REVISION OF SPECIFICATION / STR

Ref: Current Spec. No. – RDSO/2015/CG-04 with Draft Rev.01- Specification for Water Purification System for Indian Railway 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 along with 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	**In case of Firm / Individual:** Manufacturing experience of item (or similar Item) on which comments are offered	
9	**Where relevant:** 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/CD/Carriage
Research Designs and Standards Organization
Manak Nagar, Lucknow – 226011

Email: edcar.rdso@gmail.com Or jdircd@gmail.com

INDIAN RAILWAYS

SPECIFICATION FOR WATER PURIFICATION SYSTEM FOR INDIAN RAILWAY COACHES

S.No.	Month / Year of issue	Revision / Amendment	Page No.	Reason for Amendment
1.	**January- 2016**	-	**-**	**First Issue**
2.	**August-2016**	Corrigendum No.-01	7 of 13	DC-DC convertor requirement as per RDSO Spec. No. RDSO/PE/SPEC/AC/0184-2015 (Rev.0) for Switch Board Cabinet for LHB type AC EOG Coaches in Clause No. 5.15 has been added
3.	**July-2020**	Rev.01		

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RESEARCH DESIGNS AND STANDARDS ORGANISATION
Manak Nagar, LUCKNOW – 226011

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SPECIFICATION FOR WATER PURIFICATION SYSTEM FOR INDIAN RAILWAY COACHES

1.0 FOREWORD:

1.1 This specification covers the functional and technical requirements of membrane filtration for physical water purification for Indian Railway Coaches.

1.2 This specification draws reference to some of the relevant of IS:10500, IS:3025, IS:1622 and IS:7022(Part-I). For dated references, only the edition cited applies. For undated references, the latest edition of the reference document (including any amendments) applies.

2.0 SCOPE:

2.1 This specification covers general and technical requirements of membrane filtration for Water Purification System for India Railway Coaches of LHB design for provision of clean, potable and bacteria/virus less water to travelling passengers. This specification also prescribes the requirements, test methods and sampling procedure for ascertaining the suitability of water for drinking purpose.

3.0 TERMINOLOGY:

3.1 Drinking Water:

Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water supplied by pipes or any other means for human consumption.

3.2 Colloids:

Finely divided solids (particle size varying from 10^{-2} to 10^{-6}mm) which will not settle but may be removed by coagulation or biochemical action.

3.3 Contamination:

A general term signifying the introduction into water of micro-organisms, chemicals, wastes or sewage, which renders the water unfit for its intended use.

3.4 Filter:

A device or structure for removing solids from water, sewage or other liquids. The liquid is passed through a filtering medium.

3.5 Filtration:

The process of passing a liquid through a filtering medium for the removal of suspended or colloidal matter usually of a type that cannot be removed by sedimentation.

3.6 Ultrafiltration:

Ultrafiltration is a membrane-based filtration process, wherein filtration of particles is achieved through rejection by its pore to a molecular weight cut-off (MWCO) of approximately to 100,000 daltons and an operating trans membrane pressure of approximately 30 to 100psi.

3.7 Most Probable Number (MPN):

In the testing of bacterial density by the dilution method, that number of organisms per unit volume which, in accordance with statistical theory, would be more likely than any other possible number to yield the observed test results or which would yield the observed test results with the greatest frequency. Expressed as density of organisms per 100 ml.

3.8 Part Per Million (ppm):

A measure of proportion by weight and equivalent to a unit weight of solute per million unit weights of solution.

NOTE - A part per million i.e. generally considered equivalent to a milligram per litre, but this is not precise. A part per million is equivalent to a milligram of solute per kilogram of solution.

3.9 pH Value:

The pH value of an aqueous solution is the logarithm of the reciprocal of the hydrogen ion concentration (expressed in g/l) of the solution.

3.10 Turbidity:

Reduction of transparency of a sample due to the presence of particulate matter.

3.11 Total Dissolved Solids (TDS):

TDS is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular (suspended) form.

3.12 Potable Water:

Water which does not contain objectionable pollution, contamination, minerals, or infection, and is considered satisfactory for domestic consumption.

4.0 SCOPE OF WORK:

4.1 The scope of work shall include design, manufacture, supply, installation, commissioning, performance testing, and after sale service support of membrane type Water Purification System for Indian Railway Coaches of LHB design as per this specification. For prototype fitment, Second class non-AC EOG coach to RDSO layout no. CSC-1787 (99 seats)/CSC-1809 alt-1 (100 seats), shall be referred.

4.2 Suitable membrane type Water Filteration System, other suitable accessories or any other sub system/(s) required for specific design of the Water Purification System offered to Indian Railways.

5.0 DESIGN REQUIREMENTS:

5.1 The Water Purification System designed should generally be lightweight, robust, portable, easy to operate and maintenance free. The housing and other equipments of Water Purification System shall be made of non-corrosive material and the materials used shall have adequate mechanical strength and thermal resistance.

5.2 The design of Water Purification System should be compact in size and it should not require large space for its installation. It should also be simple in design for easy handling by Railway staff at maintenance depots/workshops in case any attention is required to it.

5.3 The installation of the Water Purification System should be easy and should not require any special skills and tools and plants.

5.4 The Water Purification System should work satisfactorily under the following operating conditions of IR coaches and should not affect functional requirements of Water Purification System.

a. Coach Dynamics:

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

i) Maximum vertical acceleration 1.0g

ii) Maximum longitudinal acceleration 3.0g

iii) Maximum transverse acceleration 2.0g

The vibrations are of sine wave form and the frequency vibration is between 10 Hz to 50 Hz.

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

$a = 25/f$ for values of f from 1 Hz to 10 Hz.

$a = 250/f^2$ for values of f exceeding 10Hz and up to 50 Hz.

In the direction corresponding to the longitudinal movement of the vehicle, the water Purification System shall be capable of withstanding for 30 min. at 50 Hz. Vibrations of such a value that the maximum acceleration is equal to 3g.

b. **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- $\pm 4^0$

c. Ambient conditions for a coach fitted with water purification system:

(i) Ambient temperature : -4° C to 50° C
Altitude : Sea level to 2500m

Relative humidity : 40% to 95%

(ii) The rainfall is fairly heavy.

(iii) During dry weather, the atmosphere is likely to be dusty.

(iv) Temperature variations can be quite high in the same journey or short period of time.

(v) Coaches operate in coastal region with continued exposure to salt laden air.

5.5 The design of the inlet and outlet connections shall be such that there exists no possibility of reversing the connection by workmen or possibility of intermixing of untreated and treated water inside the equipment.

5.6 The body of the unit shall be constructed with sufficient degree of resistance against safety hazards. The enclosure shall be secure and stable and should provide adequate protection against moving and electrically energized parts. Switches and controls should be protected against penetration of fluids and should have level of protection equivalent to IP54. The controls (i.e. switches, knobs, etc.) should be visible and clearly identified. Device design should prevent misinterpretation of displays and controls settings.

5.7 The Water Purification System should be designed for membrane type physical filtration by using ultrafiltration process and shall be able to filter all microorganisms and suspended particles from process water like silt, bacteria, viruses etc. and shall retain beneficiary elements, minerals and weakly alkaline. Water filtration technologies where wastage of water during purification process of water is high should not be used.

5.8 Membrane cartridges should use suitable multi capillary ultra-filtration membrane technology, wherein fiber's material shall have sufficient strength and shall be hydrophilic in nature and can work at low pressure also. The fibers shall not break during constant start/ stop operations of the Water Purification System.

5.9 The Water Purification System shall operate efficiently under forced flow.

5.10 The Water Purification System should be designed for minimum water wastage during filtration process or auto cleaning of membrane. If it is not avoidable to stop water wastage during filtration process or auto cleaning of membrane, water wastage should not be more than 10% of the filtered water in each cycle of use.

5.11 The Water Purification system should be designed for backwash/ forward flush process (auto cleaning of membrane) to remove contaminants accumulated on the membrane during filtration process.

5.12 The Water Purification System should be designed for a minimum continuous filtered water flow rate of two litres/minute.

5.13 The Water Purification System membrane should be designed for the typical particle size ranges 0.02 to 0.04 microns. In terms of approximate molecular weight, these filtering medium must remove particles greater than 100,000 daltons.

5.14 The Water Purification System should employ membrane filtration process wherein all of the process fluid flows and all particles larger than the pore sizes of the membrane can be stopped at its surface.

5.15 Power Supply:

5.15.1 110V DC supply is available from the coach circuits. This supply varies from 90V to 140V with 15% ripple in AC & Non-AC, SG and EOG ICF type coaches. 24V DC supply level with tolerance of +25% & -30% is also available in LHB AC & Non-AC, SG and EOG coaches. Moreover, 750V/415V, 3-phase AC 50Hz is also available in Rajdhani/Shatabdi Express type coaches only.

5.15.2 If any power is required, the equipments are to be so designed to withstand 30% voltage fluctuation.

5.15.3 DC-DC converter either from a reputed and established brand can be used or made in-house and be able to withstand +/- 30% voltage fluctuations, 2KVA surge, +/- 10% ripple and complying with IEC 60571 or any equivalent international standards. Industrial Grade Components to be used in all electronic items.

OR

DC-DC convertor of make as approved at S. N. 68 of BOM (Bill of Material) of specification no. RDSO/PE/SPEC/AC/0184-2015 (Rev.0) for Switch Board Cabinet for LHB type AC EOG Coaches can be used.

5.15.4 Requirements of electrical power per Water Purification System shall be specified by the tenderer in their offer.

5.16 The Water Purification System delivery unit shall incorporate a visual electrical display to provide information to indicate regarding power supply, indication for backwash/forward flush/auto cleaning of the filtering medium and when dispensing of water is taking place.

5.17 To guarantee compliance with minimum potable water requirements, and to ensure that the membrane used in Water Purification System meets Nationally/Internationally recognized safety norms, the Water Purification System shall be listed with at least one of the Nationally/Internationally recognized accreditation body such as NSF (National Sanitation Foundation), KTW, WQA (Water Quality Association), UL (Underwriters Laboratories), FDA (Food and Drug Administration) etc.

6.0 PROTOTYPE INSPECTION :

6.1 One complete system as per this specification shall be installed by the vendor/supplier on a designated coach as prototype for checking/verifying/clarifying the fitment and requirements of this specification. The installed system on designated coach shall be checked for functionality and performance.

6.2 The performance test of the Water Purification System shall be checked at the time of prototype inspection which shall include the following:

6.2.1 The continuous flow rate of filtered water from the Water Purification System shall not be less than two litres/minute.

6.2.2 The functionality of the Water Purification System shall be checked for backwash/ forward flush (auto cleaning of the membrane). The Water Purification System shall function automatically during this process. The Water Purification System shall indicate that the System is performing auto cleaning of membrane. The number of cycles of auto cleaning of the Water Purification System during 24 hours of service shall be as per manufacturer's recommendation.

6.2.3 The discharge of water during auto cleaning process should also be measured to ensure the wastage of water. It shall not be estimated more than 10% of the total filtered water by the Water Purification System.

7.0 SAMPLING CRITERIA FOR CONFORMITY:

7.1 The inspection lot size for Water Purification System shall be minimum 10 numbers or part thereof, if ordered quantity is less than 10 numbers for accepting a lot.

7.2 Representative samples for Water Purification System shall be drawn at randomly 10% of the lot size or minimum 02 numbers whichever is more.

7.3 Samples selected for Acceptance Test shall confirm the requirements as laid down in clause 8.2 of this specification. If any one of the test sample fails to meet the requirements of Acceptance test, double the number of the samples from the same lot shall be drawn for re-testing. If any of these samples fail, the entire lot shall be rejected.

8.0 TESTS:

8.1 TYPE TEST:

8.1.1 The test specified in Table-1 and Table-2 shall constitute type test and all shall be carried out at BIS/NABL/ MOEF approved laboratory at vendor cost on the samples of feed water to the Water Purification System taken at the time of inspection of a lot or when the inspecting authority/consignee/Indian Railway desires so or as agreed between purchaser/consignee/Indian Railway and manufacturer. The submission of test reports mentioned in Table-1 and Table-2 is mandatory and shall be submitted to purchaser/consignee/Indian Railways.

8.1.2 The efficiency of the filtration membrane to retain MS2 phages virus, which is nearly 22 nanometer in diameter must be certified by a reputed national/international lab/ institute. The average log-retention/log-removal value (LRV) of the filtration membrane shall not be less than 4. The firm shall submit documentary proof for MS2 Phages rejection test conducted on the membrane as used in the water purifier system.

8.1.3 The vendor/supplier shall also repeat the type tests in following cases at their cost.

1. Modification in equipment likely to affect its function or method of operation.
2. Failure or variations established in type test.

8.2 ACCEPTANCE TEST:

8.2.1 Visual check of the entire system regarding material quality, work quality, effect on aesthetics of the coach etc.

8.2.2 The sample of feed water and filtered water shall be collected as per clause 11.0 of this specification in presence of inspecting authority nominated by the consignee/ purchaser/Indian Railway. The samples collected shall be tested in independent testing laboratory at the manufacturer's cost.

8.2.3 The test specified in Table-2 are acceptance test which shall be carried out on the samples of filtered water from the Water Purification System at the time of inspection or when the inspecting authority/consignee/Indian Railways desires to do so.

8.2.4 The performance test specified under clause 6.2.1, 6.2.2 & 6.2.3 shall also be done on the installed Water Purification System at the time of inspection by inspection authority.

9.0 REQUIREMENTS OF FEED WATER:

9.1 The quality of feed water to Water Purification System for Indian Railway Coaches has been given in Table -1.

Table 1: Organoleptic, Physical and Bacteriological Parameters:

S. No.	Tests	Test Method	Requirements
1.	Colour, Hazen units, (Max.)	IS 3025:Part 4	13
2.	Odour	IS 3025:Part 5	Agreeable
3.	pH value (Max.)	IS 3025:Part 11	8.0
4.	Taste	IS 3025:Part 7 & 8	Agreeable
5.	Turbidity, NTU, (Max.)	IS 3025:Part 10	5.0
6.	Total Dissolved Solids (TDS), mg/l, (Max.)	IS 3025:Part 16	1800
7.	Total Coliform (MPN/100 ml) (Max.)	IS:1622 or APHA 22nd EDN:2012 (9221B)	5000

The quality of feed water deviating from the requirements mentioned in Table -1 above, the source of water shall be rejected.

10.0 REQUIREMENTS OF FILTERED WATER:

10.1 The filtered water of Water Purification System shall comply with the requirements given in Table -2.

Table 2: Physical and Bacteriological Parameters:

S. No.	Tests	Test Method	Requirement

1.	Colour, Hazen units, (Max.)	IS 3025:Part 4	Upto +10% of observed value of feed water (measured as per clause 9.1)
2.	Odour	IS 3025:Part 5	Agreeable
3.	pH value (Max.)	IS 3025:Part 11	Upto +10% of observed value of feed water (measured as per clause 9.1)
4.	Taste	IS 3025:Part 7 & 8	Agreeable
5.	Total Dissolved Solids (TDS), mg/l, (Max.)	IS 3025:Part 16	Upto +10% of observed value of feed water (measured as per clause 9.1)
6.	Turbidity, NTU, (Max)	IS 3025:Part 10	0.50
7.	Total Coliform (MPN/100 ml)	IS:1622 or APHA 22nd EDN:2012 (9221B)	Shall not be detectable in any 100 ml sample
8.	E-Coli (MPN/100ml)	IS:1622 or APHA 22nd EDN:2012 (9221F)	Shall not be detectable in any 100 ml sample

11.0 SAMPLING OF FEED AND FILTERED WATER:

11.1 Sampling of the filtered water from Water Purification System shall be done as per IS:1622 and IS:3025 (Part-1) respectively at an interval of three (03) months or when the consignee/Indian Railways desires to do so.

11.2 Sample shall be drawn in original sealed bottle/container and kept in protected place not exposed to damp air, dust and shoot and each bottle/container in original shall be sealed and marked with full details of sampling.

11.3 As far as possible, samples should be sent without the firm's identification markings. The labels from the bottles/container, if applied, shall be removed.

11.4 Selection of laboratory for independent testing shall be done and samples should be sent to BIS /NABL/MOEF approved labs only. Sample shall not be sent to the lab with whom vendor/supplier has arrangement for testing.

11.5 Bacteriological test samples must be collected in sterilized borosil glass containers, stored in refrigerated condition, and must be sent for testing within 24 hours of collection.

12.0 GUARANTEE/WARRANTY AND REPLACEMENT

12.1 The supplier/vendor of Water Purification System shall be fully responsible for satisfactory functioning. The warranty period for Water Purification System shall be 24

months from the date of commissioning. The supplier/vendor shall replace the items/equipments rejected due to their noncompliance with the requirements of this specification and/or the products those are failing or providing unsatisfactory service due to defective design, material or workmanship within warranty period by product/(s) complying with the requirements, free of cost within a period of two weeks.

13.0 SPARE PARTS/CONSUMABLE:

13.1 The vendor/supplier shall recommend a list of spare parts/consumables required for day to day maintenance of the Water Purification System and spares/consumables in the form of kit for the various sub-assemblies for the maintenance at the time of IOH/POH. The list shall give the estimated maintenance frequency, batch no./ part number, quantity and price of each component or as per kit.

13.2 The vendor/supplier shall ensure availability of all spares/consumables of the Water Purification System for a period of at least 6 years (2 POH cycle of LHB GS Coach). This shall be irrespective of the fact whether the vendor/supplier or his sub vendor/(s) have stopped manufacturing of the equipment/(s) to the design supplied to Indian Railway.

14.0 MARKING

14.1 Each unit of Water Purification System shall be legibly marked to indicate the followings:

1. Name and code of the manufacturer
2. Month and year of manufacture.
3. Identification marks, i.e. Part Number, Batch Number, etc.
4. Rated capacity.

15.0 PACKING

15.1 The supplier/vendor shall be responsible for proper and adequate packing of Water Purification System in assembled condition before dispatch to prevent damage in transportation, handling and storage.

16.0 TRAINING

16.1 The supplier/vendor shall arrange free of cost training to Indian Railways. Personnel in operation, maintenance and troubleshooting of the Water Purification System. The venue and period of training should be mutually agreed between supplier/vendor and purchaser/consignee/Indian Railways.

17.0 INFRINGMENT OF INTELLECTUAL PROPERTY RIGHTS (IPR)

17.1 Indian Railway shall not be responsible for infringement of IPR arising due to similarity in design of Water Purification System, manufacturing process, components used in design, development and manufacturing equipment and any other factor, which may cause such dispute. The entire responsibility to settle any such disputes/matters lies with the manufacturer/ supplier.

18.0 INSTALLATION AND COMMISSIONING:

18.1 The vendor/supplier shall consult coach manufacturing unit or a unit nominated by the consignee/purchaser/Indian Railways with respect to relevant coach detailed drawings. It would be better on the part of the vendor/supplier to visit and physically assess the existing LHB GS Coaches for better appreciation of the work contents.

18.2 Mounting, installation & commissioning of Water Purification System on the designated coach/coaches shall be carried out by the vendor/supplier at consignee's premises or the place decided by the consignee/purchaser/Indian Railways. The space envelop for fitment of Water Purification System shall be as per latest MCF drawing No. MMI000020.

18.3 The Water Purification System installed and commissioned shall be checked by the vendor/supplier for proper functionality and performance.

18.4 The vendor/supplier shall follow all the safety measures and precautions at the time of installation & commissioning of Water Purification System at the site.

18.5 The installed and commissioned Water Purification System shall be subjected to a field trial of 18 months from the date of commissioning on LHB GS Coaches.

19.0 MAINTENANCE:

19.1 The vendor/supplier shall be liable for all scheduled and un-scheduled repairs of Water Purification Systems installed by them for the satisfactory performance.

19.2 The comprehensive maintenance shall include the followings:

19.2.1 Thorough checking of the entire system in every 3 months or as recommended by the manufacturer for proper functioning of Water Purification System at the nominated maintenance depot.

19.2.2 The fault noticed or complaints received shall be rectified by the vendor/supplier free of cost by next trip or at first availability of the coach at maintenance depot or within 48 hours of the receipt of the complaint. For scheduled replacement of spares/consumables, the arrangement of spares/consumables shall be done by mutual agreement between purchaser/consignee/Indian Railway and manufacturer.

19.2.3 The vendor/supplier will be also liable to depute his staff to investigate and attend the specific problems arises in operation of Water Purification System if requested by the consignee/Indian Railways.

19.3 The vendor/supplier shall supply operation and maintenance manual with each Water Purification System free of cost in hard and soft copies to consignee for proper maintenance of Water Purification System. The Manuals shall be self-illustrated, having principle of operation, maintenance schedule of all the proprietary items of the Water Purification System being supplied by them. The Manual shall also contain information on the following:

- Details of attention required during IOH (18 months) / POH (36 months) or any other schedule of LHB GS coach/(es).
- Typical defects and their remedial measures.
- List of spares kit for day-to-day maintenance and for POH in the form of periodic overhaul kit.
- The vendor/supplier shall also submit the frequency and detailed work content of various inspection/maintenance schedule necessary for maintenance of the Water Purification System.
- Whether these requirements are time based or otherwise shall be indicated for each schedule.
- The vendor/supplier shall also supply Wall Charts (pictorial view showing all components name along with their part Nos.) of all equipments of the Water Purification System along with the equipments being supplied by them for display in maintenance depots.