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Functional Requirement Specification for Waste Bin Compactor for LHB Coaches

1. Introduction:

The Waste bin Compactor for Indian Railways LHB Coaches is to be designed for efficiently manage and reduce the volume of waste generated in each coach. This system aims to enhance cleanliness, hygiene, and environmental sustainability within the coaches. The functional requirements outlined below are essential for the proper operation and integration of the Waste Bin Compactor system.

2. Functional Requirements:

- 2.1 The waste bin compactor should be customized for application in Indian Railways LHB design coaches within the available space in coach with optimal capacity.
- 2.2 The material of waste bin compactor system should be non-corrosive. The cabinet material should have fire resistance performance of E60 as per EN 45545-3.
- 2.3 It should be compact, robust, light weight, operation & maintenance friendly, safe to users, easy to emptying with minimum human effort. It should be aesthetically pleasing.

2.4 Operating Conditions:

2.4.1 Weather limiting conditions:

S. No.	Weather condition	Limiting conditions
1	Maximum temperature	+70° C
2	Minimum temperature	-20° C
3	Maximum Relative humidity	Up to 100%
4	Average Annual Rainfall	Fairly heavy,
	Humidity	30% to 95% sometime up to 100%
5	Altitude	Sea level to 3000 m
6	Coaches operate in coastal region with continued exposure to salt laden air	

2.4.2 Coach-body displacement under dynamic conditions:

- i) Vertically- ± 100 mm
- ii) Laterally - ± 55 mm
- ii) Longitudinally- ± 10 mm
- iii) Bogie rotation about center pivot- $\pm 4^{\circ}$

2.4.3 Coach Dynamics:

The vibrations and shocks normally encountered in service are indicated as 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.

2.5 Power Supply:

- The waste bin compactor should be designed to operate on the existing power supply available in IR LHB coach circuit.
- In LHB design coaches electrical power of 110V DC supply is available from

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

2.6 Waste Collection:

- The capacity of waste bin should be sufficient enough to accommodate various type of waste generated by users in coach like paper, snakes wrappers, plastic, glass, organic waste, food disposable thali / plates etc.
- It should be easily detachable from the compaction system and should have in-built provision to collect and discharge liquid / semi-liquid waste also which may generate from food/beverage items.
- It should have a visual capacity indicator to notify the on-board train staff / concern Railway official / user.

2.7 Waste Compaction:

- It should have suitable compaction mechanism for compacting waste effectively within the waste bin. On the part of fire hazard, oil based compaction mechanism should not be used.
- The compaction process should be automated, safe, easy and should result in significant reduction in the volume of waste to optimize storage space.
- It should have high compaction ratio and each cycle time should be minimum. During compaction process it should give a clear visual indication and should restrict feeding of waste by user.

2.8 User Interface:

- The system should have a user-friendly interface for user and on-board train staff with clear and self explanatory visual notification/display to monitor the compactor status like readiness, not ready, waste feeding, compaction, when 75% of capacity by volume is achieved and waste bin is full.
- When waste is dropped in waste bin, it should be detect automatically but compaction process should start after some lag in time.
- During compaction, in no any case the feeding of waste by user should be possible. Chances of tempering/vandalism should be minimized.

2.9 Safety Features:

- The system should be designed for high level of safety measures to safeguard users / on-board staffs from injuries like electrical shock, trapping of object / body part etc.
- The system should have safety sensors and emergency stop buttons to prevent any safety hazard / accident during operation.

2.10 Maintenance and Serviceability:

- The system should be designed for easy maintenance with accessible components and clear instructions for routine checks and repairs.
- Spare parts and technical support for repairs should be readily available to minimize downtime.

2.11 Environmental Considerations:

- The compactor system should meet with the environmental standards and regulations regarding waste disposal.
- The system should be designed with minimize noise pollution during operation.

3. Performance Requirements:

- It should be compact, robust, light weight, safe to users, operation & maintenance friendly. It should not hamper / compromise the free movement of passengers.
- The waste bin compactor should be able to compact a significant volume of waste within a specified time frame, ensuring efficient operation during train journey.
- The compaction ratio (original waste volume to compacted waste volume) should meet industry standards and regulations.
- The system should meet the dynamic condition and environmental condition of coach as per National / International norms for railway application.
- The waste bin compactor and electrical / electronic components should meet with the requirement of National / International norms for railway application.
- The waste bin compactor should withstand vibrations, shocks normally encountered in service, coach-body displacement encountered due to coach dynamics and the ambient conditions in Indian terrain.

Note: Above functional requirements are indicative and not exhaustive.
