

INDIAN RAILWAYS



SCHEDULE OF TECHNICAL REQUIREMENTS C- 9908 Rev.1

BIOLOGICAL TOILETS FOR INDIAN RAILWAY COACHES (BG)

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CONTENTS

1	PREAMBLE	3
2	GENERAL REQUIREMENTS	3
3	OPERATING CONDITIONS	4
4	DESIGN & CONSTRUCTION	5
	4.1 Toilet Bowl	5
	4.2 Transport Pipe System	6
	4.3 Waste Processing	6
	4.4 Waste Collection and Processing Tank	6
	4.5 Discharge	7
	4.6 Control Panel	7
5	SUPPLY	7
6	MARKING	8
7	DOCUMENTATION	8
8	OPERATION & MAINTENANCE	8
9	PROTOTYPE APPROVAL	9
10	TESTING OF PROTOTYPE	9
11	INSPECTION	9
12	DELIVERY	9
13	INSTALLATION AND COMMISSIONING	10
14	GUARANTY/WARRANTY	10

Annexure:

Preventive maintenance schedules for IR coaches

Biological Toilets for IR coaches

1 PREAMBLE

Biological toilets convert human waste and other biodegradable substances into inoffensive liquid & gas, leaving a small amount of residue. The process is accelerated by addition of suitable biological agents.

The toilet system should provide a sealed commode with an efficient flushing system and provide odour free interior in the coach and toilets. It should be applicable to Western and Indian style toilets of mainline broad gauge (BG) coaches of Indian Railways.

This Schedule of Technical Requirements specifies the waste-processing, discharge and interfacing of Western and Indian style toilets to be fitted on different types of main line broad gauge (BG) coaches on Indian Railways.

2 TECHNICAL REQUIREMENTS

- 2.1 The Biological 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
- 2.2 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 biological toilet system is required to meet the following objectives:
- Clean, odour-less, hygienic and aesthetically pleasing toilet.
 - No discharge of unprocessed waste.
 - No spillage of wastes on the bogie parts, undergear or track.
 - Minimum life cycle cost to IR
- 2.3 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 or en-route stations for it's operation.
- 2.4 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.
- 2.5 The water consumption shall be minimum, with 100% wash of the commode (max. 2.5 ltr. per flush for Indian type and 1.5 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.

- 2.6 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°C to 55°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 acids, caustic soda etc.

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. Toilet system should be able to cater for such periods also.

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: ± 100 mm vertically
 ± 55 mm laterally
 ± 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. Air supply would not be available under this condition.

(b) Toilets in stabled coaches may be used to limited extent in some cases. No air or power supply may be available under this condition.

(c) Toilets are required to be usable in case of train getting stranded in an emergency for upto 4 hrs without air supply.

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

The system should provide functionality under these situations as well.

4 DESIGN & CONSTRUCTION

The toilet system offered should be installed in the toilet module as an integrated system, which in case of an emergency, due to the loss of power and/or air, should always be functional.

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 with stainless steel trap.
- 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 semi-processed 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.

4.1 Toilet Bowl

Both Indian squat-pan and Western style commodes are fitted on IR coaches. Seats of Western style commode 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 100mm and shall be so designed to prevent any obstruction in outflow of waste. The toilet bowl design must include an integrated water spray ring 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. 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 Biological Toilet system must have the following design and functional parameters:

- (i) The toilet bowl (Indian and European) must be totally sealed and must be equipped with an efficient water spray ring, which should cover the entire toilet pan in order to provide uniform flow of water in the toilet bowl thus ensuring 100% bowl wash.
- (ii) The toilet system must be provided with an effective stench trap to ensure 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 water stench trap should always be available between the tank and the bowl.
 - On loss of air and power, the stench trap should always be in the closed position thus ensuring that there is no passage of odour from the waste treatment tank to the toilet room.
 - During non-availability of power and air, the toilet should be fully operable and the stench trap should open to only allow the flow of waste into the tank and thereafter should remain in closed position.

4.2 Transport Pipe System

All pipes and pipe connections should be made of stainless steel to AISI 304. It should be completely leak-proof and made of non-corroding materials. Line valves should be located for easy accessibility for maintenance, and should be completely leak-proof while in use. Different circuits should be isolated so that repairs in a particular line do not require complete dismantling.

4.3 Waste Processing

Toilet system shall disintegrate/decompose the waste by the bacteria proliferating due to agents added in it. The system should be able to work satisfactorily even with foreign objects as above. The human waste may be treated in single or multiple stages to ensure complete decomposition. The tenderer shall clearly indicate the system for rendering the toilet discharge environmentally inert. Chemicals used in the toilet if any, shall be dispensed in such a manner that there is no chance of their contact with the user.

The media used in the waste treatment tanks should be of proven design. The media must be made of synthetic material which does not absorb any chemicals or detergents. The material should be highly resistant to any chemical reaction and must not allow the absorption and existence of any foreign material in the media. The media must be able to sustain high pressure washing and cleaning of the tank. Documentary evidence of the satisfactory performance of the media must be provided.

Details of chemicals/agents, along with their consumption rates and approximate costs, shall be indicated. All the consumables should preferably be available in the Indian market. All the material, chemicals/agents being used should meet environmental standards as applicable.

4.4 Waste Collection & Processing 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 which can be seen from outside.

The waste treatment tank shall be designed so that the same tank can be installed in either side or end of the coach. The waste treatment tank design must include a separate screen to collect large non-biodegradable foreign objects. This screen must be designed so that it can be easily cleaned during regular maintenance to remove such non degradable objects without the maintainer coming into contact with human waste. A proven positive venting system must be provided in the waste treatment tank for proper functioning of the biological waste treatment tank.

The maintenance requirement of the toilet system should be clearly spelt out by the supplier. The maintenance should be done at the time of the maintenance schedules of IR as given in the annexure. The waste treatment tank shall be so designed that it should be possible to clean the tank and service it without removing the tank from the coach during POH.

4.5 Discharge

The treated effluent should be disinfected before it is discharged so that there are no pathogens in it. The discharge should carry no bacteria and should be odourless. The system should be designed for discharge of non-obnoxious liquid matter. The effluent should comply with the following pollution control requirements:-

BOD	100 PPM
COD	250 PPM
PH	5.5 to 8.0

The discharge should not directly impinge on the bogies, undergear and the rails.

4.6 Control Panel

The control unit if any, should be of a miniature size, for easy fitment inside the coach. The tenderer shall indicate it's size, location and fixing arrangements. The unit must have the following characteristics:

- Service friendly modular design
- Rugged construction to withstand the vibration, heat & dust of IR coaches
- Self-diagnostic features with indications for various faults and visual alarms for attracting the attention of operating personnel.
- PLC to allow adjustment of variables such as flush water volume etc.

The tenderer should provide an output signal with a display to inform passengers about non-functioning / occupied toilets. A mechanism to render the toilet in-operative in case the tank is full may also be provided.

Power & Air consumption / cycle under normal operation and in stand-by condition should be specified by the tenderer.

5. SUPPLY

The Biological Toilet system must be supplied as a complete toilet system in which all the components including Toilet Bowl (Oriental and European), odour 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 suppliers must submit documentary proof of the system being of proven design and for the various components and material used in the toilet system.

The successful tenderer shall provide detailed drawings and specifications of the components critical to it's 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. In case consumables are not available in Indian market, 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 to be 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.

It should be possible for on-board staff to carry out trouble-shooting and undertake emergent rectification of problems with minimum equipments and by using self-diagnostic alarm system.

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.

9 PROTOTYPE APPROVAL

The prototype approval of the toilet system will be done by RDSO at firm's premises. 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 6 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:

- (i) Dimensional check as per drawings
- (ii) Proper & leak free connections of air & water pipelines
- (iii) Proper working of system control & indications
- (iv) Waste treatment tank capacity
- (v) Proper stench trap and no odour passing through to the toilet room from the waste treatment tank
- (vi) Water consumption per flush for Indian and Western style.
- (vii) Emergency operation without power/air supply and suitable arrangement for by-passing this feature
- (viii) Overflow provision in waste treatment tank
- (ix) Functional check of the flush cycle
- (x) Endurance test of valves
- (xi) 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 earlier. 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