INDIAN RAILWAYS

SPECIFICATION

FOR

SMART WAGON

SPECIFICATION NO. WD-35-MISC-2024 (Rev.0)

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ISSUED BY

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1.0 PREAMBLE

1.1. The Indian Railways Freight Rolling assets currently plying the network, count to about 400,000 wagons, with sizable number of new wagons entering the network every year. These wagons are fitted with various variants of Three-Piece Bogie (CASNUB, LCCF and LWLH variants). The general arrangements of the Three-Piece Bogies are indicated in Annexure-I. Diagrams of a typical Open Type Wagon, Tank Type Wagon, Flat Type Wagon and a Covered Type Wagon are indicated in Annexure-II, Annexure-III, Annexure-IV and Annexure-V respectively. These wagons are given schedule maintenance i.e. Routine Overhauling (ROH) and Periodic Overhauling at nominated Wagon depots and Wagon Workshop at an interval of 18/24 Months and 54/72 Months respectively apart from regular yard examinations and out of course repairs. Presently, there is no on-board monitoring system to monitor the health of a wagon and its components during service to minimise enroute failures and breakdowns through condition monitoring of different subassemblies.

1.2. Maintenance of freight rolling stock in Indian Railways has traditionally been preventive and breakdown-based. However, with the advent of technology and global developments, Indian Railways aims to move towards a condition-based predictive maintenance regime. This new approach will necessitate the implementation of condition monitoring systems for rolling assets and the analysis of vast amounts of data available on IR using AI/ML technologies.

1.3. While some progress has been made in condition monitoring through the installation of wayside equipment such as HAHW, WILD, OMRS, Machine Vision etc. and data capture and analysis platforms like FMM and WISE, there is still a significant gap in on-board monitoring of freight rolling assets.

1.4. To achieve the objective of condition monitoring, it is imperative to focus on Enhancing On-Board Monitoring, Data Analysis and AI/ML Integration and Collaborative Efforts and Innovations.

1.5. By focusing on these areas, Indian Railways can move towards a more efficient and effective maintenance regime, reducing downtime and enhancing the reliability of freight rolling stock, improved safety, improved reliability, higher utilization, increased up-time and reduced operation cost of the railway assets by enabling Optimized Maintenance and reduction in sudden catastrophic failures of these assets.

1.6. Railway Board vide its L. No 2024/E&R/10 (10)/3 (E-3468020) dt.03.07.2024 has also mandated RDSO to work on the development of specification for smart wagon.

1.7. This document is aimed towards Indian Railways' pursuit of on-board condition monitoring by installing vehicle borne IoT sensors which enable a 'SMART WAGON' platform that shall monitor not only the health and safety of key components of the freight wagons from the point of view of component health and its safety, but also enable the railway fleet of wagons to be utilised in a better manner with enhanced visibility, optimised maintenance solutions, asset utilisation, emergency response, etc.

1.8. The objective is to develop a complete IoT enabled platform for the rail environment and use machine learning models which are based on the data available from equipment and utilisation of software to enable optimized maintenance and condition monitoring of wagons using AI (Artificial Intelligence) modules as a repository which can be connected to all custodians of freight stock simultaneously using IoT based solutions. Introducing such a framework would require stringent service level agreements in place to ensure several parameters like data collection, data security, accuracy, equipment down time etc.

1.9. The baseline expectations of the Railways' specification "Draft Specification for Development, Supply, Installation, and Commissioning of the On-Board Rolling Stock Condition Monitoring System" (Specification Number: OBCMS/DCM/N/1, November 2016) should also be taken as a reference document. All devices used should be environmentally friendly and battery replacement cycle for deployed products should not be less than the highest prescribed POH cycle time of freight stock which at present is 06 years, wherever applicable.

1.10. Any of the systems mentioned in this specification, should work in parallel and compliment with current wayside systems (HAHW, HBD, MVIS, WILD, OMRS etc.) deployed by Indian Railways and not cause any adverse effect in their operation. System shall be capable of capturing and transmitting data among existing wayside condition monitoring systems and IT applications running on IR like FMM, WISE, FOIS etc. using machine to machine standard communication protocol (API's). It shall be imperative upon the firm that the Conditioned and Processed Data with actionable insights generated by the on-board condition monitoring platform is maintained for record keeping with CRIS/any organisation nominated by IR for integrating with relevant applications. Additionally, in case of any issues arising in operations, and a request is made by IR to audit Raw Data including all sensor level data that is being captured and stored for analysis/report, the firm must submit all the required information related to that situation.

1.11. The SMART WAGON aims integration of cutting-edge technology to achieve better utilization and optimization of assets, as well as workforce and materials, by embracing state-of-the-art solutions and focusing on efficiency.

2.0 SCOPE

2.1 This document lists the functional requirements of a system for on-board condition monitoring of Wagons on Indian Railways, encompassing a gateway device for frequent communication to the cloud, condition monitoring sensors such as wheel and bearing health sensors, safety sensors such as load sensors to detect different levels of loading/tilted load detection, door/hatch open and close sensors, hand brake monitoring sensor, brake health monitoring sensors, and sensors for wagon level impact forces, etc. The platform should be built to integrate additional sensors if required for particular applications as deemed necessary by the Indian Railways.

2.2 The scope of specifications includes supply and installation of system, capturing of data, storage and processing of data in cloud to generate various reports analysis of historic data and transfer of same as per the requirement and direction of Indian Railways. The Scope also includes the platform to have capability to set up automated alert thresholds for any of the SMART WAGON sub systems and deliver the alerts on a real time basis to any email ID/phone number decided in the programmable alert structure. The scope also includes requirement of after sales support, AMC, modification, upgradation and updating of algorithms, modification of sensors etc. throughout the service life of equipment.

2.3. **Scope of Supply and Installation**

S. No.	Description of requirement*	Quantity per wagon(Nos.)**
1	Gateway / Data Concentrator Unit with integrated GSM & GPS capability#	1
2	Bearing & Wheel health monitoring Module ##	8
3	Load & Tilt detection Module##	4
4	Applied/Release Hand - Brake monitoring module	1
5	Tank Wagon Temperature Monitoring Module	As per requirement
6	Door/Hatch monitoring module	As per requirement of the specific

		type of wagon
7	Brake System Health Monitoring Module	As per requirement
8	System Certification, Testing, and Standards	As per international and RDSO standards.
9	Software and Algorithms	Algorithms that analyse raw data to create actionable alerts.
10	Web and Mobile Phone Applications	Cloud Enabled dedicated server setup, application hosting and maintenance with maximum safety and data security norms as per MEITY guidelines. Easy to use mobile phone application for installation and commissioning

* The list of items described is indicative; the actual scope of supply will be determined by the conditions specified in the tender.

** No. of sensors specified are indicative and may vary based on the type of wagon, parameters to be recorded etc. However, firm may suggest changes in required no. of sensors meeting overall functional requirement.

Gateway required with smart wagon should cater to all functional requirement of GPS system envisaged for IR freight stock so as smart wagon is not required to be equipped with standalone GPS module.

Bearing & Wheel health monitoring Module and Load & Tilt detection Module, collectively or individually shall also be capable of detecting and sending alert through data concentrator in case of a derailed wagon.

2.4. Firm shall generally follow the system, technology, standards, testing protocols and quality requirements mentioned in this specification. However, the firm can also offer alternate proven system, technology, standards, testing protocols, quality requirements, etc. equivalent or better than the given in this specification. Firm shall submit the detailed test report, documentary evidence and the justification/evidence to establish that the offered solution can provide consistent output to the desired level of accuracy/performance as specified in this document. However, prior written approval of DG (Wagon), RDSO shall be obtained before use of the alternate solution.

3.0 FUNCTIONAL REQUIREMENTS

In general, the equipment, devices, and systems used for condition monitoring and creating a SMART WAGON platform should be "fit and forget" type, requiring minimal user intervention once installed. The 'SMART WAGON' platform will enable onboard Condition Monitoring of wagons and higher asset utilisation of the fleet by meeting the following functionalities:

3.1 Proven Scalability & Reliability

Considering the vast scale of Indian Railways' network, it is crucial that any platform used should have demonstrated capability of scaling to handle millions of data points / month considering the sheer scale of the potential deployment and the number of sensor nodes that it might entail. Any platform under consideration should have proven scale and deployment in other Railway networks globally to ensure ability to have rapid adoption.

3.2 Open and Interoperable Platform

The entire platform should be stable enough and must demonstrate through a "live demo" the ability to handle multiple IoT sensors which feed data directly into the platform to better enable the end user to get a singular view about a non-powered rolling stock asset. The platform must have Integrated hardware, software, and analytics with an open ecosystem for interoperability with other data sources and IoT sensors. The platform must be "open" and must use standard communication protocols between IoT sensors to ensure addition of multiple other IoT sensors if and when required as approved by Indian Railways.

3.3 Proven Analytics, Artificial Intelligence Deployment and Reports

Any platform under consideration must be robust enough and have demonstrated the capability of comprehensive analytics, software capabilities with algorithms, pattern recognition, machine learning and reporting with evidence on Indian Railways or other international railway networks. The report customisation must be possible and be a part of the platform to ensure modification of reports as per end user expectations/Indian Railways.

3.4 Geo-fencing capability and Automated Alerts

The Platform must have the capability to add, edit and delete geo fencing and ensure that any asset while entering or leaving the geofence can create automated alerts. Additionally, the platform must have capability to set up automated alert thresholds for any of the SMART WAGON sub systems and deliver the alerts on a real time basis to any email ID/phone number decided in the alert structure.

3.5 **Accuracy and Map Matching**

As one of the main use cases of the "SMART WAGON'' platform is to improve accuracy & operational uptime, it is critical that any platform under consideration should have an integrated GIS layer for mapping context to ensure accurate mileage and geo positioning of the wagon assets.

3.6 **Worldwide connectivity:**

As the Indian railway network is expanding with potential operations in other countries, any platform under consideration should have the capability to access valuable data through all cellular networks (LTE/4G/5G) and receive positioning from NAVIC, GPS, Galileo, Glonass satellites etc.

3.7 **Data Management and Storage:**

It shall be binding on firm that data is maintained centrally with CRIS or any other authorised organisation of Indian Railways using standard communication/ data transfer protocol. All analysis, use of AI/ML etc. as envisaged in this document shall be done on the data transferred from central/ cloud server maintained by CRIS/ authorised organisation of Indian Railways.

3.8 **Data Security & Access Control:**

As per the protocols of the Indian Government, any data related to the "SMART WAGON" platform must sit within the land borders of India and must be encrypted by the latest security standards available. Access control methodology must ensure limited access only to authorised personnel covered under Non-Disclosure Agreements as per the norms of the Government of India and with MEITY empanelled cloud service providers (CSP's).

3.9 **Integration with CRIS Servers:**

The platform must have already built in API's to ensure that from the first deployment and trials; besides the data as detailed in para 3.7 above, all processed data, reports and alerts related to the health, safety, utilisation or any other situation are also transferred to CRIS Servers/any other Server as desired by Indian Railway for further integration into the Railway network.

3.10 **Power Source for bearing health sensor and wheel health sensor:**

Power Source for bearing health sensor (BHI) and wheel health sensor (WHI): As per the requirements of the OBCMS (Specification Number: OBCMS/DCM/N/1, November 2016) energy harvesting technology will be preferred.

3.11 **Warranty:**

As wagons are non-powered assets, the platform under consideration should ensure that any sensors used meets stringent warranty requirements of the Indian Railways and must ensure minimum warranty of 6 years from the date of commissioning. Scheduled maintenance/replacement should be done at the time of ROH and POH only. However, in case of breakdown failures, immediate attention shall be arranged by the firm at next scheduled maintenance of wagon in yard, sick line, ROH, POH etc.

(a) The Firm is fully responsible for maintaining the platform and ensure continuous improvement of the algorithms, sensor technologies, software services and cloud architecture etc. This maintenance includes replacing defective devices throughout its warranty period.

(b) In the event of a defective or malfunctioning device during the warranty period, the supplier is obligated to replace the device at his own cost.

(c) It will be responsibility of firm to impart training to Indian Railway personnel on removal and fitment of sensors, gateway, etc. for undertaking requisite scheduled as well as breakdown repair on wagons. This shall be ensured at nominated depots / workshops by firm without any additional cost. Post satisfactory training a certificate to this effect shall be issued by concerned gazetted officer. For the intervening period it shall be responsibility of the firm to remove and re-fit sensor, gateway, etc. to facilitate wagon maintenance as and when required.

(d) Firm shall also be responsible to provide requisite training materials, installation / maintenance manuals, mobile based training app, workshop training sessions etc. to Indian Railways' personnel.

(e) The supplier shall ensure availability of spares and device software updates/patches throughout the warranty period at his own cost.

(f) The Firm shall also undertake to ensure availability of all requisite spare parts for a minimum period of 15 years from the date of commissioning of the equipment. In case any specific spare part is not available at a later date for whatever reason, an equivalent or superior spare part that performs all the functions of the original spare part can be accepted subject to prior approval of the same by RDSO. In making such substitution of spares, which should have minimum impact on the existing architecture/software/layouts etc. The expenditure in modifying the system/sub-system/architecture shall be borne by the firm.

(g) The Firm shall give an undertaking that should there be any need for modification arising out of feedback or during the warranty, it will be carried out by the firm without any additional cost to the Indian Railways.

3.12 **Availability of equipment:**

The uptime requirement of the entire system should be equal or greater than 90% including the sensors, cloud availability and other supporting algorithms.

3.13 **Maintenance/AMC:**

After warranty period, i.e. 6 years, complete system must be maintained with necessary improvements/data services/cloud hosting requirements and other functional requirements which can be extended as per the requirements of the end user/Indian Railways and supported by the Supplier/OEM Supplier. Cost and terms and condition for AMC shall be decided mutually by Indian Railways and the firm.

3.14 **Alerting Structure:**

The platform under consideration should be built with IoT sensors which have the ability to be always listening for any inputs which might cross any predefined thresholds specified by the end user. The system must not solely be a time based data capturing system alone. The "SMART WAGON" alerts platform should be an event based platform, which monitors and reports events in real time and not in hourly or daily increments of time alone.

3.15 **Communication:**

In normal operations, the frequency of data transferred to the cloud must be at every 10 minute intervals or better, while the wagon is in motion and every 12 hours when the wagon is in idle condition, where standard reports related to the health of the wagon must be reported. Each data transmission should include latest GPS Coordinates, speed, and last measured health of the wagon components being monitored.

In case any of the sensors measure readings above the specified limits defined in the alerting structure, an immediate alert message should be delivered, regardless of the time of the last data transmission to the cloud. Such alerts shall be suitably geo-fenced, so as alerts are sent to nearest maintenance depot/personnel, besides other predefined structure of reporting.

To enable this real time alerting structure, the system can have smart energy management systems which enable the devices to deliver the lifecycle expectations.

3.16 **Theft Alerts:**

All on-board equipment shall be designed to have adequate antitheft measures, however the platform must also be capable to have anti-theft system and be able to generate alerts in case of tampering/dislocation /falling of the devices on the "SMART WAGON".

Apart from technological solutions, special mounting solutions should be provided to avoid theft or damage during service.

4.0 SUB-SYSTEMS FUNCTIONAL REQUIREMENTS

4.1 All SMART WAGON Sub-systems should be self-powered with a minimum warranty and battery life of 6 years. They should be easy to install and designed with adequate antitheft measures. All fitment schemes and alterations must be approved by DG (Wagon), RDSO prior to first deployment.

4.2 All SMART WAGON Sub-systems should be able to communicate with the Gateway device using the specified standard technology and should ensure instantaneous alerts if any thresholds are passed during the monitoring of the assets.

4.3 All SMART WAGON Sub-systems should meet the environmental conditions of the Railway network, and must be compliant to internationally accepted testing protocols such as ATEX/PESO, IECEX and/or relevant standards as listed in this document or accepted internationally.

4.4 Mounting arrangements shall be proven for desired operating conditions and designed along with poke-yoke to ensure the integrity of the device throughout the service life of the components. Suppliers shall submit detailed drawings with test reports as per relevant National/International standards or provide proof of best practices in the field, certifying that the proposed design will sustain Indian Railway operating conditions.

5.0 SUB-SYSTEM DETAILED FUNCTIONAL REQUIREMENT

5.1 Gateway / Data Concentrator Unit with integrated GSM & GPS capability

5.1.1 The device should be "**fit and forget**" type, requiring minimal user intervention once installed.

5.1.2 GPS (GNSS) module and Internal hardware:
The GNSS module must support all necessary frequency bands for signal reception, including L1 / L5 band. It should encompass a minimum of 50 channels and should support Indian SBAS (Satellite based augmentation system), specifically GAGAN.

5.1.3 GNSS Compatibility
The module should offer support for all Global Navigation Satellite Systems (GNSS), including NavIC. The GNSS module should be adaptable to switching exclusively to the NavIC platform through Over-The-Air (OTA) configuration in case of potential government mandates.

5.1.4 AGNSS Functionality

The device must support Assisted GNSS (AGNSS).

5.1.5 Positional Accuracy

It is imperative that the circular error probability (CEP50) should be less than 5 meters, ensuring precise location information.

5.1.6 Accelerometer

The device must incorporate a 3-axis accelerometer with G-force.

5.1.7 Autonomous Positional Accuracy

The GNSS module should deliver autonomous positional accuracy within 15 meters or better for 90% of the time.

5.1.8 Data Storage Capacity

The device shall have capability to store a minimum of one month data packets in case of loss of network.

5.1.9 Operating Temperature Range

Devices must operate reliably within an extensive temperature range, from -20°C to +85°C.

5.1.10 Temperature Sensor

The device should feature an internal temperature sensor with the ability to halt transmissions ensuring safety and longevity.

5.1.11 Communication Module Requirements:

Network Compatibility: The communication module should incorporate a 5G or 4G module with auto fallback feature. The module may also include support for NB IoT /LTE M1 with auto fallback feature, as required to achieve the objective of seamless connectivity and ensuring effective data transmission.

5.1.12 M2M e-SIM/Physical SIM: The device should have M2M e-SIM/Physical SIM that offers minimum dual profile support or ability to switch between network providers from the backend or via SIM.

5.1.13 OTA Firmware Update: The module should support Over-The-Air (OTA) firmware updates and configurations, allowing for remote maintenance and software enhancements. Firmware Update On The Air (FUOTA) mechanism should accept individual, group wise or bulk upgrade commands.

5.1.14 Cloud Connectivity: The device must possess the ability to transmit data directly to the platform, ensuring efficient and secure data storage and management.

5.1.15 Network Support: The Supplier should ensure network support throughout the device's warranty period, guaranteeing continuous communication, network availability, and the proper recharging of SIM/e-SIM.

5.1.16 Data Preservation: In the absence of network connectivity, the device must be capable of preserving collected data and transmitting it to the server during the next scheduled communication. Devices must be designed such that battery consumption is as low as possible.

5.1.17 Intelligent Power Management: The device should incorporate intelligent power management, including early registration abort, to conserve power when operating in areas with limited cellular coverage.

5.1.18 Sensor connection compatibility: The device needs to be compatible with Bluetooth Low Energy (BLE) version 5.0 or higher / Ultra High Frequency (UHF)/Radio/LORA to enable connectivity with a minimum number of sensors concurrently as per the requirement of the specification. The device must have a minimum communication range of 40 meters for sensor connectivity.

5.1.19 Physical Security Requirements:
Anti-Theft and Tampering Alert System: The device should feature an alerting system that to detect unauthorized access, removal, theft tampering, or any attempts to breach the device enclosure. This system must promptly generate alerts in response to such incidents, thereby upholding the device's integrity and security.

5.1.20 Battery Requirements:
Operational Longevity: The device must be able to log and transmit data packets at 10 min intervals to the server. The device should have the lifecycle of 6 years as required in this specification.

5.2 **Bearing and Wheel Health Monitoring Module##:**

5.2.1 Improving the reliability and safety by early warning of distress or impending failures in wheels and wheel bearings using the vibration signature of the bearings and wheels as well as temperature monitoring at bearing level, which is strategically placed on the adapter or any other desired location close to the bearing.

5.2.2 Improvement in reliability of these assets by detecting early signs of deterioration in wheels, wheel bearings thus providing ample time for planning, preventive and predictive maintenance and avoiding sudden breakdowns in service.

5.2.3 Enabling scientific decision-making for maintenance of assets based on accurate deterioration trending and quantified indices of state of health of these assets so as to plan condition-based maintenance rather than time-based maintenance.

5.2.4 It should be possible to install Gateway, Bearing and Wheel Health Monitoring Module, and other sensors on "in service" wagons within normal scheduled maintenance time.

5.2.5 The proposed system should be capable of being used with existing CTRB bearings without having to make any structural modifications in the roller bearings or any major intrusive modification in the bearing adapter/bogie frame.

5.2.6 Easy operation of the "SMART WAGON" System by simple, automatically generated and actionable alerts.

5.2.7 System should be "future proof" to the extent that any change in communication technology and sensor electronics should not degrade its performance nor should necessitate that Indian Railways is compelled to change the purchased system to reap its intended benefits.

5.3 **Load and Tilt detection Module##:**

5.3.1 Load monitoring solution should be an enabler for the Railways to monitor loading/unloading events during regular operations.

5.3.2 Load monitoring solution should also enable the Railways to detect and alert overloading events, tilted load detection in case the loads are not evenly distributed on the wagons which will further enhance the safety on the Railway network

5.3.3 It should be possible for data from each load monitor to be further analysed individually to build algorithms to predict possible issues in wear and tear components such as spring breakages, side bearing failures etc.

Bearing & Wheel health monitoring Module and Load & Tilt detection Module, collectively or individually shall also be capable of detecting and sending alert in case of a derailed wagon.

5.4 **Tank Wagon/Container Temperature Monitoring Module**

5.4.1 Temperature Monitoring solution should be easy to mount on standardised locations on the wagons to ensure continuous live monitoring of the goods being transported in the wagons.

5.4.2 Temperature range of measurement should be from $-50℃$ to $+150℃$ with a resolution of 1.0℃, this device should be self-powered and also have the functionality to give instant alerts in case of any thresholds being are breached, ensuring the device's integrity and security.

5.5 **Door/Hatch monitoring module:**

5.5.1 Door/Hatch monitor should be easy to mount on standardised locations on the wagons to ensure continuous live monitoring of the open/close status of the doors and also have functionality to give instant alerts in case of the door status changing in non-authorised locations or outside geo fences or while the wagon is on move.

5.6 **Applied/Release Hand - Brake monitoring module:**

5.6.1 Hand brake monitor should be easy to mount on the wagons to ensure continuous live monitoring of the engagement of the hand brake and create instant alerts if wagons are in moving condition with engaged hand brakes.

5.7 **Brake System Health Monitoring Module:**

The Brake System Health Monitoring Module should be an easy to mount device that monitors the 4 main pressures of the air brake system of the wagon - the Brake Pipe, Brake Cylinder, Control Reservoir, and Auxiliary Reservoir and provide alerts through the main platform in case of any discrepancies.

6.0 TECHNICAL QUALIFICATIONS CRITERIA

6.1 **Performance requirements for Non-Restricted Supply:**
Following experience of the Supplier/ Lead Technical firm, in case the bid is submitted by a JV/Consortium of firms, shall be required to qualify them as non-restricted supplier when the proposal is called for.

6.1.1 The platform technology and deployment history be under exclusive ownership of one single firm. Further, the firm must have experience in the delivery of a highly scalable Platform (server/software/analytics) of condition monitoring of devices on Railway applications. The platform must have demonstrated, through any one of the Sub-Systems/Sensors (as indicated at para 5.0 of this specification), key features mentioned in this specification in deployment to existing clients of non-powered rolling stock assets. The platform should have demonstrated the ability to handle a minimum of 10 million data points per month or 2500 wagons simultaneously.

6.1.2 **Data concentrator experience**: The Firm shall furnish documentary proof of performance, including backend support hardware / firmware upgrades and availability of spares, for a period of 6 years or higher of the offered Data Concentrator/gateway device.

OR

Wireless sensor experience: Installation of at-least 2500 nos. wireless On-Board Condition Monitoring sensors on non-powered rolling stock assets. Any of these sensors must have run in the field for at least 2 (two) years or experience of over 1,000,000 kilometres of accumulated sensors kilometres in service operation.

6.1.3 All offered sub-systems should have history of use in existing Railway networks and firm shall submit documentary evidence for the same. Untested and un-tried products/technology shall not be considered.

6.1.4 A performance certificate issued by the customer, specifying the details of the executed item/s, their quantity & value/s and the period of completion of such items of the PO/Contract as per technical qualifying criteria mentioned above shall be submitted.

6.2 **Performance requirements for Restricted Supply (Developmental Source):**
Following experience of the Supplier/ Lead Technical firm, in case the bid is submitted by a JV/Consortium of firms, shall be required to qualify them as developmental supplier when the proposal is called for. The firm shall be treated as a Developmental Source and the maximum quantity for placing an order on the firm shall be as per the extant guidelines of Indian Railways applicable for developmental source.

6.2.1 The platform technology and deployment history be under exclusive ownership of one single firm. Further, the firm must have experience in the delivery of a highly scalable Platform (server/software/analytics) of condition monitoring of devices on Railway applications. The platform must have demonstrated, through any one of the Sub-Systems/Sensors (as indicated at para 5.0 of this specification), key features mentioned in this specification in deployment to existing clients of rolling stock assets. The system should have demonstrated the ability to handle a minimum of 2 million data points per month or 500 rolling stock managed simultaneously.

6.2.2 **Data concentrator experience**: The Firm shall furnish documentary proof of performance including backend support hardware / firmware upgrades and availability of spares for a period of 2 years or higher of the offered Data Concentrator device.

OR

Wireless sensor experience: Installation of at-least 500 nos. On-Board Condition Monitoring sensors on rolling stock assets. Any of these sensors must have run in the field for at least 1 (one) year or experience of over 200,000 kilometres of accumulated sensors kilometres in service operation.

6.2.3 A performance certificate issued by the customer, specifying the details of the executed item/s, their quantity & value/s and the period of completion of such items of the PO/Contract as per technical qualifying criteria mentioned above shall be submitted.

7.0 DETAILED DELIVERABLES EXPECTED FROM THE SYSTEM:

7.1 System should have a communication module and should incorporate a 5G or 4G module with auto fallback feature. The module may also include support for NBIoT /LTE M1 with auto fallback feature, as required to achieve the objective of seamless connectivity and ensuring effective data transmission. The system shall be compatible with Railway data transfer network.

7.2 Storage, transfer and analysis of data shall be governed as per para 3.7 of this specification.

7.3 Sensors within the SMART WAGON system must be always ON to ensure capturing of any and all events. In case any event threshold limit is exceeded a near real time alert must be sent to the cloud for further processing.

7.4 In normal working conditions (where event threshold limits are not surpassed), the data communication with the cloud server will happen every 10 minutes to ensure near real

time data acquisition even in normal working conditions. The system should be smart enough to modify ping frequency in conditions when the wagon is stationary to ensure equipment lifecycle.

7.5 In case of cellular network not available, the system should have adequate storage capacity on board to store a minimum of 1 month of data which can be transferred to the cloud as soon as connectivity is restored.

7.6 The condition monitoring system shall not be specific to any particular bearing type or to any specific bearing supplier but should function with multiple types of bearings that are running on Indian Railways.

7.7 Firm must specify the accuracy of their system on an overall basis with reference to False–Positive and False–Negative alarm performance. Except vibration sensors, all sensors must ensure accuracy of 10% or less false positives in reporting.

7.8 Only in the case of vibration signature monitoring sensors at the wheel and bearing location, IR will allow false positive of more than 10% for a period of maximum 18 months for first 2500 wagons fitted with this system.

7.9 Bearing and Wheel Health Vibration alerts shall be measured and transmitted when the train is operating in normal service i.e. speed greater than 15 km/h. It shall be possible to geo-fence such alerts.

7.10 The condition monitoring software algorithm should also report the state of the health of the bearing, wheels on discreet band zone – "Green Zone" for unconditionally safe to run, "Yellow Zone" - for beginning of noticeable deterioration and "Red Zone" - for indication to pull out the asset as soon as possible since it is reaching an impending failure stage.

7.11 The "condition band" (Green band, Yellow band and Red band) as mentioned above shall, after appropriate configuration and calibration, enable the operator to distinguish between bearings/wheels with none or low level of rate of degradation, those that require to be kept in sight for further monitoring and finally those requiring prompt attention to allow continued reliable operation of the train without a line-failure of the asset.

7.12 Besides the above mentioned "Zone Bands", all parameters of the all assets should be possible to be plotted and trended over time/distance to identify the deterioration rate/trend. This should enable prioritisation of maintenance activities, thus enabling reducing damage to assets and maximising useful wheel life.

7.13 The wheel condition monitoring system must be able to enable the operator to detect defects arising of Rolling contact fatigue like wheel shelling, wheel flats, etc.

7.14 In the event of sensor damage, a warning shall be generated to the cloud platform to enable safe replacement of the sensor at the next maintenance location. The cloud platform should have a mechanism to flag and display such defective sensor/data concentrator continuously to the personnel manning such terminals until the same is/are repaired/replaced.

7.15 Alert levels shall be configurable and set by the operator to enable simple, actionable responses. However, the vendor shall take the responsibility of identifying the values and setting the limits and alarm thresholds in consultation with Indian Railways. A time period of 6 months shall be given to the supplier to understand the Indian Railways operations and maintenance scenario and practices for setting such thresholds. The supplier shall be obligated to assist Indian Railways personnel in understanding the logics of the thresholds so set by them – to the full satisfaction of the Indian Railways personnel. A maximum period of 6 months from the date of commissioning on the last vehicle of all the purchased units under the first order shall be permitted to the supplier to do any fine-tuning of their system algorithms. However, for all subsequent purchases this period shall be limited to 02 months.

7.16 A system of cellular text alerts & mail-based alert and acknowledgements to nominated maintenance personnel of Indian Railways shall be designed with necessary checks and compliances. Such a system should be completely automated with provisions to escalate level of attention in case the nominated personnel do not acknowledge the relevant text.

7.17 All sensor data shall be time, date and location stamped. Data location shall be typically accurate to CEP50 less than 5m or better either on raw or processed data. Date and Time stamps shall be taken from the GPS system or the backend.

7.18 The allocation of sensor nodes to a data concentrator and train will be easily configured either through the terminal input of the data concentrator using a non-contact programming device (Bluetooth, NFC, Zigbee, etc.) or by remote connection with the user website.

7.19 The only configuration required for sensor nodes shall be the sensor node serial number with railway wagon number.

7.20 Indian Railways should also be able to extract the data in usable format that is being sent between WSN & data concentrator and data concentrator & analytics program on demand or conditional basis to better understand certain events.

8.0 MARKING AND TRACEBILITY

8.1 Device Identification

The device should be uniquely identified through laser engraving, with the device ID prominently marked on the top of the enclosure and discreetly inside the device. To ensure uniqueness, suppliers should use a unique four-letter prefix provided by CRIS/RDSO followed by a unique serial number.

8.2 QR Code Integration

Each device is equipped with a laser engraved QR code on the enclosure. This QR code contains essential information and is designed to have a lifespan compatible with the device itself. The QR code includes the following details:

a) Supplier Name (Maximum 4 letters)
b) Model Number
c) Device ID as mentioned above.
d) Date of Manufacturing
e) Battery Type (Lithium-ion, Nickel-metal Hydride, Lithium, Lithium Polymer, etc.)
f) Battery Capacity (in mill ampere-hours, mAh)
g) Device Type (Solar or Non-Solar)
h) SIM IMEI

9.0 INSPECTION

Prior to dispatch, a nominated agency by Indian Railways as the designated inspection authority, will conduct a thorough examination of each hardware/ software/ sensor/ platform/etc. This comprehensive inspection will encompass a detailed evaluation of all functionalities, verification of necessary certifications, and a meticulous visual examination. This inspection is a crucial step in confirming the quality and adherence of the equipment to specified standards. The firm shall submit the detailed parameters, testing standard, testing methodology, testing equipment and acceptable limit for each item offered as per the specification. The inspection will be carried out in the premises of the supplier. Supplier shall provide all the required assistance to carry out inspection.

Apart from the above, the railway consignee will perform an independent inspection before installation. This inspection will verify the physical condition, make, model, etc. of the device supplied. The consignee will meticulously check for any damages to the devices to ensure they are fit for deployment.

10.0 MAKE IN INDIA

The Firm shall ensure due compliance of public procurement (Preference to Make in India) Order, dated 15.06.2017. In this regard, Railway Board letter No 2015/RS(G)/779/5 dated 12.06.2020 or latest policy guidelines on this, shall be referred.

11.0 OPERATING AND SERVICE CONDITIONS

The equipment shall be sturdy and suitable for the following service conditions normally to be met in railway rolling stock service:

Sr No	Environmental Parameters	Conditions
1	Ambient Temperature	-20 to +85 degree Celsius
2	Train Speed (Max)	120 kmph
3	Relative Humidity	up to 100% during rainy season
4	Atmosphere Condition	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6mg/m3. In most of iron ore and coal mine areas, the dust concentration is very high.
5	Rainfall	Very high in certain areas
6	Coastal Area	Humid and salt laden atmosphere with maximum pH value of 8.5, sulphate of 7mg per litre, maximum concentration of chlorine 6mg per litre and maximum conductivity of 130micro Siemens/cm
7	Wind Speed	High wind speed in certain areas, with wind pressure reaching 216 kg/m2 as per IS:875-Part 3(2015).

12.0 THE STANDARDS FOR COMPLIANCE

The following standards/equivalent standards or their latest versions shall govern the specifications to which the equipment and systems shall comply with. Whenever there is any ambiguity regarding interpretation of standards, procedures and norms, the stricter of the conflicting norms shall be applicable.

Firm shall generally follow the Standards mentioned in this specification. However, the Firm can also offer alternate standards. Firm shall submit the detailed test report,

documentary evidences, and the justification/ evidence to establish that the same can provide consistent output to desired level of output/ accuracy/ performance of the offered solution vis-à-vis specified in the specification to Director General (Wagon)/RDSO, Lucknow for obtaining approval before use.

S. No.	Standard	Description
1.	AAR-S-5702 / EN 50125-1 / EN 60529 / IEC 60571 / IEC 61287 / IEC 62236	Standards for Electrical & Electronics Equipment
2.	CMMI-SVC / IRIS	For service provision
3.	IS 2500	For sampling plans
4.	ISO 27001	For information security management systems
5.	ISO 9001	For Quality Management System
6.	ISO 9421 / as per the requirement of user	Guidelines for user interface development
7.	TIA-942 / MEITY Guidelines	For server uptime
8.	BS 7608 (fatigue) EN 13749	For Bogie mounted equipment
9.	EN 61373 (shock and vibration tests) EN 12663 (equipment mounted to vehicle bodies) EN 45545 (fire precautions)	For Bogie and coach mounted equipment
10.	EN 62311 and EN 62479 (exposure to EMI) EN 50121 (electromagnetic compatibility) R&TTE directive 1999/5/EC ETSI EN 301 489	Standards for Electrical Equipment
11.	EN 50155	For Power supply
12.	EN 50126	Railway Applications - The Specification and Demonstration of Reliability, Availability, maintainability and Safety (RAMS)
13.	NEMA-3	For Compliant enclosure unit

Indian Railways Standard (IRS), General Conditions of Contract (GCC) shall also be applicable while doing interpretation of the various financial, operative and purchase conditions in executing the above-mentioned work. However, in case of conflict, conditions contained in this specification will prevail.

13.0 REFERENCE TO VARIOUS SPECIFICATIONS

References have been taken from the following standard specification in this document:

a) CRIS 300000 wagon tender functional and technical requirement.
b) EN 50155 Regional standard for electronic equipment used on rolling stock for railway applications
c) RDSO/2022/EL/FRS/0032 REV.'0'.
d) Railway Board Specification number : OBCMS/DCM/N/1 NOV 2016
e) FUNCTIONAL REQUIREMENTS SPECIFICATION FOR UNATTENDED AXLE BOX LEVEL ACCELERATION MEASUREMENT SYSTEM
f) ELRS/ SPEC/SI/0015 Reliability of electronics used in rolling stock application

14.0 GENERAL SERVICE CONDITIONS AND GENERAL RULES

a) IEC-60529 - 2013-08 Degrees of protection provided by enclosures (code IP)
b) IEC 60571-Railway applications-Electronic Equipment used on rolling stock
c) IEC 61287 - Railway applications - Electronic Power Converters mounted on board rolling stock
d) IEC 61373 Rolling stock equipment shock and vibration tests
e) IEC 62236-3-2 Railway applications - Electromagnetic compatibility - Part 3-2: Rolling stock – Apparatus

15.0 EQUIPMENT/UNIT SYSTEM LEVEL VALIDATION

15.1 Software Updates

Besides the regular updation in the software, the Firm must provide periodic software updates that align with the latest standards set by Indian Railways or any govt. agency .

15.2 Electromagnetic Compatibility

The device should function seamlessly under all transportation conditions without interference with electromagnetic devices, such as signalling eq uipments, 25 kV OHE (Overhead Equipment for electric traction) and other wayside installations, etc.

15.3 **Gateway / Data Concentrator Unit with integrated GSM & GPS capability**

Device	Function	Validation	Certification Required
Gateway / Data Concentrator Unit with integrated GSM & GPS capability	Fitment in Wagon	RDSO Approval	Drawing Approval & Relevant Test Reports
	Stability of Fixation	Shock and Vibration Testing	EN 61373 or Equivalent
	Handle the Environmental Conditions	Covers aspects such as temperature, humidity, shock, vibration, and other parameters	EN 50155 or Equivalent
		Ingress Protection	IP 67 or better
		Impact Testing	IK8 or better
	Safety on Rail Operations	Battery Testing	IEC 60086 and IS 16046: Part 2:2018, IEC 62133 or Equivalent
		CE Certification for GSM function ROHS Certification for PCB and components	CE Certificate ROHS Certification or Equivalent
		Electromagnetic Compatibility	IEC 61000 / IS14700 and IEC 60571 or Equivalent
	Safety of Goods	ATEX/PESO/IECEx	Zone 2 or Equivalent

15.4 **Bearing and Wheel Health Monitoring Module**

Device	Function	Validation	Certification Required
Bearing and Wheel Health Monitoring Module	Fitment in Wagon	RDSO Approval	Drawing Approval
	Stability of Fixation	Shock and Vibration Testing	EN 61373:2010 or Equivalent
	Handle the Environmental Conditions	Covers aspects such as temperature, humidity, shock, vibration, and other parameters	EN 50155 IEC 63211 or Equivalent

		Ingress Protection	IP 66 or better / IPX9k or better
		Impact Testing	IK8 or better
		ROHS Certification for PCB and components or Equivalent	ROHS Certification or Equivalent
		Electromagnetic Compatibility	ETSI EN 301 489-1/3/17, ETSI EN 300 328 or Equivalent
	Safety of Goods	ATEX/PESO/IECEx	Zone 2 or Equivalent

15.5 **Load and Tilt Detecting Module**

Device	**Function**	**Validation**	**Certification Required**
Load and Tilt Detecting Module	Fitment in Wagon	RDSO Approval	Drawing Approval
	Stability of Fixation	Shock and Vibration Testing	EN 61373 or Equivalent
	Handle the Environmental Conditions	Covers aspects such as temperature, humidity, shock, vibration, and other parameters	EN 50155 or Equivalent
		Ingress Protection	IP 67 or better / IPX9k or better
		Impact Testing	IK8 or better
	Safety on Rail Operations	Battery Testing	UN 38.3 or Equivalent
		CE Certification for GSM function ROHS Certification for PCB and components or Equivalent	CE Certificate ROHS Certification or Equivalent
		Electromagnetic Compatibility	EN 50121-3 or Equivalent
	Safety of Goods	ATEX/PESO/IECEx	Zone 2 or Equivalent

15.6 **Applied/Release Handbrake Module**

Device	Function	Validation	Certification Required
Applied/Release Handbrake Module	Fitment in Wagon	RDSO Approval	Drawing Approval
	Stability of Fixation	Shock and Vibration Testing	EN 61373 or Equivalent
	Handle the Environmental Conditions	Covers aspects such as temperature, humidity, shock, vibration, and other parameters	EN 50155 or Equivalent
		Ingress Protection	IP 67 or better / IPX9k or better
		Impact Testing	IK8 or better
	Safety on Rail Operations	Battery Testing	UN 38.3 or Equivalent
		CE Certification for GSM function ROHS Certification for PCB and components or Equivalent	CE Certificate ROHS Certification or Equivalent
		Electromagnetic Compatibility	EN 50121-3 or Equivalent
	Safety of Goods	ATEX/PESO/IECEx	Zone 2 or Equivalent

15.7 **Tank Wagon Temperature Monitoring Module**

Device	Function	Validation	Certification Required
Tank Wagon Temperature Monitoring Module	Fitment in Wagon	RDSO Approval	Drawing Approval
	Stability of Fixation	Shock and Vibration Testing	EN 61373 or Equivalent
	Handle the Environmental Conditions	Covers aspects such as temperature, humidity, shock, vibration, and other parameters	EN 50155 or Equivalent
		Ingress Protection	IP 67 or better / IPX9k or better
		Impact Testing	IK8 or better
	Safety on Rail	Battery Testing	UN 38.3 or Equivalent

	Operations	CE Certification for GSM function ROHS Certification for PCB and components or Equivalent	CE Certificate ROHS Certification or Equivalent
		Electromagnetic Compatibility	EN 50121-3 or Equivalent
	Safety of Goods	ATEX/PESO/IECEx	Zone 2 or Equivalent

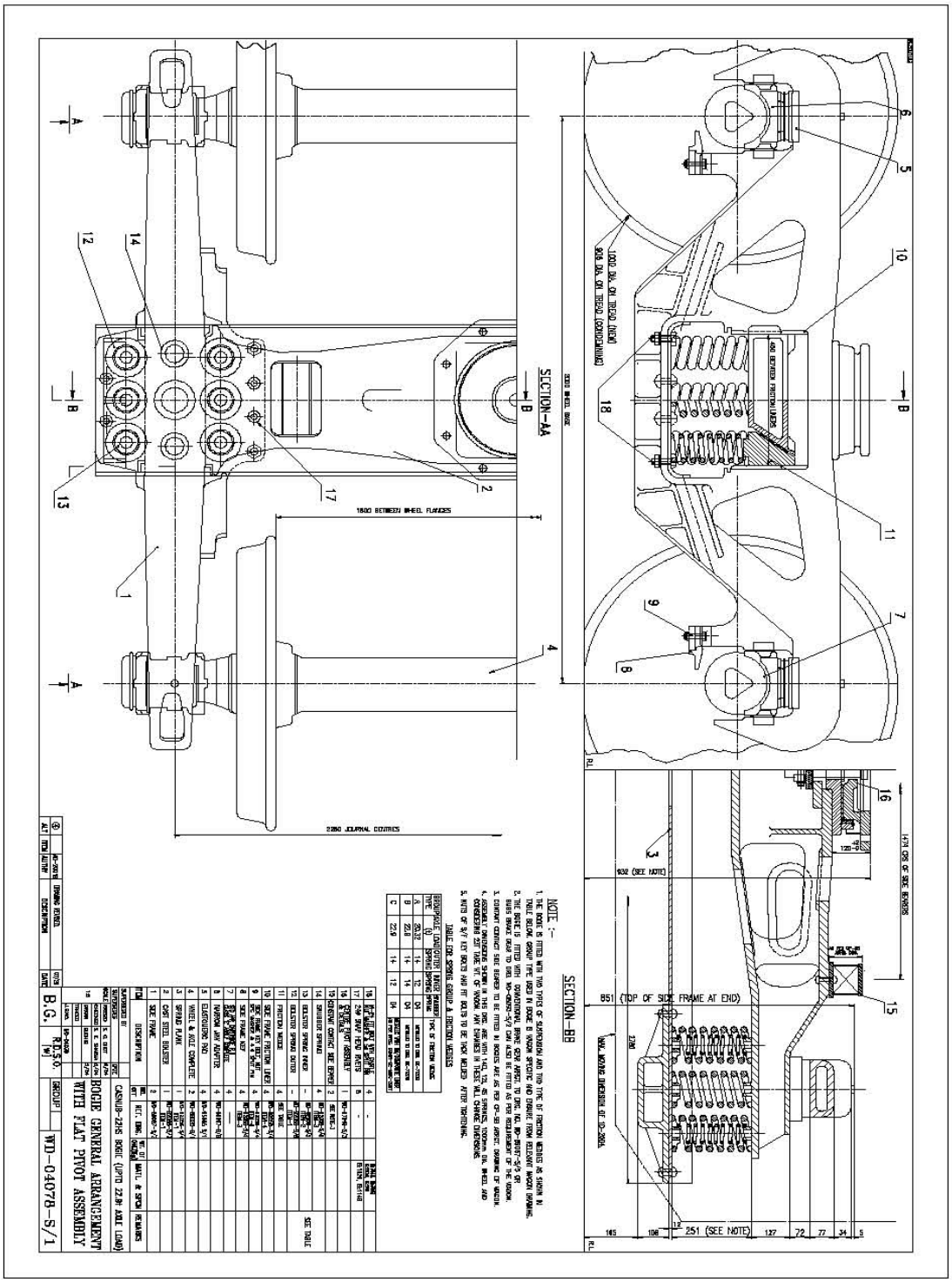
15.8 **Door/Hatch Monitoring Module**

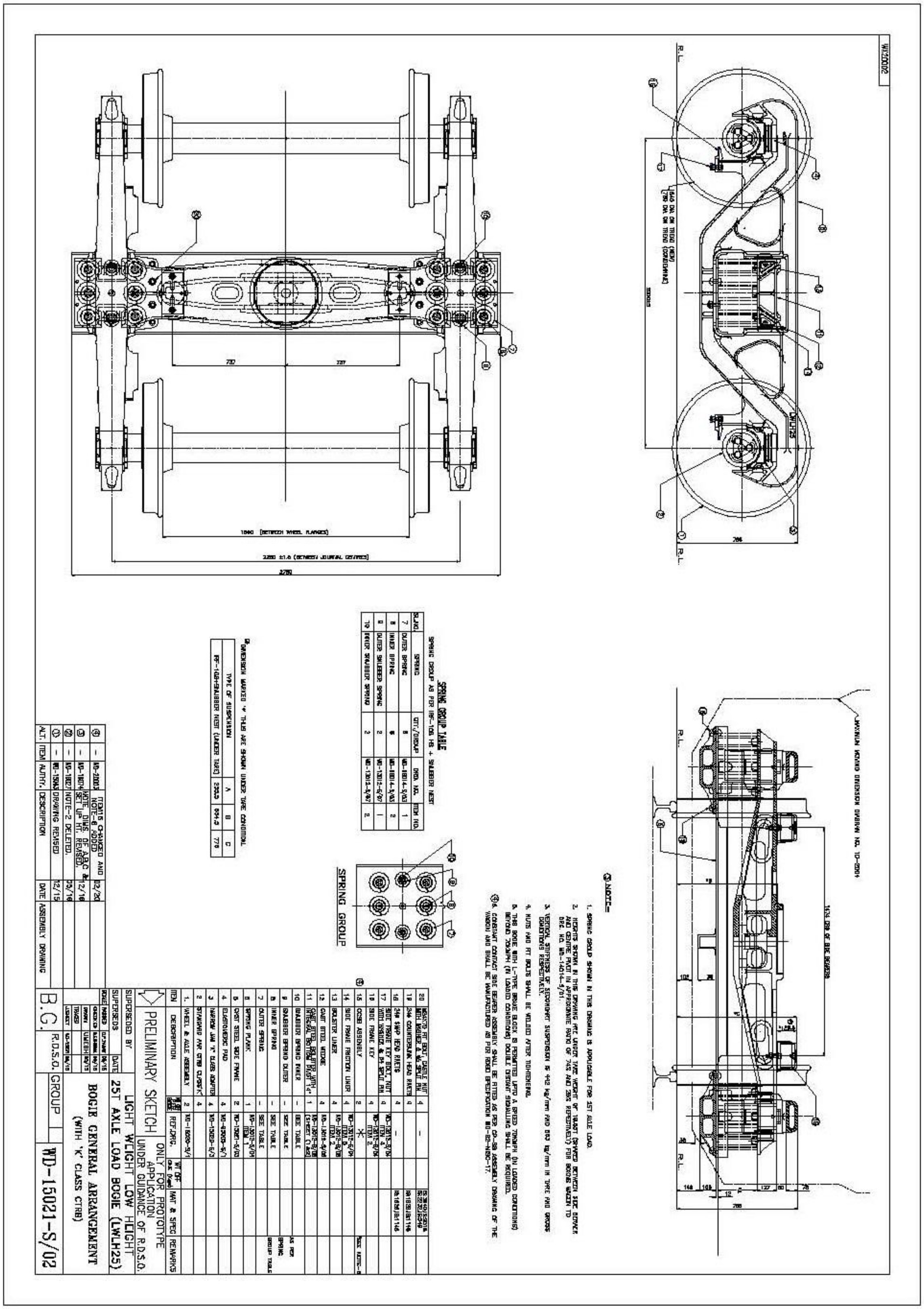
Device	**Function**	**Validation**	**Certification Required**
Door/Hatch Monitoring Module	Fitment in Wagon	RDSO Approval	Drawing Approval
	Stability of Fixation	Shock and Vibration Testing	EN 61373 or Equivalent
	Handle the Environmental Conditions	Covers aspects such as temperature, humidity, shock, vibration, and other parameters	EN 50155 or Equivalent
		Ingress Protection	IP 67 or better / IPX9k or better
		Impact Testing	IK8 or better
	Safety on Rail Operations	Battery Testing	UN 38.3 or Equivalent
		CE Certification for GSM function ROHS Certification for PCB and components or Equivalent	CE Certificate ROHS Certification or Equivalent
		Electromagnetic Compatibility	EN 50121-3 or Equivalent
	Safety of Goods	ATEX/PESO/IECEx	Zone 2 or Equivalent

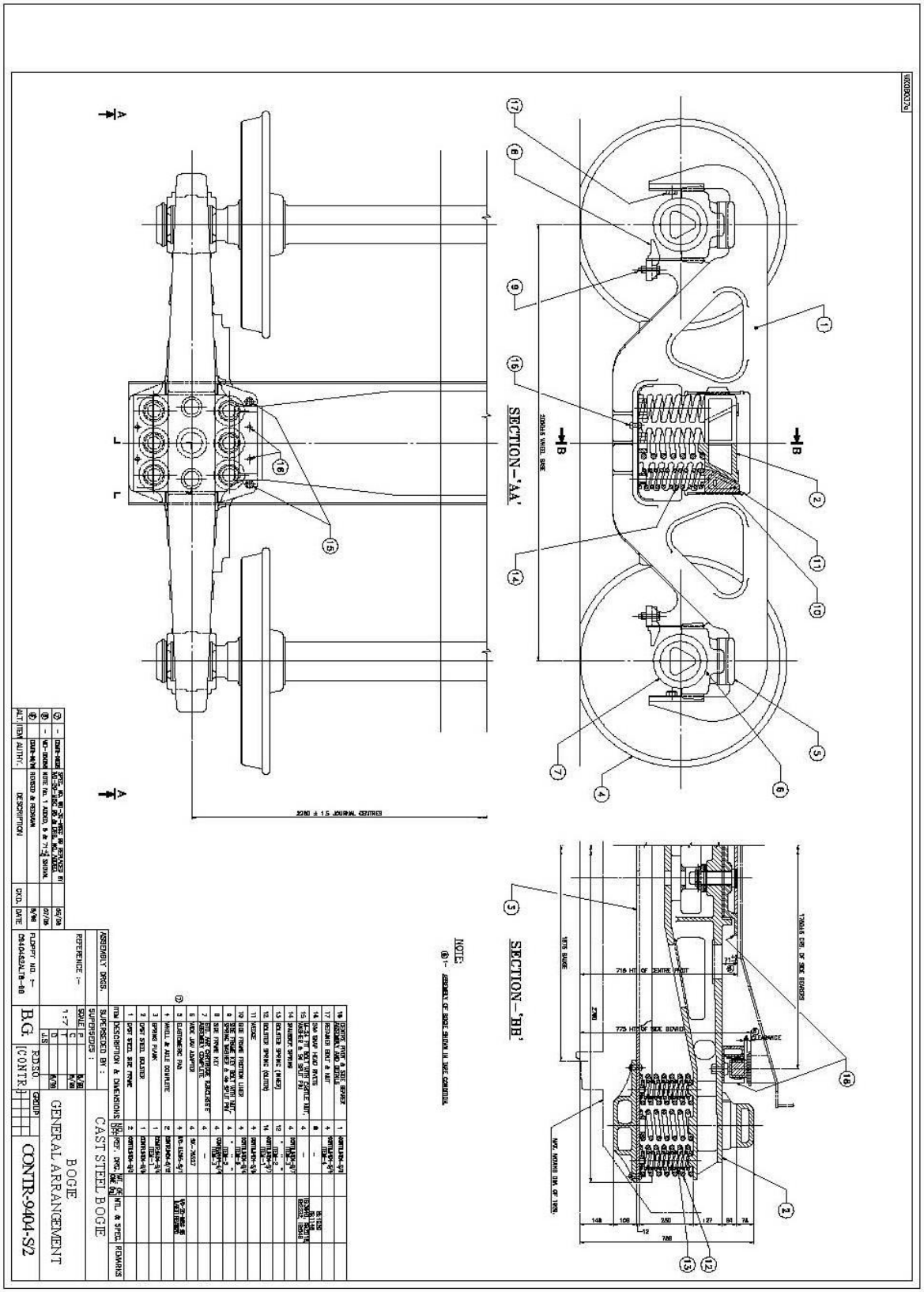
NB: It will be binding on firm that besides above standards, offered product is suitable for Indian Railway operating conditions. Offer of the firm should provide unconditional acceptance towards the same.

ANNEXURE – I

General Arrangements of the Three-Piece Bogies

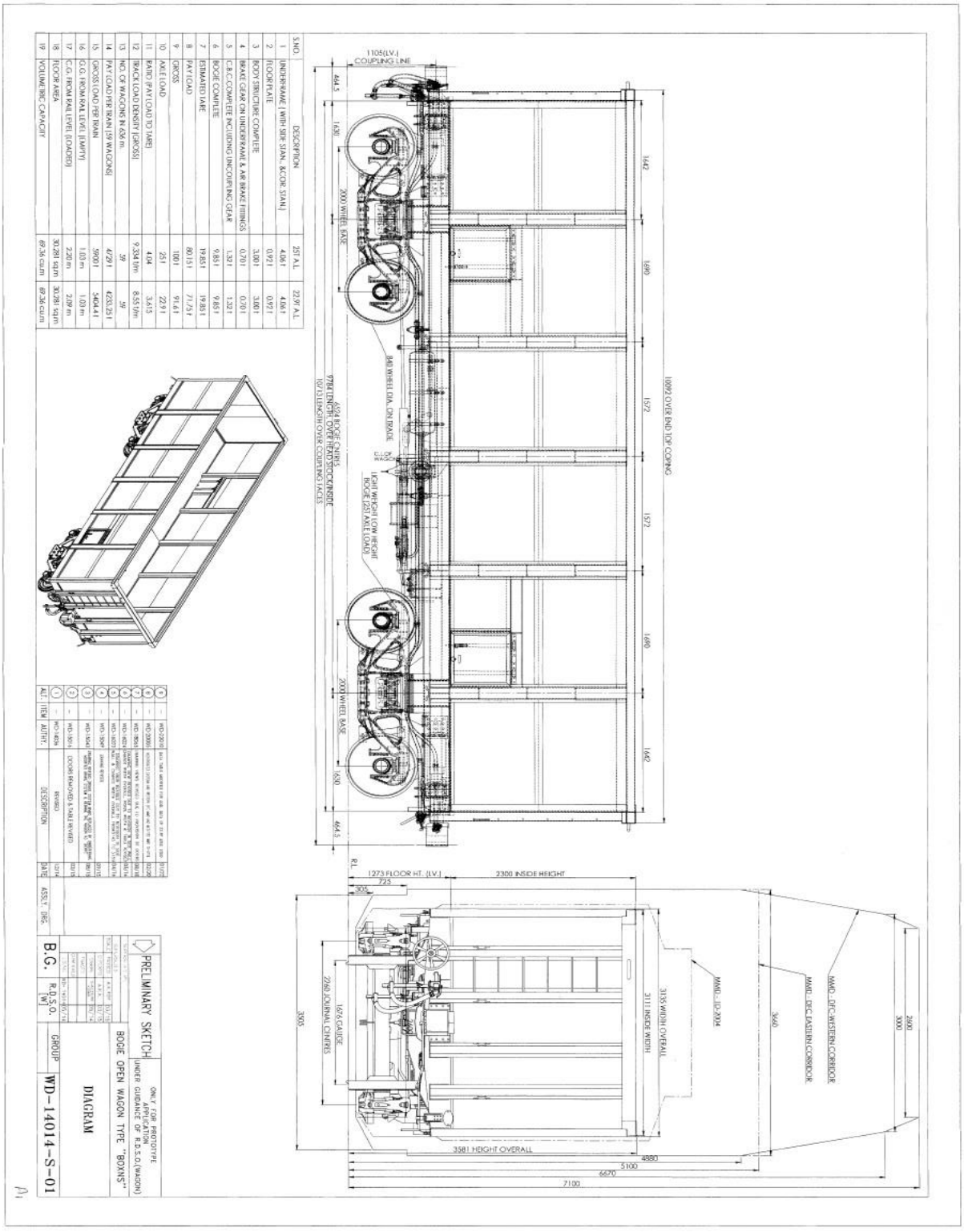



SPRING GROUP TABLE
SPRING GROUP
PRELIMINARY SKETCH
ONLY FOR PROTOTYPE APPLICATION UNDER GUIDANCE OF R.D.S.O.
LIGHT WEIGHT LOW HEIGHT
25T AXLE LOAD BOGIE (LWLH25)
BOGIE GENERAL ARRANGEMENT
(WITH 'K' CLASS CTRB)
B.G.
R.D.S.O.
GROUP
WD-15021-S/02


SECTION–'AA'
SECTION–'BB'
NOTE:
(1)– ASSEMBLY OF SIDE SHOWN IN LIKE CONDITION.
BOGIE
GENERAL ARRANGEMENT
CAST STEEL BOGIE
CONTR-9404-S2
B.G. (CONTR)

ANNEXURE –II

Diagrams of a Open Type Wagon



S.NO.	DESCRIPTION		
		25T A.L.	22.9T A.L.
1	UNDERFRAME (WITH SIDE SILL & CROSS SILL)	4.06 t	4.06 t
2	FLOOR PLATE	0.92 t	0.92 t
3	BODY STRUCTURE COMPLETE	3.80 t	3.80 t
4	BRAKE GEAR ON UNDERFRAME & AIR BRAKE FITTINGS	0.70 t	0.70 t
5	C.B.C. COMPLETE INCLUDING UNCOUPLING GEAR	1.32 t	1.32 t
6	BOGIE COMPLETE	9.85 t	9.85 t
7	ESTIMATED TARE	19.85 t	19.85 t
8	PAY LOAD	80.15 t	71.75 t
9	GROSS	100 t	91.6 t
10	AXLE LOAD	25 t	22.9 t
11	RATIO (PAY LOAD TO TARE)	4.04	3.615
12	TRACK LOAD DENSITY (GROSS)	9.334 t/m	8.55 t/m
13	NO. OF WAGONS IN 656 m	59	59
14	PAY LOAD PER TRAIN (59 WAGONS)	4729 t	4235.25 t
15	GROSS LOAD PER TRAIN	5900 t	5404.4 t
16	C.G. FROM RAIL LEVEL (EMPTY)	1.03 m	1.03 m
17	C.G. FROM RAIL LEVEL (LOADED)	2.20 m	2.08 m
18	FLOOR AREA	30.281 sq.m	30.281 sq.m
19	VOLUMETRIC CAPACITY	69.36 cu.m	69.36 cu.m

A/L	ITEM	AUTH'Y.	DESCRIPTION	DATE	ASS'Y.	DRG.
0	–	RDSO/2010	ISSUED FOR PROTOTYPE	12/14		
0	–	RDSO/2009	REVISED FOR PROTOTYPE	02/09		
0	–	RDSO/2008	ISSUED FOR PROTOTYPE	02/08		
0	–	RDSO/2007	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/2004	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/2003	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/2002	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/2001	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/2000	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1999	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1998	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1997	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1996	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1995	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1994	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1993	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1992	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1991	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1990	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1989	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1988	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1987	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1986	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1985	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1984	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1983	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1982	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1981	ISSUED FOR PROTOTYPE	09/15		
0	–	RDSO/1980	ISSUED FOR PROTOTYPE	09/15		

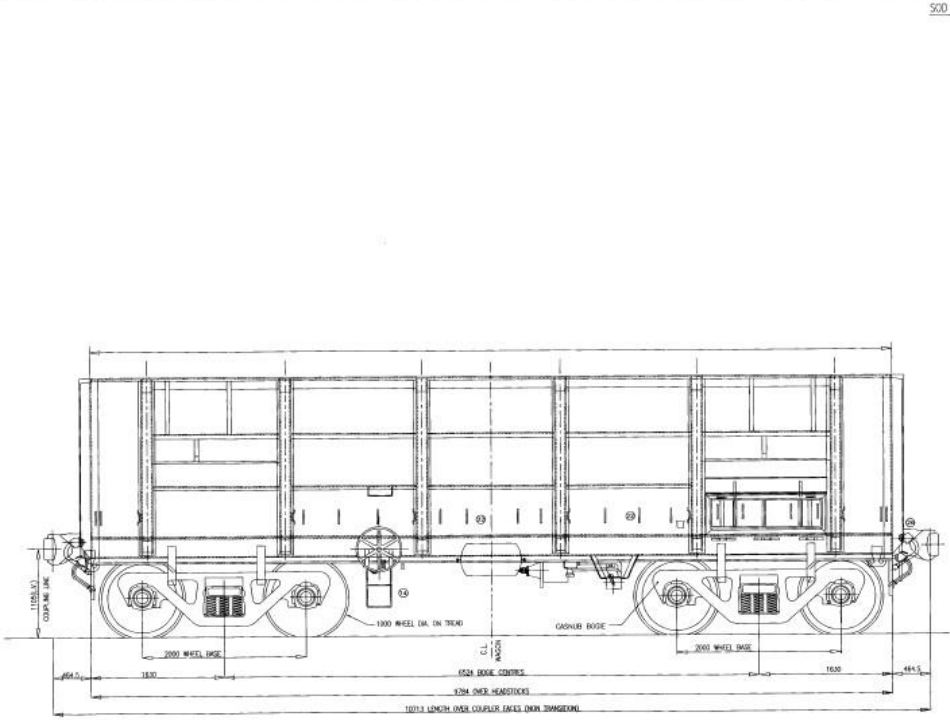
PRELIMINARY SKETCH
ONLY FOR PROTOTYPE APPLICATION
UNDER GUIDANCE OF R.D.S.O.(WAGON)

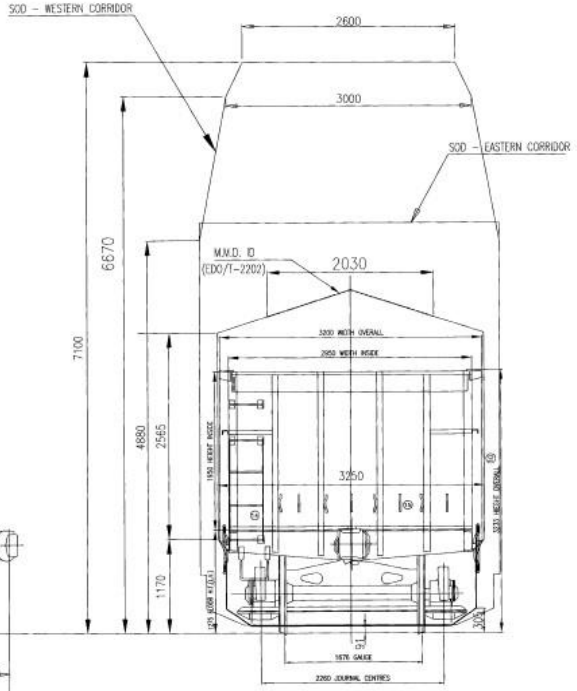
BOGIE OPEN WAGON TYPE "BOXNS"

DIAGRAM

B.G.	R.D.S.O. [W]	GROUP
		WD-14014-S-01

A1





S.NO	SUMMARY OF WEIGHTS (ESTIMATED)	BOXN/BOXNCR				BOXNHS			
		MEASURES	MEASURES	MEASURES	MEASURES	MEASURES	MEASURES	MEASURES	MEASURES
1.	UNDERFRAME	3.85 t.	3.85 t.	3.85 t.	3.85 t.	3.85 t.	3.85 t.	3.85 t.	3.85 t.
2	FLOOR PLATE	1.30 t.	1.30 t.	1.30 t.	1.30 t.	1.30 t.	1.30 t.	1.30 t.	1.30 t.
3.	BODY STRUCTURE COMPLETE	4.77 t.	4.77 t.	4.77 t.	4.77 t.	4.77 t.	4.77 t.	4.77 t.	4.77 t.
4.	BRAKE GEAR ON UNDERFRAME	0.69 t.	0.69 t.	0.69 t.	0.69 t.	0.69 t.	0.69 t.	0.69 t.	0.69 t.
5.	C.B.C. COMPLETE INCLUDING UNCOUPLING GEAR	1.29 t.	1.29 t.	1.29 t.	1.29 t.	1.29 t.	1.29 t.	1.29 t.	1.29 t.
6.	BOGIE COMPLETE (WHEEL SPRINGS,WHEELS & AXLES, CARTRIDGE BEARINGS WITH ADAPTORS, AND CENTRE PIVOTS	3.410 t.	3.410 t.	3.410 t.	3.410 t.	3.410 t.	3.410 t.	3.410 t.	3.410 t.
7.	FOUR PAIRS OF WHEELS , AXLES & BEARINGS	6.08 t.	6.08 t.	6.08 t.	6.08 t.	6.08 t.	6.08 t.	6.08 t.	6.08 t.
8.	BEARING ADAPTERS & ELASTOMERIC PAD	0.144 t.	0.144 t.	0.144 t.	0.144 t.	0.144 t.	0.144 t.	0.144 t.	0.144 t.
9.	BOLSTER SPRINGS AND SNUBBER SPRINGS	0.116 t.	0.116 t.	0.116 t.	0.116 t.	0.146 t.	0.146 t.	0.146 t.	0.146 t.
10.	CENTRE PIVOT ASSEMBLIES	0.224 t.	0.224 t.	0.224 t.	0.224 t.	0.224 t.	0.224 t.	0.224 t.	0.224 t.
11	BOGIE BRAKE GEAR COMPLETE	0.60 t.	0.60 t.	0.60 t.	0.60 t.	0.60 t.	0.60 t.	0.60 t.	0.60 t.
12	ESTIMATED TARE	22.48 t.	22.48 t.	22.48 t.	22.48 t.	22.51t.	22.51t.	22.51t.	22.51t.
13	PAY LOAD	58.8 t.	64.8 t.	68.8 t.	68.8 t.	58.77 t.	64.77 t.	68.77 t.	68.77 t.
14	GROSS	81.28 t.	87.28 t.	89.28 t.	91.28 t.	81.28 t.	87.28 t.	89.28 t.	91.28 t.
15	AXLE LOAD	20.32 t.	21.82 t.	22.32 t.	22.82 t.	20.32 t.	21.82 t.	22.32 t.	22.82 t.
16	RATIO (PAY LOAD TO TARE)	2.61	2.88	2.97	3.06	2.61	2.88	2.67	3.05
17	TRACK LOADING DENSITY (GROSS)	7.58 t/m	8.15 t/m	8.33 t/m	8.52 t/m	7.59 t/m	8.15 t/m	8.33 t/m	8.52 t/m
18	NO. OF WAGONS PER TRAIN	59	59	59	59	59	59	59	59
19	PAY LOAD PER TRAIN (59 WAGONS)	3469 t.	3823 t.	3941 t.	4059t.	3467 t.	3821 t.	3959 t.	4057t.
20	GROSS LOAD PER TRAIN	4795 t.	5149 t.	5267 t.	5385 t.	4795 t.	5149 t.	5267 t.	5385 t.
21	C.G. FROM R.L.(EMPTY)	1.09m	1.09m	1.09m	1.09m	1.09m	1.09m	1.09m	1.09m
22	C.G.FROM R.L.(LOADED) (COAL)	1.904 m	1.926 m	1.933 m	1.939 m	1.904 m	1.926 m	1.933 m	1.939 m
23	FLOOR AREA	28.87 m²	28.87 m²	28.87 m²	28.87 m²	28.87 m²	28.87 m²	28.87 m²	28.87 m²
24	VOLUMETRIC CAPACITY	56.29 m³	56.29 m³	56.29 m³	56.29 m³	56.29 m³	56.29 m³	56.29 m³	56.29 m³
25	C.G.FROM R.L.(LOADED) (IRON ORE)	1.522 m	1.536 m	1.541 m	1.545 m	1.522 m	1.536 m	1.541 m	1.545 m

S.NO.	BOGIE DATA (TARE)	mm
1.	HT.OF BOTTOM BOGIE FRAME FROM R.L.AT CENTRE	165
2.	DISTANCE FROM R.L.TO TOP OF TOP PIVOT	930
3.	DISTANCE FROM R.L. TO TOP OF SIDE BEARER $	A
4	HEIGHT OF SPRINGS #	B
5	WHEEL DIA.ON TREAD	1000
6	WHEEL DIA.ON TREAD CONDEMNING SIZE	905
7.	DIA.OF WHEEL SEAT	210
8	JOURNAL CENTRES	2260
9	JOURNAL SIZE	140X270

⑰ $ A = 911 FOR CASNUB 22W, A=921 FOR CASNUB –22 N (M), A =921 FOR CASNUB –22 NL/NLB, & A= 921 FOR CASNUB HS BOGIE.
# B =254 FOR CASNUB –22 N,CASNUB –22 N (M), CASNUB – 22 NL & NLB
B= 251 FOR CASNUB HS BOGIE.

S.NO.	WAGON DATA (LIGHT)	(mm)
1.	HEIGHT OF CENTRE BUFFER COUPLER FROM R.L.	1105
2.	DISTANCE BETWEEN WHEEL FLANGES AND FLOOR	2405
3.	SIDE BEARER CLEARANCE (NOMINAL)	–

NOTE:-
1. (29)
1.1 WITH 12MM PIPE CONDUMITED RELEASE,AIR BRAKE (29)
1.2 HIGH TENSILE (NON TRANSITION TYPE CENTRE BUFFER COUPLER)
1.3 CAST STEEL FRICTION SNUBBED BOGIES TYPE CASNUB TO LATEST SPECIFICATION.

ALT	ITEM	AUTHY.	DESCRIPTION	DATE	ASSLY. DRG.
⑳	–	RDSO/	CORD. REPRESS DUE TO CHANGE IN DOOR	01/02	
⑲	–	RDSO/	DATA REVISED AGAINST ITEMS 18,19 AND 20.	11/00	
⑱	–	RDSO/		06/2001	
㉑	–	RDSO/		06/2001	
㉒	–	RDSO/	MWD ID=2004 UPDATED."DFC" REP BY "SOD"	06/2001	
㉓	–	RDSO/		06/2001	
㉔	–	RDSO/		06/2001	
㉕	–	RDSO/		06/2001	
㉖	–	RDSO/		07/02	
㉗	–	RDSO/	MWD 1929 DELETED.	02/11	
㉘	–	RDSO/		07/07	
㉙	–	RDSO/		11/06	
㉚	–	RDSO/		11/06	
㉛	–	RDSO/		11/06	
㉜	–	RDSO/		06/05	
㉝	–	RDSO/		06/05	
㉞	–	RDSO/		03/05	
㉟	–	RDSO/		01/05	
㊱	–	RDSO/		01/04	
㊲	–	RDSO/		10/02	
㊳	–	RDSO/		10/02	
㊴	–	RDSO/		5/02	
㊵	–	RDSO/	DWN. 3203 AND 3205	11/01	
㊶	–	RDSO/	REVISED & REDRAWN	07/01	
㊷	–	RDSO/	REVISED & REDRAWN	12/96	

SUPERSEDED BY	
SUPERSEDES	
SCALE PASSED	R.P.O.(P)"A" 26/02
1:20 CHECKED	M.S.PANCHOLI 26/02
DRAWN	K.L.SHUSAI 4/02
TRACED	S.S.KUMAR 7/01
J.O.NO.	

B.G. | R.D.S.O. [W] | GROUP

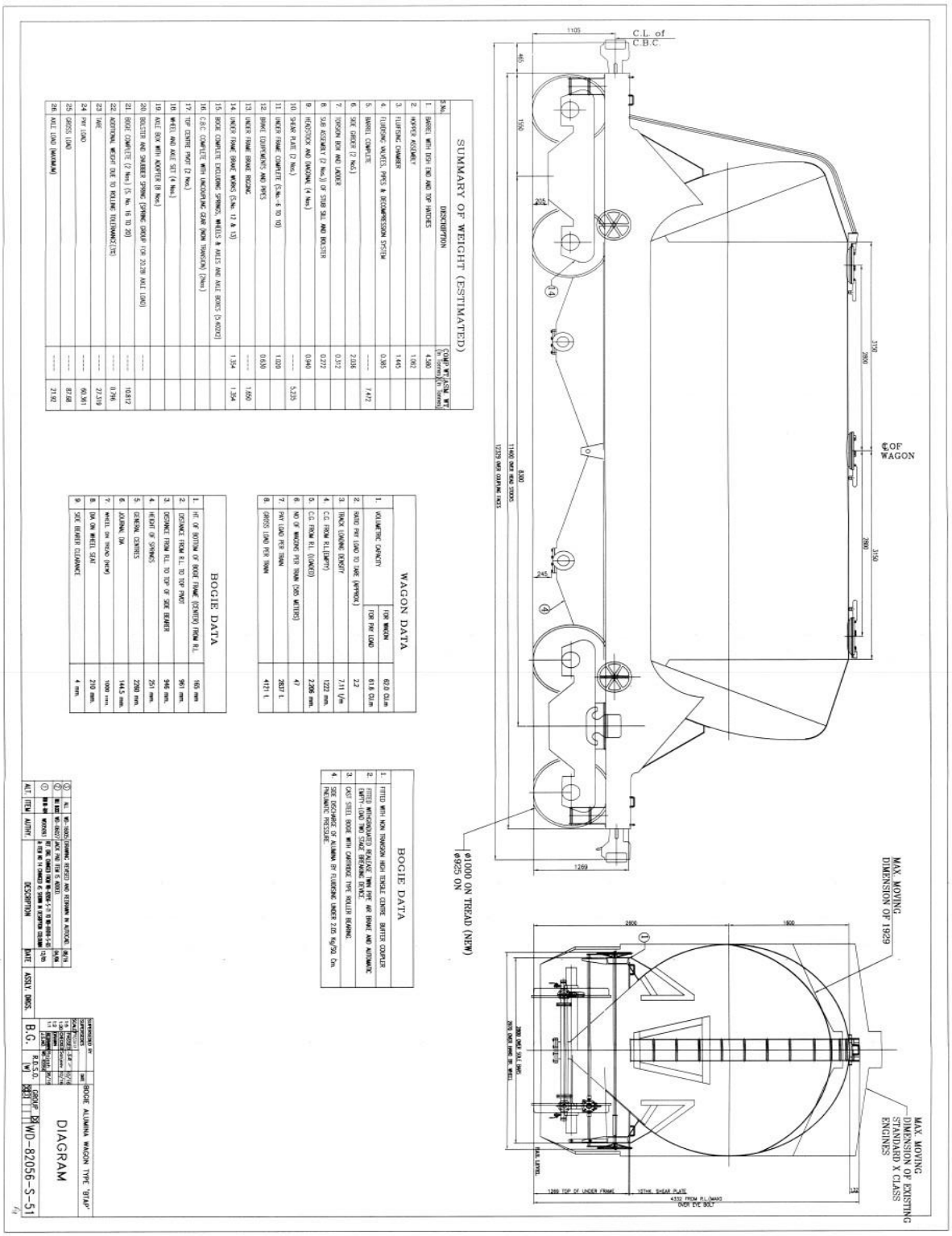
BOGIE OPEN WAGON TYPE 'BOXN,BOXNHS' (29)

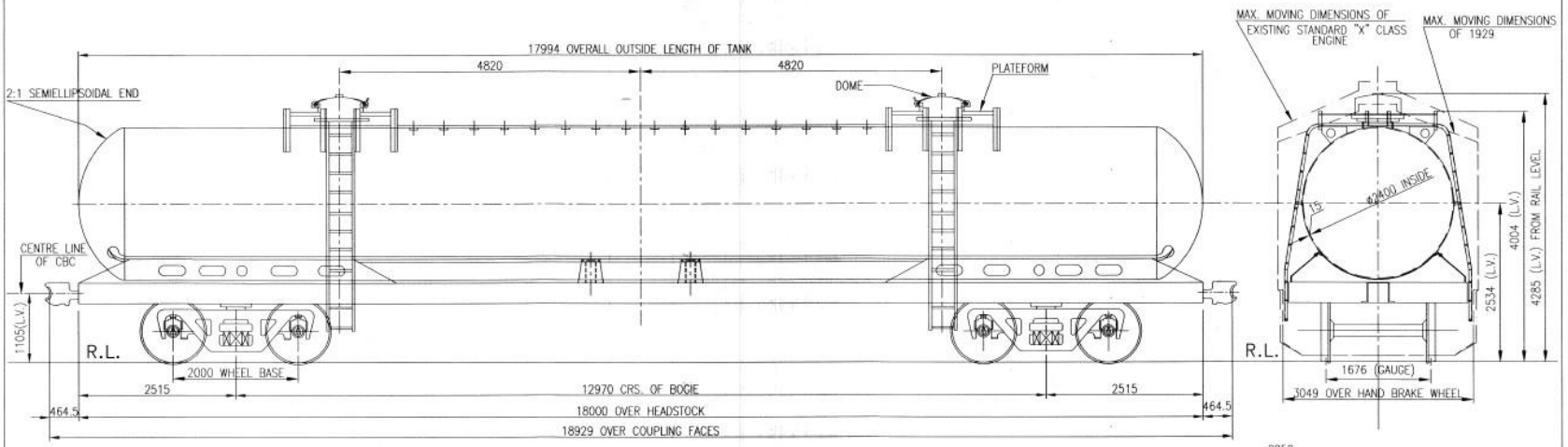
आरेख
DIAGRAM

WD-80007/S-2

ANNEXURE –III

Diagram of a Tank Type Wagon



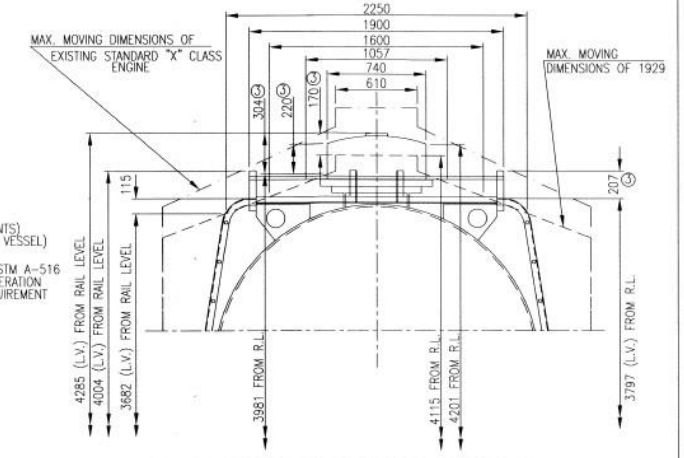


SUMMARY OF WEIGHTS (ESTIMATED)

DESCRIPTION	WEIGHT IN (TONNES)	
	VARIANT–A	VARIANT–B⑦
UNDERFRAME STRUCTURE COMPLETE	6.04	6.04
CRADLES	1.75	1.75
BARREL COMPLETE WITH ALL FITTINGS & ATTACHMENT	19.30	19.30
BRAKE GEAR COMPLETE (INCLUDING AIR BRAKE PIPE ETC.)	0.65	0.55
C.B.C. COMPLETE WITH UNCOUPLING GEAR	1.644	1.644
TWO BOGIES	11.08	11.08
PLATEFORM AND LADDER	0.45	0.45
TWO CENTRE PIVOT	0.09	0.09
NUTS, BOLTS, RIVETS ETC.	0.50	0.60
TARE	41.60	41.60
PAY LOAD WITH A Sp. Gr. OF 0.499 AT 55°C	37.60	37.60
GROSS LOAD	79.2	79.2
AXLE LOAD	19.8 ④	19.8
TOTAL VOLUMETRIC CAPACITY OF BARREL (Cu. M)	79.48	79.48
MINIMUM REQUIREMENT OF VAPOUR SPACE AT 55°C	5%	5%
TRACK DENSITY PAY (t/m)	1.986	1.986
TRACK DENSITY GROSS (t/m)	4.184 ④	4.184
C.G. FROM R.L. (EMPTY), IN METERS	1.60	1.60
C.G. FROM R.L. (LOADED), IN METERS	2.03	2.03

LEADING FEATURES

1. LADING =LIQUEFIED PETROLEUM GAS
2. DSIGN TEMPERATURE =–30°C TO ,55°C
3. DESIGN PRESSURE =17.00 Kg/cm2
4. WORKING PRESSURE =15.85 Kg/CM2 (225 lbs./sq. INCH)
5. TEST PRESSURE =22.10 Kg/cm2
6. SPECIFICATION FOR DESIGN, MANUFACTURE & INSPECTION =IS: 2825–69 (WITH LATEST AMENDMENTS) (APPLICABLE FOR CLASS–I PRESSURE VESSEL)
7. LOADING TEMP. OF COMODITY=----------
8. STEEL USED FOR BARREL AND ATTACHMENT =B.S. 1501–224 GR. 32A LT.30 OR ASTM A–516 GR. 70 SUITABLE FOR LOW TEMP. OPERATION TOGETHER WITH SUPPLEMENTARY REQUIREMENT S–5 OR EQUIVALANT.
9. MAX. LOADING CAPACITY OF THE LIQUID AT 55°C BY VOLUME =95% OF TOTAL VOLUME
10. MAX. LOADING CAPACITY BY WEIGHT =37.60 t
11. BARREL INSULATION =NONE
12. LOADING AND UNLOADING =FROM TOP ONLY
13. DOME FITTINGS *SAFETY VALVES. *LIQUID GAS VALVES. *LIQUID LEVEL GAUGING DEVICE. *EXCESS FLOW CHECK VALVES. *SAMPLING VALVE WITH ACCESSORIES. *THERMOMETER WELL.
14. C.B.C. USED =NON TRANSITION TYPE



INFRINGEMENT TO MAX. MOVING DIMENSIONS OF 1929

ALT.	ITEM	AUTHY.	DESCRIPTION	DATE	ASSEMBLY DRAWINGS
⑦	–	WD–17066	DRG. REDRAWN IN AUTO CAD. BTPGLN (VARIANT–B) DIAGRAM DRG. No. WD–09051–S–02 MERGED WITH THIS DRG.	10/17	
⑥	–	WD–15051	REFERENCE OF BTPGLR DELETED.	10/15	
⑤	–	WD–13011	REFERENCE OF BTPGLR ADDED.	3/13	
④	–	WD–01070	CHANGE WEIGHT 19.8 WAS 20.32 & 4.184 WAS 4.19	7/94	
③	–	WD–99005	DRG. REVISED.	1/99	
②	–	WD–94063	DRG. REVISED.	7/94	
①	–	WD–94017	DRG. REVISED.	2/94	

PRELIMINARY SKETCH

ONLY FOR PROTOTYPE APPLICATION UNDER GUIDANCE OF R.D.S.O. (WAGON)

SUPERSEDED BY

SUPERSEDES

SCALE			DATE
1:25	PASSED	A. N. Mehta	11/93
	CHECKED	Manjeet Singh	11/93
	DRAWN	S. K. Khare	11/93
	TRACED		
	J.SHEET	WD–93047	

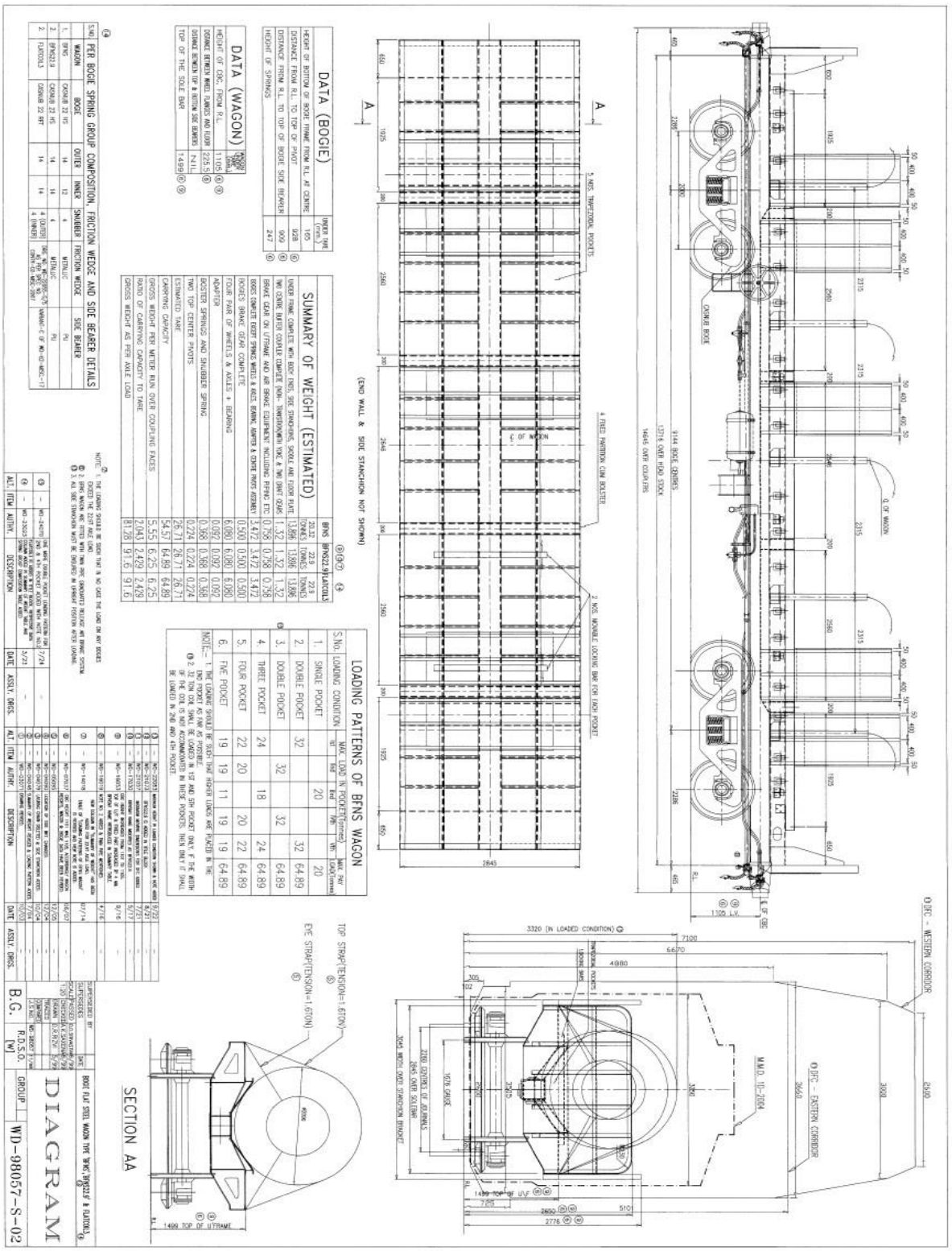
BOGIE L.P.G.TANK WAGON TYPE 'BTPGLN'

DIAGRAM

B. G. | R.D.S.O. [W] | GROUP | WD–93047–S–51

Annexure-IV

Diagram of a Flat Type Wagon



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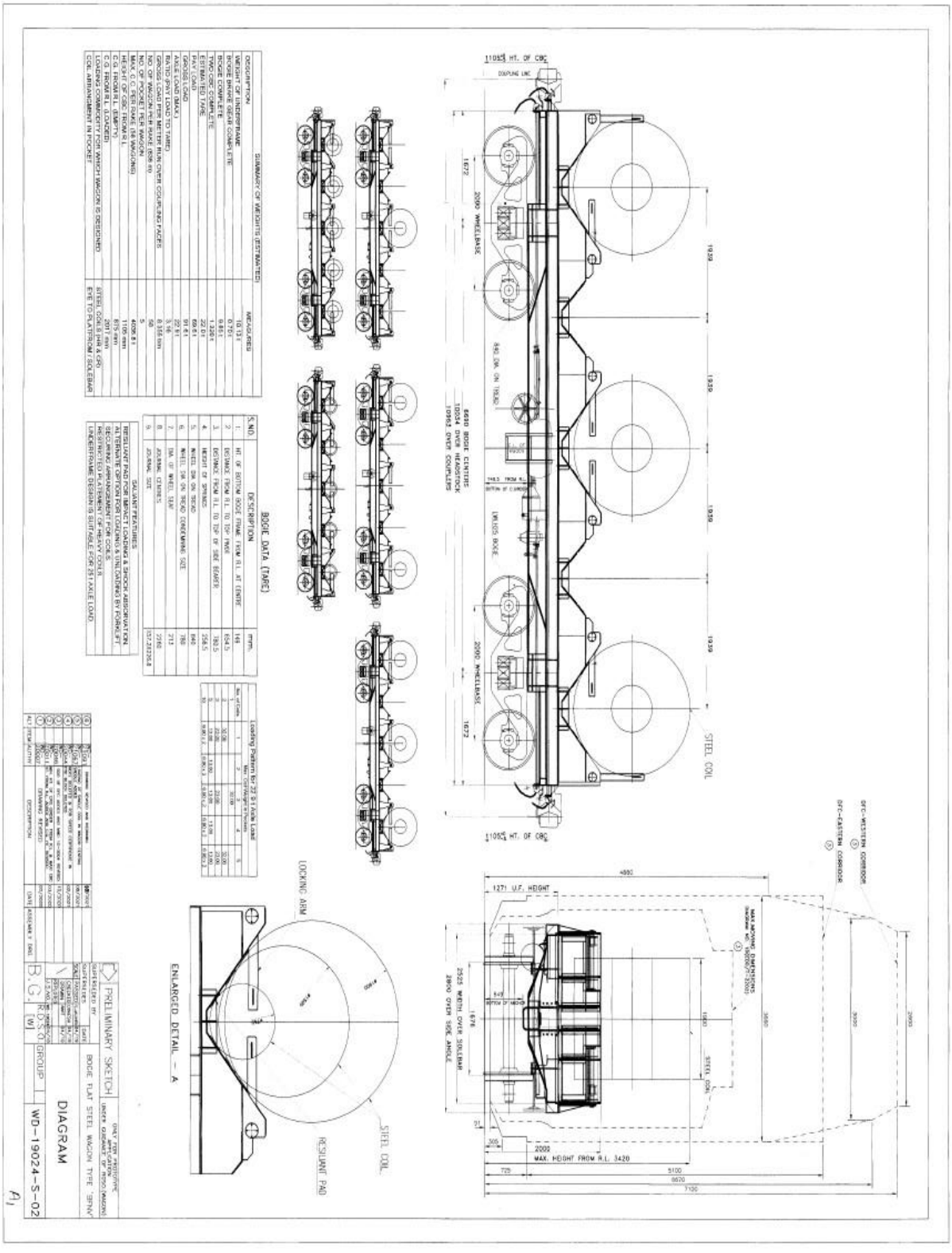
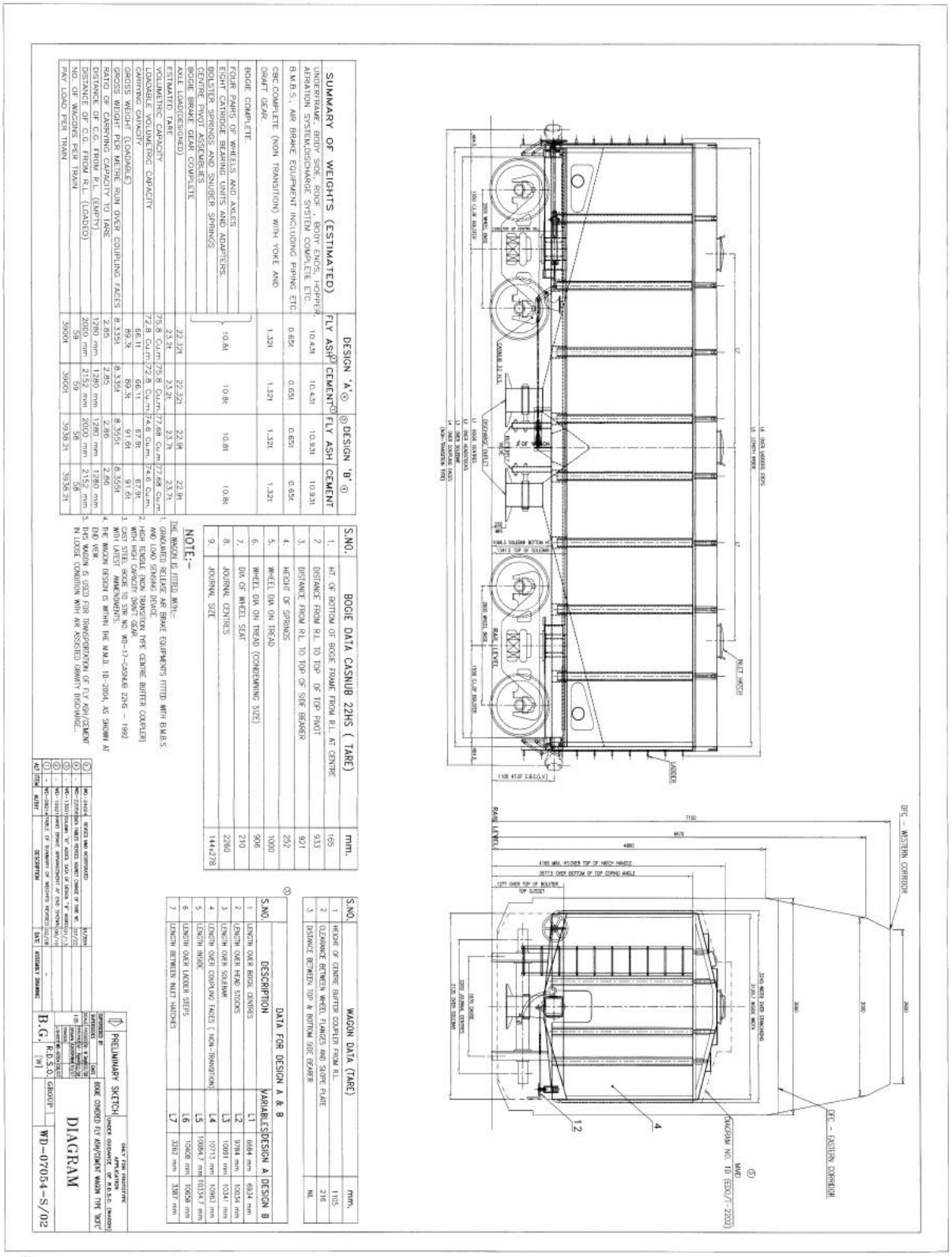
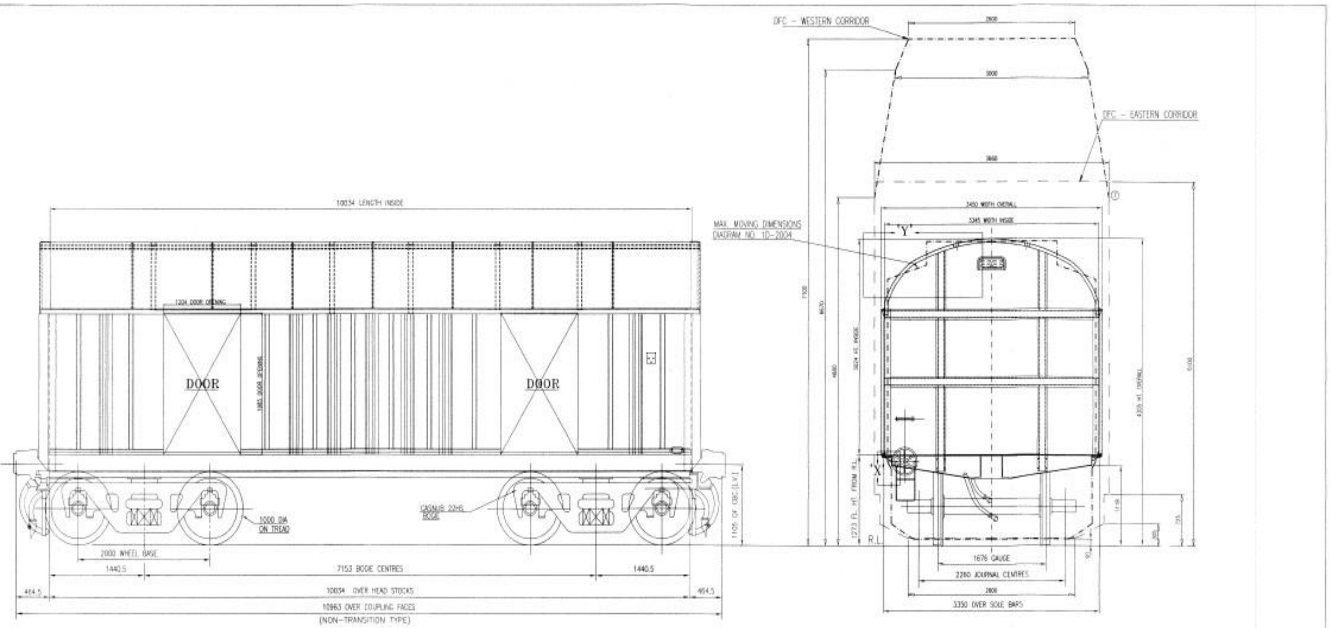

SUMMARY OF WEIGHTS (ESTIMATED)
DESCRIPTION
WEIGHT OF UNDERFRAME
BOGIE BRAKE GEAR COMPLETE
BOGIE COMPLETE
TWO BOGIES COMPLETE
EMPTY WAGON TARE
PAY LOAD
GROSS LOAD
AXLE LOAD (MAX.)
MAXIMUM LOAD TO BE CARRIED
GROSS LOAD PER METER RUN OVER COUPLING FACES
NO. OF WAGON PER RAKE (58 W)
NO. OF POCKET PER WAGON
MAX. C.G. FROM RAIL (IN WAGONS)
MAX. C.G. FROM R.L. (EMPTY)
C.G. FROM R.L. (LOADED)
LOADING COMMODITY FOR WHICH WAGON IS DESIGNED
COIL ARRANGEMENT IN POCKET
BOGIE DATA (TARE)
S.NO.
DESCRIPTION
mm.
LOCKING ARM
RESILIENT PAD
STEEL COIL
ENLARGED DETAIL – A
PRELIMINARY SKETCH
BOGIE FLAT STEEL WAGON TYPE 'BFNV'
DIAGRAM
WD-19024-S-02
B.G. R.S.D. GROUP (W)

Annexure-V

Diagram of a Covered Type Wagon





SUMMARY OF WEIGHTS (ESTIMATED)	MEASURES DESIGN A,B,C,D	⑤ DESIGN E	⑥ DESIGN-G
UNDERFRAME, BODY SIDES ROOF & ENDS COMPLETE	6.9 t.	6.9 t.	7.1 t.
FLOOR PLATES.	1.03 t.	1.03 t.	1.03 t.
UNDERFRAME BRAKE GEAR, AIR BRAKE EQUIPMENT INCLUDING PIPING.	0.75 t.	0.55 t.	0.55 t.
TWO CBC.COMPLETE (NON TRANSITION) WITH YOKE AND DRAFT GEAR.	1.32 t.	1.32 t.	1.32 t.
BOGIES COMPLETE EXCEPT SPRINGS,WHEELS & AXLES, CARTRIDGE BEARINGS WITH ADAPTERS AND CENTRE PIVOTS	10.8 t.	10.8 t.*	10.8 t.*
FOUR PAIRS OF WHEELS AND AXLES			
EIGHT CATRIDGE BEARING UNITS AND ADAPTERS.			
BOLSTER SPRINGS AND SNUBER SPRINGS			
CENTRE PIVOT ASSEMBLIES			
BOGIE BRAKE GEAR COMPLETE			
VOLUMETRIC CAPACITY	92.54 cu.m.	92.54 cu.m.	92.54 cu.m.
ESTIMATED TARE	20.8 t.	20.6 t.	20.8 t.
CROSS WEIGHT AS PER AXLE LOAD (22.9X4)	91.60 t.	91.60 t.	91.60 t.
CARRYING CAPACITY	70.8 t.	71 t.	70.8 t.
GROSS WEIGHT PER METRE RUN OVER COUPLING FACES	8.35 t.	8.35 t.	8.35 t.
RATIO OF CARRYING CAPACITY TO TARE	3.40	3.45	3.40
AXLE LOAD	22.9 t.	22.9 t.	22.9 t.
DISTANCE OF C.G. FROM R.L. (EMPTY)	1134 mm	1134 mm	1134 mm
DISTANCE OF C.G. FROM R.L. (LOADED)	2327 mm	2327 mm	2327 mm
NO. OF WAGONS IN 636m TRAIN	58	58	58
PAY LOAD PER TRAIN	4106 t.	4118 t.	4106 t.

⑤ * Wt. INCLUDES Wt. OF BOGIE WITHOUT BOGIE BRAKE GEAR AND Wt. of BMBS WITHOUT APM, APM RESERVOIR AND HOSE PIPES

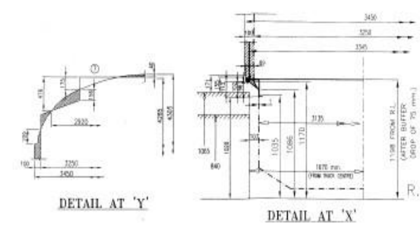
DATA (WAGON)	WAGON UNDER TARE (m.m)
HEIGHT OF CENTRE LINE OF CENTRE BUFFER COUPLER FROM RAIL LEVEL	1105
DISTANCE BETWEEN WHEEL FLANGE AND BOTTOM OF FLOOR	240.5
DISTANCE BETWEEN TOP & BOTTOM SIDE BEARERS	NIL
HEIGHT OF TOP OF SOLE BAR AT BOGIE CENTRE FROM R.L.	1269
DISTANCE BETWEEN LOWEST FITTING (BOGIE PULL ROD SAFETY STRAP) AND R.L.	155
VERTICAL DISTANCE BETWEEN LOWEST PART OF U/F (BOLSTER BOTTOM FLANGE AND TOP OF BOGIE SIDE FRAME AT CENTRE	260
VERTICAL DISTANCE BETWEEN LOWEST PART OF U/F (CROSSBAR BOTTOM FLANGE AND TOP OF BOGIE SIDE FRAME AT PEDESTAL JAW	255
CAMBER OF UNDER FRAME (MEASURED FROM HEAD STOCK TO HEAD STOCK	10
MINIMUM CLEARANCE BETWEEN WHEEL FLANGE AND NEAREST UNDER FRAME MEMBER IN LOADED CONDITION AT 10° CURVE	50 mm

DATA (BOGIE)	WAGON UNDER TARE (m.m)
MINIMUM HEIGHT OF BOGIE SIDE FRAME BOTTOM FROM R.L. AT CENTRE	165
DISTANCE FROM R.L. TO TOP OF TOP PIVOT	934
DISTANCE FROM R.L. TO TOP OF BOGIE SIDE BEARER	921
HEIGHT OF SPRING TOP ON EACH BOGIE FROM R.L.	538.5

NOTE:-

THE WAGON IS FITTED WITH:-

④ 1. TWIN PIPE GRADUATED RELEASE AIR BRAKE SYSTEM
2. HIGH TENSILE (NON TRANSITION TYPE CENTRE BUFFER COUPLER.)
3. CAST STEEL BOGIE TO STR NO. WD-17-CASNUB 22HS BOGIE 92 WITH LATEST AMMENDMENTS.
4. THE WAGON DESIGN INFRINGES THE M.M.D. 1D-2004, AS SHOWN AT DETAILS AT 'X' & 'Y'.
④ 5. DRG. NO. OF DOOR ARRANGEMENT & DETAILS AS SHOWN IN DESIGN "D" OF DRG. WD-06076-S-01 ALT-4, OR LATEST ALTERATION.
④ 6. THIS DIAGRAM IS ALSO APPLICABLE FOR SINGLE PIPE GRADUATED RELEASE AIR BRAKE SYSTEM.



DETAIL AT 'Y' DETAIL AT 'X'

ALT	ITEM	AUTHY	DESCRIPTION	DATE	ASSEMBLY DRAWING
⑦		WD-20006	[illegible]	02/20	
⑥		WD-15003	DATA OF DESIGN-'G' ADDED	01/15	
⑤	-	WD-11054	DATA OF DESIGN E ADDED.	02/12	
④	-	WD-10068	TWIN PIPE AND NOTE NO.-5&6 ADDED.	10/10	
③	-	WD-08102	REVISED & REDRAWN	11/08	
②	-	WD-08043	REVISED & REDRAWN	5/08	
①	-	WD-07019	[illegible] REMOVED AND NOTE MODIFIED	3/07	

PRELIMINARY SKETCH — ONLY FOR PROTOTYPE APPLICATION UNDER GUIDANCE OF R.D.S.O. (WAGON)

BOGIE COVERED WAGON TYPE 'BCNHL'

DIAGRAM

B.G. R.D.S.O. [W] GROUP WD-06076-S-02