

# INDIAN RAILWAYS



## SCHEDULE OF TECHNICAL REQUIREMENTS

### VACUUM TOILETS FOR INDIAN RAILWAY COACHES (BG)

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## Contents

1	PREAMBLE	3
2	TECHNICAL REQUIREMENTS	3
3	OPERATING CONDITIONS	4
4	DESIGN & CONSTRUCTION	4
	4.1 Water pressuriser unit	
	4.2 Flushing Efficiency	
	4.3 Toilet Bowl	
	4.4 Air Filter	
	4.5 Waste Collection/Retention Tank	
	4.6 Transport Pipe System	
	4.7 Control Panel	
	4.8 Vacuum Generation	
	4.9 Evacuation System	
5	SUPPLY	7
6	MARKING	7
7	DOCUMENTATION	8
8	OPERATION & MAINTENANCE	8
9	PROTOTYPE APPROVAL	8
10	TESTING OF PROTOTYPE	9
11	INSPECTION	9
12	DELIVERY	9
13	INSTALLATION AND COMMISSIONING	9
14	GUARANTY/WARRANTY	10

Annexure:

Preventive maintenance schedules for IR coaches

## **SPECIFICATION FOR VACUUM TOILET SYSTEM**

### **1 PREAMBLE**

Vacuum toilet system is required for standard mainline rolling stock to flush out the toilet waste with minimum water consumption to a collection / retention tank mounted below the under frame. The toilet system should provide a sealed commode with an efficient flushing system and provide odour free interior of the toilets applicable to Western and Indian style toilets of mainline broad gauge (BG) coaches of Indian Railways.

This Schedule of Technical Requirements specifies the technical details of vacuum (Western and Indian style) toilets to be fitted in main line broad gauge (BG) coaches on Indian Railways.

### **2. TECHNICAL REQUIREMENTS**

The Toilet system offered must be of a proven and established design and successfully operating on International Railways. Documentary evidence along with certificate of performance (clearly specifying the operating conditions and design) of the toilet system supplied during last 5 years to various Railway systems, should be provided by the tenderer, alongwith contact details of the users. The design of the toilet system should be suitable for application on various designs of Indian Railways passenger coaches. The tenderer may however make suitable changes in his original design to adapt the same to IR's requirements. This shall be done at the tenderer's sole responsibility and cost.

Generally, IR mainline passenger coach has 4 toilets, of either Western commode or Indian squat-pan types. Some coaches may have only 2 or 3 toilets. The number of toilets and their type (Indian or western) depends upon the coach type. Irrespective of coach designs the toilet system is required to meet the following objectives:

- Clean, odour-less, hygienic and aesthetically pleasing toilet.
- No discharge of waste.
- No spillage of wastes on the bogie parts, undergear or track.
- Minimum life cycle cost to IR

The toilet system should be simple to operate and safe for users. It should not contain any components, which are prone to pilferage. It should be robust, reliable and low-maintenance, and should require minimum ground facilities at the terminals for it's operation.

The system should be able to handle normal waste and even some foreign objects thrown in (such as bottles, caps, napkins, plastic bags & cups etc.) either by segregating or by processing the same. Any choking should be possible to be rectified on the spot without needing attention of maintenance depot.

The water consumption shall be minimum, with 100% cleaning of the commode (max. 0.8 ltr. per flush for Indian type and 0.8 ltr. for Western type). As the air supplied from the coach may contain dirt and moisture, the toilet should include suitable filter and moisture arrester.

The toilet system is required to suit the space constraints of different types of coaches. All parts of the system should be at least 225 mm above rail level (preferably 400 mm). The equipment should not impede free -movement of the bogies, nor the routine inspection & maintenance of various bogie/coach subassemblies.

### 3. OPERATING CONDITIONS

Ambient Conditions:  $-4^{\circ}\text{C}$  to  $55^{\circ}\text{C}$  with 100% humidity and dust. Temperature variations can be quite high in the same journey or short period of time. Most coaches are based in coastal cities, with continued exposure to salt laden air. Coach exteriors and underframe are cleaned weekly by washing with mild cleaning agents, and the toilets by approved cleaning agents.

Water Supply: (a) In AC coaches, one tank of 40 ltr. capacity is available over the toilet roofs at each end, at a height of about 2030 mm from toilet floor. Water is pumped to these from under-frame mounted main water tanks. Water-flow to the flushing valve is by gravity.

(b) In non-AC coaches, one tank of 450 ltr services each toilet at a height of 2030 mm from toilet floor. These tanks are not pressurised and the water flow from these tanks is by gravity.

Pneumatic Supply: Air at 5-6 bar is available in coaches on run in brake system air-reservoir of 200 lts. A limited quantity of this can be made available for the toilet system, if needed. Air supply will not be available in some conditions of operation, such as prolonged shut down of locomotive, coach being stranded for some purpose, coach undergoing maintenance in depot etc.

Vacuum Generation: No arrangements exist in Indian Railway Coaches.

Power Supply: 110 V DC supply is available from the coach circuits. This supply varies from 90-140 V with 15% ripple. 415 V 3 phase AC is also available in Rajdhani Express type coaches only.

Car-body dynamics:  $\pm 100$  mm vertically  
 $\pm 55$  mm laterally  
 $\pm 10$  mm longitudinally  
 $\pm 4^{\circ}$  bogie rotation about centre pivot

Duty Cycle: The toilet should be ready for use by the next passenger within 1-2 minutes. The toilet shall be used upto approx 150 times in 24 hrs. Journey varying upto 77 hrs are performed by IR coaches.

Special Conditions: (a) In departmental coaches placed in sidings, toilets are used upto 10 times in 24 hrs for duration upto 48 hrs.

(b) Toilets in stabled coaches may be used to limited extent in some cases.

(c) No discharge is permissible in the maintenance pit-lines, where coaches are given scheduled maintenance

### 4 DESIGN & CONSTRUCTION

The toilet system offered should be installed in the toilet module as an integrated system. The complete system must be a modular unit. The main system components which will all be in the scope of supply of the supplier are:

- Lavatory bowl (Oriental/European design).

- Flushing arrangement including interfacing for water, compressed air supply, Retention Tank
- Control panel and associated ancillaries for the system operation.
- Associated water hoses, pneumatic piping and electrical wiring .
- Ground facilities required at the terminals

The technical implications/reasons for capacity rating of important components of the system shall be explained in detail by the tenderer. Similarly, critical dimensions in the fixing & location drawings shall be clearly indicated by the tenderer.

The system should be so designed that during routine maintenance does not require contact with waste by maintenance personnel. Before extensive repairs, a manual drain and flush of the complete system should be possible.

The tenderer should indicate the consumption of power, air, water & chemical if any per use and per hour by the toilet system offered.

#### **4.1 WATER PRESSURISER UNIT**

It pressurizes the flush water using the compressed air. This pressurized water is flushed into the toilet bowl through the flush nozzle.

#### **4.2. FLUSHING EFFICIENCY**

The water consumption for flushing the toilet should be adjustable so as to suit the type of toilet bowl and local habits. Very good flushing efficiency and reliable performance is required. The water consumption should be very small so as to have relief on the waste collection / retention tank and thus allowing increased use of the toilets by the passengers. The typical water consumption should be below 0.8 litre per flush for Indian (Asian) type toilet and below 0.8 litre for western type toilet. The suction system, the toilet bowl material and surface finish of the bowl material should be such so that the toilet can be cleaned / flushed properly with minimum possible water consumption.

For achieving most efficient flushing, a water pressuriser is required to be used. Water at a pressure of 4 bar or more may be used during a flush cycle. Water consumption of the system offered should be indicated. Heavy vacuum in the system is desirable so as to avoid choking. System working with 50% to 40% vacuum is preferred.

#### **4.3 TOILET BOWL**

Both Indian squat-pan and Western style commodes are fitted on IR coaches. For the information of the tenderers, seats of Western style commodes is 400 - 425 mm above the toilet floor, the Indian style squat pan is mounted on / below the floor, projecting less than 50 mm above the floor. The total height of the toilets should be such as to avoid infringement with under-frame members (space available approx. 135mm).

The diameter of the toilet bowl outlet hole should be minimum 90mm and shall be so designed to prevent any obstruction in outflow of waste. The toilet bowl design must include an integrated water spray system which covers the entire toilet bowl. The toilet bowl should be manufactured from Stainless Steel to AISI 304.

The toilet bowl should be aesthetically pleasing. For optimum cleaning, the bowl should be made of anti-friction surfaces, stainless steel being preferred. The outlet hole diameter size should be adequate to handle normal waste and some foreign objects thrown in such as

bottles, caps, napkins, plastic bags & cups etc. The waste should never be visible or flow backwards into the bowl even in cases of mal-functioning.

The system shall, in no case, permit bad odours to escape into the toilets or around the coach. The Toilet system must have the following design and functional parameters:

- (i) The toilet system must be provided with an effective sealing arrangement to ensure the sealing of odour from the waste treatment tank to the toilet room. The system adopted for odour sealing must be of a proven design which totally seals the space between the toilet bowl and the waste treatment tank and must meet the following operating criteria:
- During normal operating conditions, when both air and power are available, a seal should always be available between the tank and the bowl.
  - On loss of air and power, the seal should ensure that there is no passage of odour from the waste treatment tank to the toilet room.

The technical implications/reasons for capacity rating of important components of the system shall be explained in detail by the tenderer. Similarly, critical dimensions in the fixing & location drawings shall be clearly indicated by the tenderer.

The system should be so designed that during routine maintenance does not require contact with waste by maintenance personnel. Before extensive repairs, a manual drain out and flush of the complete system should be possible.

The tenderer should indicate the consumption of power, air, water & chemicals if any per use and per hour by the toilet system offered.

#### **4.4 AIR FILTER**

The filter is required to be provided to prevent malodors when the ejector is activated. This is also required to secure blowing out of dirt ingress. It should be suitably located for easy replacement. Replacement is preferred after 12/18 months. Its replacement cycle to be indicated.

#### **4.5 WASTE COLLECTION / RETENTION TANK**

The tank shall be of stainless steel to AISI 316L with sufficient capacity for duty cycle mentioned earlier. If under-slung tanks are provided, they shall be of superior quality stainless steel, designed to withstand ballast stone hits and cattle run over by the trains. The tenderer shall ensure high quality of material, fabrication and welding, for completely leak proof construction. Level sensors should be provided in the collection tank so that the tank levels can be monitored from outside. The toilet should not become inoperative under such conditions.

The retention tank shall be so designed that it should be possible to clean the tank and service it without removing the tank for the coach except during extensive maintenance. There should be a provision for cleaning the tank and flushing the complete system without removal from the coach.

#### **4.6 TRANSPORT PIPE SYSTEM**

All pipes and pipe connections should be made of stainless steel to AISI 304. In case of choking, it should be possible to close all line and then increase vacuum in the tank and open to the choked toilet so as to facilitate removal of choking. Any other superior method to attend the choking and repair problem can be accepted; the details of the same be described/explained. Sketch showing the transport pipe system should be furnished; cost and description of the special pipe joints shall also be furnished. The description and type of

pipe required to be provided by the purchaser should also be indicated. Space provision to accommodate 50mm diameter pipe has been kept in the coach floor. Its suitability should be confirmed and / or suitable alternative arrangement to be indicated.

#### **4.7 CONTROL PANEL**

The size of the valve control panel / component panel to be indicated along with its positioning. Service friendly electric control panel should be suitable for mechanical and environmental conditions encountered in railway rolling stock. It shall be able to monitor as well as provide alarm indications in case of the following:

- i) Compressed air supply
- ii) Water supply / shortages
- iii) Electrical supply
- iv) Collection tank level
- v) Vacuum failure and blockage in the system
- vi) Signal indication regarding occupancy of the toilet
- vii) Automatic indication in case of non-functioning of the toilet

#### **4.8 VACUUM GENERATION**

It is preferred to use reliable and easily maintainable ejector for vacuum generation to achieve optimal capacity with extremely low air consumption. Optional cost for any other system for vacuum generation may be given. Vacuum control switch should be introduced, which will automatically start the ejector if the vacuum level decreased below the preset constant vacuum level.

#### **4.9 EVACUATION SYSTEM**

The facilities required for the ground / stationary evacuating set for emptying the collection / retention tank should be furnished along with functional details. The details for the fixed/mobile units which are used for emptying the retention tank may also be given. It is clarified that evacuation of tanks at intermediate stations is not possible as the stoppage time is very short.

It is required to be confirmed whether the ejector for the toilet system could be used in emptying the collection tank for its waste discharge to the ground tank.

The tanks should be provided with suction outlets on both sides of the tank. The suction pipes will be fitted to these outlets at evacuation lines set up at the terminals. The effluents should be released into the sewer lines for which necessary pipelines should be laid down.

#### **5. SUPPLY**

The Toilet system must be supplied as a complete toilet system in which all the components including Toilet Bowl (Oriental and European), Odor Sealing mechanism, electro-pneumatic control system, complete waste treatment tank, plumbing system, wiring etc. must be provided by the supplier.

#### **6. MARKING**

Tenderer's name with the serial/batch number along with month and year of manufacture shall be marked at a visible location for identification. Notices for users and maintenance personnel shall also be supplied for fixing in the coach, as decided between the tenderer and IR.

## 7 DOCUMENTATION

The successful tenderer shall provide detailed drawings and specifications of the components critical to its proper functioning.

Sufficient numbers of illustrative manuals shall be supplied for installation, commissioning, preventive maintenance and trouble-shooting.

Consumables required for the system (including chemicals for cleaning, disinfections as well as waste processing) shall be informed. A list of spares to be kept by the maintenance points shall be informed with their costs.

The tenderer shall submit the life-cycle costing for the toilet system offered by him, and include the following cost details :

- i. Landed cost of the toilet system
- ii. Annual recurring cost of operation
- iii. Annual recurring cost of preventive maintenance
- iv. Annual recurring cost of repairs

## 8 OPERATION & MAINTENANCE

The tenderer should make an offer for a normal requirement of spares and consumables for 2 years period. IR may purchase these at their option. The tenderer must undertake to develop vendors for supply of consumables in Indian market within 1 year of the supply.

The tenderer shall supply detailed operation & maintenance instructions, clearly indicating Do's and don'ts.

The tenderer shall conduct training of IR personnel in installation, operation, trouble-shooting, repairs and preventive maintenance of the toilet system at his cost. Details of the proposed training should be indicated.

The tenderer shall give details about the technical support made available to Indian Railways during warranty period and the after-sales service after warranty period.

The system should be robust, reliable and requiring minimum maintenance. These should be quantified by mean time between failures (MTBF) and mean time to repair (MTTR).

Preventive maintenance schedule shall be detailed by the tenderer, which should coincide with the existing maintenance schedules for the coaches as given in Annexure-II.

It should be possible for on-board staff to carry out trouble-shooting and undertake emergent rectification of small problems with minimum equipments.

The tenderer should enter into an (post-warranty) Annual Maintenance Contract and/or an Annual Operation Contract separately for at least 5 years, which may be entered into by Indian Railways. Indian Railways may require the contractor to undertake normal running maintenance of the supplied system also. Costs per annum of such maintenance, separately for on-board maintenance during run and for terminal maintenance, should be quoted clearly.

Indian Railways will require the contractor to undertake normal running maintenance of the supplied system also. Costs per annum of such maintenance, separately for on-board maintenance during run and for terminal maintenance, should be quoted clearly.

## 9 PROTOTYPE APPROVAL

The prototype approval of the toilet system will be done by RDSO. The successful tenderer must submit detail drawings and specification indicating functional and technical details of the system. The manufacturer should offer the prototype for inspection within 14 weeks of the placement of order. The tenderer shall stand fully responsible in respect of design,



manufacture and servicibility of the complete system. The tenderer shall submit the details of the mechanical and electrical interfaces of the toilet system.

## 10 TESTING OF PROTOTYPE

The testing of 4 prototype types (2 Western and 2 Oriental) shall be done by RDSO and other Railway representatives. The suppliers must design and commission a test stand for testing of prototypes. The following parameters will be checked:

- (a) Dimensional check as per drawings
- (b) Proper & leak free connections of air & water pipelines
- (c) Proper working of system control & indications
- (d) Proper sealing arrangement so that no odour passing to the toilet room
- (e) Water consumption per flush for Indian and Western style.
- (f) Emergency operation without power/air supply and suitable arrangement for by-passing this feature
- (g) Overflow provision in retention tank
- (h) Functional check of the flush cycle
- (i) Endurance test of valves
- (j) Any other test

All moving parts of the system especially the stench trap system, water & pneumatic valves are to be tested upto a minimum 50,000 cycles of continuous trouble free operation. A test certificate of the same is to be submitted by the manufacturer.

## 11 INSPECTION

The authorised representative shall do the inspection, either at the consignee or the firm's premises as mutually agreed to by the purchaser and the tenderer.

## 12 DELIVERY

The tenderer shall indicate the delivery period. Deliveries made earlier may be accepted as per IR's convenience. Before commencing supplies, drawings and specifications indicating functional and technical details of the system shall be submitted by the firm for IR's approval. The fitment drawings shall clearly indicate dimensions critical to proper functioning of the system. Specifications & design of critical components shall also be pre-approved by IR. Notwithstanding any such approval, the tenderer shall stand full responsibility in respect of design, manufacture and serviceability of the complete system.

The tenderer shall assist IR in developing the interface of the toilet system with the coach sub- assemblies and structures.

After design approval 1 coach set of the toilet system shall be supplied to IR for installation & commissioning trials. Railways may ask the tenderer at this stage to undertake modifications to the balance supplies, if considered necessary by them.

After successful installation, the remaining supplies shall be delivered. The tenderer shall supply consumables for 6 months use along with the supplies.

## 13 INSTALLATION AND COMMISSIONING:

Installation and commissioning of the first two toilet system of each supplier will be carried out by the supplier in the premises of the consignee in presence of RDSO. Railways may ask the tenderer at any stage to undertake modifications to the balance supplies, if

considered necessary by them. After successful installation, the tenderer shall supply consumables for 6 months use along with the supplies.

#### **14 GUARANTY/WARRANTY**

The tenderer will provide warranty services at the base depot or another location as decided mutually between IR & the tenderer, for 30 months from the date of supply or 24 months from fitment, whichever is lower. During warranty, the tenderer shall rectify the toilet system by replacing or repairing components at his cost.

The warranty period would get extended on a pro-rata basis if warranty is not provided within 15 days of notice. Tenderer shall also undertake to ensure availability of all the spare parts for a minimum period of 10 years after purchase.

## PREVENTIVE MAINTENANCE SCHEDULES OF IR COACHES

### **A. MAINTENANCE SCHEDULE IN DEPOTS**

Type of Schedule	Periodicity
(i) Trip Schedule	At the end of each trip or as prescribed.
(ii) Schedule 'A' or monthly examination	1 month +/- 3 days
(iii) Schedule 'B' or Tri-monthly Examination	3 months 3 days
(iv) Schedule 'C' or Half Yearly Examination	6 months +/- 7 days
(v) Special Schedule	As prescribed by each Railway

### **B. MAINTENANCE SCHEDULE IN WORKSHOPS**

#### ***Non-Air Conditioned Coaches***

(i) Coaches in Mail and Express rakes	
(a) Coaches earning less than 2 lakhs Kms.per annum	12 months
(b) Coaches earning more than 2.5 lakhs kms.per annum	12 months with IOH after 6 months
(c) Coaches earning between 2 and 2.5 lakhs kms.per annum	adopt (a) or (b) as per local conditions 18 months
(ii) Coaches in other rakes	18 months

#### ***Air Conditioned coaches***

(i) Rajdhani & Shatabdi Express coaches	
(a) POH	after 4 lakhs kms or 18 months whichever is earlier
(b) IOH	after 2 lakhs kms or 9 months whichever is earlier
(ii) All other coaches (POH only)	12 months

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