

## REVISION OF SPECIFICATION / STR

**Ref:** Current Spec. No. RDSO/2017/CG-06 (Rev-3), specification of bio-vacuum Hybrid toilets for LHB type coaches.

1. RDSO is reviewing the specification/STR to cater to the latest technological developments in the field, modify clauses not relevant in the present context and making them more enabling with focus on functional requirements.
2. It is requested that your comments / suggestions with regard to improvements / modifications in specification / STR of this item may be submitted in the following format alongwith the justification for the changes required.

### **Part A: Basic Information**

SN	Particulars	Information
1	Name	
2	Designation	
3	Professional Qualification	
4	Organization / Firm's Name	
5	Address for Correspondence	
6	Contact No.	
7	Email ID	
8	<b>In case of Firm / Individual:</b> Manufacturing experience of item (or similar Item) on which comments are offered	
9	<b>Where relevant:</b> Whether any technical document to support suggested changes is available / enclosed for better appreciation	

### **Part B: Comments / suggestions on the specification**

SN	Clause No. of RDSO STR / Spec	Clause, as exists in RDSO STR / Spec	Clause , as it should read after incorporation of comments / suggestions in the RDSO Spec / STR	Justification for changes

**Comments may be sent to:**

Director/SS/Carriage  
Research Designs and Standards Organization  
Manak Nagar, Lucknow – 226011

Email: edcar.rds@gmail.com Or dirsrds@gmail.com

INDIAN RAILWAYS



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**SPECIFICATION OF BIO-VACUUM HYBRID TOILETS  
FOR LHB TYPE COACHES**

S.No.	Month/Year of issue	Revision / Amendment	Page No.	Reason for Amendment
1.	January 2018	Nil	N. A.	First Issue
2	April 2018	Rev-01	All	Technical Review
3	January 2019	Rev-02	All	Technical review based upon feedback from PUs and Zonal Railways etc.
4	December 2019	Rev-03		Technical Review
<b>5</b>	<b>August 2020</b>	<b>Rev-04</b>		Technical Review

Issued By:

**Carriage Directorate**

**Research Designs and Standards Organization**

**Manak Nagar, Lucknow - 226011.**

Signature			
Name & Designation	Sonu Kumar Gupta JE Design/ Carriage Prepared By	A.K.Gautam SSE Design/ Carriage Checked By	Gaurav Kumar Singh Director Carriage Approved By

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Name & Designation	Sonu Kumar Gupta JE Design/ Carriage Prepared By	A.K.Gautam SSE Design/ Carriage Checked By	Gaurav Kumar Singh Director Carriage Approved By

## SPECIFICATION OF BIO-VACUUM HYBRID TOILETS FOR LHB TYPE COACHES

### 1. PREAMBLE :

- 1.1. This technical specification covers general conditions, technical & operational requirements, inspection, testing procedure of bio-vacuum toilets for LHB type coaches. This specification also covers the maintenance by supplier during warranty and AMC for post warranty period.
- 1.2. Bio-Vacuum toilet is integration of vacuum toilet with existing IR-DRDO bio digester already being fitted in LHB type coaches. Bio vacuum toilets shall be customised with existing lavatory module being fitted along with bio digester. However supply of the IR-DRDO bio digester is not in scope of the supply.
- 1.3. Vacuum evacuation system for Bio-tanks will transfer the fecal matter from the bowl /pan to the bio tank by positive suction and also clean the lavatory bowl/pan with pressurised jet automatically, without affecting functionality of bio digester.

### 2. ELIGIBILITY CRITERIA

- 2.1. Firm should be a proven supplier of vacuum evacuation system and should have supplied at least 500 vacuum evacuation systems or vacuum toilets for rolling stock application, either by firm or by their principals (OEM), which should have been in satisfactory operation for at least 2 years. They should submit records of previous supplies and credentials.
- 2.2. For firms not covered under clause 2.1, however, if firm has developed bio vacuum toilets indigenously or in collaboration with OEM and meets the technical and functional requirements of this specification, they can be considered for developmental order followed by prototype approval and field trial for 6 (six) months from the date of fitment as per clause no. 9 of this specification. Firms approved under this clause shall be treated at par to the firms approved under clause no. 2.1 after successful supply and commissioning of at least 500 units in Indian Railways.
- 2.3. Firm or their principal should have well-established manufacturing and testing facilities. Firm & their principal should have established quality control system and organization to ensure quality of the product and should be an ISO 9000 certified company or should have an internationally certified quality control system.

### 3. SCOPE OF WORK:

Fitment of vacuum toilet in existing lavatory module shall be interfaced with existing IR-DRDO bio-digester already fitted by Indian Railways in LHB type coach. Supply, Installation and commissioning of complete system will be in the scope of tenderer.

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3.1. The main system components of the supply would be:

- a) Lavatory pan/ bowl (Indian squatting/ Western design).
- b) Vacuum toilet system and pressurised flushing arrangement including interfacing for supplies like water & compressed air etc.
- c) PLC/ Microcontroller/ Microprocessor based Electro pneumatic Control panel and associated accessories for the system operation.
- d) Associated plumbing & water hoses, pneumatic piping and electrical wiring etc.
- e) Leak proof rubber seal for entry joint of discharge pipe to bio digester tank.
- f) Passenger instruction notices as per ICF drawing no. ICF/STD-6-4-048 or as specified by the Railways.
- g) Any other material and interface required with existing coach systems to make the vacuum toilet fully functional & operational without any constraints.

Note: IR-DRDO bio digester tank is not part of scope of this specification. However the system supplied must interface with existing design of bio digester tanks for different coaches.

#### 4. TECHNICAL REQUIREMENTS

- 4.1. Vacuum toilet system shall be installed within the space envelope earmarked. The space envelope for control panel and tank location etc. of LHB type coaches is shown in RCF drawing No. MI005426 & MI005710 respectively.
- 4.2. LHB type coaches have different combination (Indian squat pan type and western commode type) of toilets having 2, 3 or 4 toilets. Bio-Vacuum toilet system should be suitable for application on all LHB type coaches. Its fitment should be done without losing coach / lavatory module aesthetics and ensuring serviceability, however, minor changes may be necessary while installation of prototype, which shall be ensured during regular supply. The supplier should confirm the combination of Indian / western toilets before supply.
- 4.3. The vacuum evacuation system shall be designed such that it sucks out the waste from each toilet with minimum use of water into the Bio- digester tank installed under the carriage. The toilet system shall be isolated from the bio-tank to avoid bad odour in the passenger area.
- 4.4. The toilet system should be of robust design, reliable, safe, simple to operate and passenger friendly and require minimum maintenance. It has to be a proven design, suitably modified to match Indian conditions and passenger habits.
- 4.5. It shall be ensured that bio-vacuum toilet shall remain usable as normal bio toilet, in case of non-availability of pressurized air and / or electrical power. It shall be ensured that gases / odour generated in bio digester do not enter in toilet room in any situation. Same flush button / knob should work as By-pass flush to work as normal bio-toilet in case of no power / no air.

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- 4.5.1. For indicating status, provision of Colour LED indication shall be given. Indication should be in Green colour when power and compressed air is available and system is in normal mode. Indication to be in Red colour when compressed air is not available and system is in bypass mode.
- 4.6. The design of the toilet system should have protection from pilferage and components used in vacuum toilet system shall be made of corrosion resistant material.
- 4.7. The equipment should neither impede free movement of the bogies, nor the routine inspection & maintenance of various bogie/coach sub-assemblies. To ensure this the system should be contained within the space envelop as mentioned earlier.
- 4.8. The maintenance requirement of the toilet system should be clearly spelt out by the supplier in the operating and maintenance instructions submitted during approval.
- 4.9. The system should be able to handle normal waste and even some foreign objects thrown in and which are smaller than the toilet bowl outlet hole (such as bottle caps, napkins, plastic bags & cups etc.) either by segregating or by vacuum suction into the bio digester tank.

## 5. OPERATING CONDITIONS

All parts of the bio vacuum toilets installed under the carriage shall be at least 225 mm above the head of rail level and it shall not restrict the free movement of bogies or the periodical repair-maintenance work.

All mechanical, pneumatic, hydraulic, electrical and electronic components of the vacuum evacuation system shall operate under the following conditions without any problems.

### 5.1. Ambient Conditions:

- (i) Altitude : Sea level to 2500m
- (ii) Operating temperature : 1°C to 55°C
- Max. Temperature under Sun : 70° C
- (iii) Relative humidity : upto95%
- (iv) The rainfall is fairly heavy.
- (v) During dry weather, the atmosphere is likely to be dusty.
- (vi) Temperature variations can be quite high with-in range specified in the same journey or short period of time.
- (vii) Coaches operate in coastal areas with continued exposure to salt laden air.
- (viii) Coaches may be subjected to frequent external washing with detergents and cleaning of toilets by cleaning agents.

### 5.2. Car-body dynamics:

- 5.2.1. Equipment shall withstand satisfactorily the vibrations and shocks normally encountered in service as indicated below:

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- |                                      |      |
|--------------------------------------|------|
| a. Maximum vertical acceleration     | 1.0g |
| b. Maximum longitudinal acceleration | 3.0g |
| c. Maximum transverse acceleration   | 2.0g |

5.2.2. The vibrations are of sine wave form and the frequency vibration is between 1 Hz to 50 Hz.

The amplitude 'a' expressed in millimeters is given as a function of 'f', by equations

$$a = 25/f \text{ for values of 'f' from 1 Hz to 10 Hz.}$$

$$a = 250/f^2 \text{ for values of 'f' exceeding 10Hz and up to 50 Hz.}$$

5.2.3. In the direction corresponding to the longitudinal movement of the vehicle, the equipment is subjected for 2 min. to 50 Hz. Vibrations of such a value that the maximum acceleration is equal to 3g.

5.2.4. LHB type coach length over coupler is approximately 24 meters.

5.2.5. **Coach-body displacement encountered under dynamic conditions.**

- |  |                 |
|--|-----------------|
| i) Vertically-                         | ±100 mm         |
| ii) laterally -                        | ±55 mm          |
| iii) longitudinally-                   | ±10 mm          |
| iv) bogie rotation about center pivot- | ±4 <sup>0</sup> |
| v) Maximum Speed of train -            | 160 KMPH        |

## 6. SYSTEM INTERFACE AVAILABLE

### 6.1. Water Supply:

- There is one tank of 30 ltr capacity available over each toilet at a height of about 2030 mm from toilet floor in air conditioned coaches. Water is pumped to these from under-frame mounted main water tanks. These tanks are not pressurized and the water flow from these tanks is by gravity.
- For Non-AC LHB coaches tank of 390 liter approx. is available at the same height.

### 6.2. Pneumatic Supply:

- A limited quantity of air supply of around 15 lit./min per coach can be made available connected to feed pipe at 6 kg/cm<sup>2</sup> with provision of one 75 ltr. reservoir in the coach exclusively for toilet system.
- Minimum 2 (two) number of normal usages per toilet shall be ensured (using existing 75 liter air reservoir) when the pressurized air supply as specified above is disconnected/ cut-off.
- Requirement of compressed air per toilet used and per coach shall be clearly specified by the firm.

### 6.3. Power Supply:

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- i. 110 Volt AC/ DC power supply is available in all AC LHB coaches. If any power is required, the equipments be so designed to withstand 30% voltage fluctuations. However 110V DC only is available in Non-AC coaches.
- ii. AC-DC / DC- DC converter fitted should be able to withstand +/- 30% voltage fluctuations, 2 KVA surge, +/- 10% ripple and power backup, if required, may be provided by supplier ensuring the duty cycle and fitment within the space envelop. All electrical and electronic equipment should be complying with IEC 60571 or any equivalent international standards.
- iii. Industrial Grade Components are to be used in all electrical /electronic items.
- iv. Total peak power requirement per coach shall not exceed 800 watts.
- v. Requirement of power shall be clearly specified by the supplier.

## 7. DUTY CYCLE

Operation of flush cycle should start instantly as soon as flush button is pressed and toilet should be ready within 1 (one) minute after each use. One toilet may be used upto 150 times for defecations in 24 hrs.

## 8. DESIGN REQUIREMENT

- 8.1. The system offered must be modular and must be supplied as a complete system to handle human waste as specified. It should take minimum possible time for replacement of each module (Say two to three hours maximum). The supplier should indicate replacement time module wise.
- 8.2. The technical implications/reasons for capacity rating of important components of the system must be explained in detail by the supplier. Similarly, all critical dimensions in the fixing & location drawings shall be clearly indicated by the supplier along with details of all mechanical and electrical interfaces between toilet system and the coach.
- 8.3. The system should be so designed that day to day maintenance does not require contact with waste by maintenance personnel. Before extensive repairs, complete evacuation and flushing of the system should be possible.
- 8.4. The supplier must indicate the consumption of power, air, water & cleaning chemical if any, each usage and hourly basis by the toilet system offered.

### 8.5. Flushing System:

- 8.5.1. The water consumption shall be minimum {with 0.5 liter (min.) to 0.8 liter (max.) water per flush} for 100% cleaning of the commode or pan. The system should have the facility to adjust water consumption further to a lower or higher value, if required.
- 8.5.2. The vacuum suction system and the design of toilet bowl should be such that the toilet can be cleaned / flushed properly with minimum possible water consumption as specified above. System should be designed such that it can

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work satisfactorily with reduced level of normal vacuum level and it should be possible to increase the level of vacuum in case of choking etc.

## 8.6. Water pressurizing unit

8.6.1. Adequately pressurised water should be used for efficient flushing of entire toilet bowl through nozzles /spray ring for 100% clean bowl/ lavatory pan and at the same time it should also be ensured that fecal matter should not splash during flushing cycle. For this purpose pneumatic / electro pneumatic water pressuriser should be used subject to overall consumption of max. allowable air of 15 Liter per minute /coach.

8.6.2. Water supply for flushing may contain dirt and other suspended impurities. Water filter needs to be provided to ensure trouble free operation of flushing system. Maintenance free and leak proof isolating valve is to be provided for filter cleaning.

## 8.7. TOILET PAN/ BOWL /Trough Floor

8.7.1. In Western commode toilets, material of toilet bowl shall be stainless steel to AISI 316L or better grade with surface finish no. 7 or better of IS:6911-92 (Tab. No. 8). Toilet bowl should have strong mounting and fittings to the coach interface. Design of western commode shall be similar to drawing no. MLW63004.

8.7.2. Toilet seat and seat covers of WC shall be non-metallic and will be made of Nylon or a superior Non Metallic material suitable for intended use with ruggedness. Height of the seat may be 400 to 425 mm above the toilet floor.

8.7.3. Requirement of Indian style toilet pan shall be similar to RCF Drawing no. LE63202 alt. 2 or latest of stainless steel to AISI 316L or superior with surface finish no. 7 or better of IS:6911-92 (Tab. No. 8). Drawings referred in the specification are representative in nature. Purchaser may ensure the issue of applicable drawings.

8.7.4. The diameter of the toilet pan / bowl outlet hole should be optimal to fulfill the requirements of clause No. 4.5 & 8.10 of this specification and shall be so designed as to prevent any obstruction in outflow of waste. The waste should never be visible or flow backwards into the bowl even in cases of malfunctioning.

8.7.5. The toilet system must be provided with an effective sealing arrangement of a proven design to ensure the sealing of odour from the waste tank to the toilet room. This condition must be satisfied not only during normal operation but also when there is loss of air or power or both.

8.7.6. Western/Oriental bowls shall be equipped with level sensor / any other sensor in the system to avoid flooding due to any circumstances of blockage in the system. By sensing the water level of lavatory pan / bowl, the system shall automatically attempt to discharge accumulation of lavatory pan / bowl by vacuum suction, if fails it shall render the system to idle till it is rectified.

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8.7.7. In case of malfunctioning of the toilet the indication shall be provided so that the passengers refrain from using it.

## 8.8. BIO DIGESTER TANK

8.8.1. Bio digester tank shall be provided by the railway authorities to the applicable design for LH and RH side. Vendor / supplier shall be required to ensure that they have acquired sufficient know how of IR-DRDO bio digester for interfacing vacuum toilet to the existing bio digester.

- a) Interface System with bio digester should be so designed and manufactured that no unprocessed waste should spill, leak or overflow from the waste retention tank either during run or during maintenance in Depot. It should also not allow foul smell to come out.
- b) Details of mounting arrangement to be worked out by supplier in consultation of purchaser clearly indicating the scope of work.

8.8.2. List of Drawings applicable for provision of IR-DRDO bio digester in LHB type coaches are attached as Annexure 1. Drawings listed at annexure 1 are for reference purpose only, Intellectual property rights of Designs /Drawings shall remain with Indian Railways.

## 8.9. CONTROL PANEL

The system is to be designed with PLC/ Microcontroller/ Microprocessor based Electro Pneumatic Control panel which will also provide indications for easy maintenance of the system and shall fulfill requirements of para 8.9.2.

8.9.1. The Control panel should be modular and plug in type for easy fitment and maintenance and shall be fitted inside the coach. The supplier shall indicate its size, location and fixing arrangements suiting to existing provisions made in lavatory module and coaches. The control panel should be provided in the space mentioned in the RCF drawing no. MI005425 alt. Nil.

8.9.2. PLC/ Microcontroller/ Microprocessor Control unit, should have IP67 protection from dust and water. Control unit and other electronic / electro-pneumatics shall be enclosed in a box with lockable opening doors/ panel (Preferably special tooling for locking and unlocking the panel). Entire box should conform to minimum IP54 protection from dust and water. Mounting holes required for box shall be interfaced to the existing studs on lavatory module.

The unit must have the following characteristics:

- i. Maintenance friendly modular design
- ii. Rugged construction to withstand vibration, heat & dust of IR coaches
- iii. Control panel should have provisions to allow adjustment of variables such as air supply / pressure, vacuum level, flush water volume and pressure etc. by authorized persons only.
- iv. All electrical and pneumatic devices and connections on control panel should be plug in type.

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- v. All the electronic module of Control Panel should conform to IEC 60571 or equivalent international standards. Industrial Grade Components shall be used in all electrical/electronic items.
- vi. Manual override switch in the control panel be provided to operate the valves in case of emergency.
- vii. Control panel should be able to provide alarm signals / indications with sufficient inbuilt memory storage to log up to 10,000 important events along with date and time stamp of last 6 months in case of the following cases. System should have non-volatile and non-removable data-logging memory and RS485 port for interfacing to Smart Coach. If there is requirement of specific software for data transfer / viewing, the same is to be provided by the supplier.
  - a. Failure of Compressed air supply.
  - b. Failure of Water supply / shortages.
  - c. Indication of Electrical supply.
  - d. Vacuum failure and blockage in the system.
- viii. Communication interface
  - a. Standard RS485 communication port shall communicate parameters to Smart-Coach controller via industry standard MODBUS-RTU protocol (9600 baud rate) to include:
    - i) Make and ID number of equipment.
    - ii) Number of flush operations.
    - iii) Toilet status – Ready or faulty.
    - iv) Fault logs, at least including-
      - 1. Toilet choking.
      - 2. Failure of compressed air/ low pressure.
      - 3. Failure of water supply.
      - 4. Vacuum failure / low vacuum.
      - 5. Power supply status (in case of power backup).
  - b. **Optional** GSM / GPRS based communication module for generating SMS messages for maintenance purpose may also be provided, if specifically asked by purchaser Railway / PU. In such case, provision of active SIM and data plan for GSM module shall be responsibility of supplier.
  - c. The documentation details of the communication interface shall be provided by the supplier.

#### 8.10. VACUUM GENERATION

- 8.10.1. Reliable and easily maintainable ejector should be used for vacuum generation to achieve optimal capacity with least possible compressed air consumption at available air pressure 6 Kg /cm<sup>2</sup>, however system should be able to work satisfactorily upto 4kg/cm<sup>2</sup> compressed air pressure also. Minimum 34% vacuum level (i.e. 500 mmHg vacuum) should be achieved after each cycle of flushing and system should be ready within one minutes of

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each cycle, however supplier shall ensure that all the waste from the toilet bowel shall be transferred efficiently without clogging. The minimum evacuated air volume shall be at least 3.5 liters. (Evacuated air volume is the air extracted from the transfer tank during each flush).

8.10.2. Alternatively any other method for vacuum generation (Minimum 34% vacuum level i.e. 500 mmHg vacuum) may also be accepted subject to compliance of functional, operational and technical requirements of this specification.

**8.11. Flushing Button:** Common Flush button / manual flush knob shall be installed at ergonomically suitable location. Standard height of flush button / knob is 1300 ± 20 mm from floor level.

~~8.10.3.~~ **8.11.1. Flushing button/ Interface to actuate flush cycle should not be affected by splashing of water in toilet. Flushing button design should be rugged and reliable for trouble free operation.**

## 9. TESTING AND APPROVAL

9.1. The supplier shall submit the details of the toilet system including layout drawings, interfaces required, integration requirement, operation and maintenance manual, Quality assurance plan, including requirement of spares and consumables for approval by Production Units / Zonal Railways.

9.2. Suppliers whose bio-vacuum toilets have already met the requirements of para 9.3 of this specification by any Production Unit / Zonal Railway shall be exempted to clause no. 9.3.

### 9.3. Prototype Approval:

9.3.1. Prototype approval of the toilet system (01 Western style and 01 Indian Style) will be done by Production Units / Zonal Railways. Prototype approval shall be done by actual fitment on a coach and successful functional test as per this specification.

9.3.2. All moving parts of the system specially the stench trap system, water & pneumatic valves are to be tested up to a minimum 50,000 cycles of continuous trouble free operation. The supplier / OEMs of the valve manufacturer may do this test in consultation with Production Units / Zonal Railways for which trial scheme be submitted and got approved by Production Units / Zonal Railways and test certificate should be submitted before approval of the prototype.

All the test certificates shall also be submitted by the supplier/OEMs for testing of all the critical components/assemblies of vacuum toilet. These test certificates should contain details of test conducted and measurements recorded.

9.3.3. Following parameters will be checked during prototype approval :

- I. Dimensional check
- II. Air & water pipelines connections.
- III. Working of system controls & indications.
- IV. Odour sealing arrangement.

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- V. Water consumption per flush
- VI. Functional check of the flush cycle.
- VII. Demonstration / testing of vacuum generation as per clause no.8.10.
- VIII. Any other tests considered necessary.

9.3.4. Vendors having developmental orders under clause no. 2.2 of this specification shall require service field trial on 05 coach sets (each of 01 Western type and 03 Indian Style). After successful prototype approval complete toilet system (05 coach set) shall be installed & commissioned by the manufacturer / supplier for field trials of at least 6 months before bulk supply.

9.3.5. Field trials shall be jointly monitored by Zonal Railways/PUs and concerned supplier as per trial scheme finalized for this purpose. Criteria for successful completion of field trial shall be elaborated in trial scheme.

9.3.6. Performance monitoring of the coaches fitted with bio vacuum toilets for field trial (for supplier under clause no. 2.2 )will be done in actual train service for a minimum period of 6 months with an objective to monitor the following:

- a) Proper & leak free connections in the complete system including air, water pipelines and interface piping up to retention tank.
- b) Proper working of system control & indications.
- c) Proper stench trap and no odour passing through to the toilet room from the bio digester tank.
- d) Functional check of the flush cycle.
- e) Proper functioning of the complete system including clean-ability & maintenance of hygiene.
- f) Details of attention /maintenance requirement with coach number, date and time.

## 10. MARKING

10.1. Manufacturer's name plate with serial/batch number along with month and year of manufacture shall be fitted at a visible location for identification on major assemblies of the system supplied.

10.2. Bright coloured push button for flushing / operation cycle shall be provided with description in bold letters and graphic symbol for ease of indication to users as per requirements of Railways.

## 11. DOCUMENTATION AND TRAINING

11.1. Following the acceptance of the prototype, contractor shall provide technical manuals as given below about the vacuum toilet systems in English. The information should be both printed and in electronic format and shall be provided to IR.

- I. Operating and maintenance instructions
- II. Periodic Maintenance Schedule (Daily / Trip/ Monthly), if any.
- III. Schematic diagrams of Installation & commissioning and their instructions
- IV. Schedule of operating principles.

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- 11.2. List of Do's and Don'ts for operation of vacuum toilet shall be provided by supplier fixed at mutually agreed suitable location of the toilet, to match with look and feel of other signage provided in the toilet.
- 11.3. The contractor shall provide theoretical and practical training to the staff of workshops and zonal railways for a period of 05 days free of cost. Supplier shall also be able to deliver optional testing equipments for supplied toilet system.

## 12. WARRANTY AND SPARES

- 12.1. Firm shall be liable for warranty of 72 months from the date of fitment. During warranty, the supplier shall rectify the equipment by repairing or replacing components with original spares at his cost. The warranty period would get extended on a pro-rata basis if warranty repairs / replacement are not provided within 5 days of notice. If supplier fails to provide warranty services within 5 days of notice, Railway reserves the right to take action as per extant rules.
- 12.2. During warranty period, day to day cleaning of toilet and filters as prescribed by OEM shall be carried out by Zonal Railways.
- 12.3. Preventive maintenance visit(s) has to be undertaken by the supplier /OEM during the warranty period. During these preventive maintenance visit(s), the supplier / OEM should also change the parts which are required to be changed as per OEM's technical manuals to achieve 72 months warranty.
- 12.4. Supplier shall ensure the availability of spare parts of the supplied system for a period of at least 10 years.

## 13. ANNUAL MAINTENANCE CONTRACT (AMC)

- 13.1. The firm should submit separate offer for comprehensive AMC for 6 years after end of the warranty. In case the user Railway wants to operate the Comprehensive AMC, firm shall follow the rates quoted in the tender. To meet the operating requirements of the Indian Railways, firm shall provide pan-India service unless otherwise specified in the tender conditions.
- 13.2. AMC offer should include the list of the spares (indicating Make/OEM) and their recommended frequency of replacement, cost etc.

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### **Annexure-1**

Drawings listed for Lavatory module of LHB type coaches are for reference purpose only, Intellectual property rights of Designs /Drawings shall remain with Indian Railways.

S.No.	Drawing No.	Description
1.	MI005710 or CG-18100	Mounting of IR-DRDO bio-digester system on LHB coaches.
2.	MI005711	Mounting of IR-DRDO bio-digester system on LHB coaches(RH)
3.	MI005426	The space envelope for control panel
4.	LE63202	Requirement of Indian style toilet pan
5.	MLW63004	Euro bowel assembly complete
6.	1 10113.0.30.000.002	Sanitary facilities complete chair car
7.	1 10112.0.30.000.002	Sanitary facilities complete exec chair car
8.	1 10112.0.30.000.004	lavatory module euro 1 mounting
9.	1 10113.0.30.000.003	lavatory module orient mounting
10.	1 10113.0.30.000.005	lavatory module euro 2 mounting
11.	1 10112.0.30.000.014	lavatory module euro 1 complete
12.	1 10113.0.30.000.013	lavatory module orient complete
13.	1 10113.0.30.000.015	lavatory module euro 2 complete
14.	1 10112.0.30.100.005	pipe laying for water in lav module euro 1 complete
15.	1 10113.0.30.100.006	pipe laying for water in lav module euro 2 complete
16.	1 10113.0.30.100.007	pipe laying for water in lav module orient complete
17.	1 10113.0.30.100.004	pipe laying for water under the coach
18.	1 10113.0.30.100.003	pipe laying for water in the body of the coach
19.	1 10113.0.30.110.006	roof water tank mounting 30 L NPP end mounting
20.	1 10113.0.30.110.007	roof water tank mounting 30 L PP end mounting
21.	1 10113.0.30.130.002	lavatory equipment euro 2 mounting
22.	1 10113.0.30.130.003	lavatory bowl orient mounting
23.	1 10113.0.30.130.005	lavatory bowl European mounting

**Note : All the drawings should be read with latest alteration applicable only.**

Signature			
Name & Designation	Sonu Kumar Gupta JE Design/ Carriage Prepared By	A.K.Gautam SSE Design/ Carriage Checked By	Gaurav Kumar Singh Director Carriage Approved By