(b) Indicate a stop signal using a portable fusee or portable flash mechanism for special signals

(2) Drivers and conductors

Indicate a stop signal using a fusee for rolling stock and radio communication

15.3 Measures for Fire Outbreaks on Trains, Underground Stations, etc.

For the prevention of hazards, and the safety and prompt evacuation of passengers when a fire breaks out on a train, which is running in an underground station, etc., or in an underground station, etc., the following rules shall be stipulated.

(1) In the event a fire breaks out on a running train, the train shall be driven to the next station or out of the tunnel in principle.

(2) The relevant trains shall be stopped at their nearest stations and shall be kept there.

(3) In the event a train on fire is parked at a station or a station is on fire, trains approaching the concerned station shall not be stopped at the concerned station in principle.

ATTACHMENT

List of Codes and standards

Comply

AUTOMATIC FARE COLLECTION (AFC)

- ISO/IEC 15408 Evaluation criteria for IT security
- ISO/IEC 18092 Telecommunications and information exchange between systems
- ISO/IEC 14443 Identification cards

Reference

CIVIL, UNDERGROUND STRUCTURES AND FACILITIES

- Design Standards for Railway Structures (issued in Japan)
- AASHTO (American Association of States Highway and Transportation Officials) Specification
- BS (British Standard)
- IRC (Indian Railway Code)
- Any other internationally recognized codes and standards
- Bangladesh National Building Code (BNBC)

ROLLING STOCK

- JIS R 3205 laminated glass
- JIS R 3206 reinforced glass
- JIS R 3213 safety glass
- JIS E 4603 Electric Measuring Speedometers for Railway Rolling Stock
- ISO 5660-1:2002 Reaction-to-fire tests