



**Government of India**

**भारत सरकार  
रेल मंत्रालय**

**Technical Specification  
For  
Machine Vision Based Inspection System for Rolling Stock**

**Specification No. RDSO-SPN-RE-MVIS-2018 (Rev.2)  
March 2022  
(Draft)**

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**ABBREVIATIONS**

AC	Alternating Current	IRSOD	Indian Railway Schedule of Dimensions
AMC	Annual Maintenance Contract	JSON	JavaScript Object Notation
API	Application Programming Interface	LHB	Linke Hofmann Busch Coaches
CAMC	Comprehensive Annual Maintenance Contract	MVIS	Machine Vision Inspection System
CRIS	Centre for Railway Information Systems	NABL	National Accreditation Board for Testing and Calibration Laboratories
DPRS	Distributed Power Rolling Stock	OCR	Optical Character Recognition
EMU	Electric Multiple Unit	OHE	Overhead Equipment
EMI	Electromagnetic Interference	PRC	Pre-Stressed Concrete Sleeper
ICD	Interface Control Document	RFI	Radio Frequency Interference
ICF	Integral Coach Factory Coaches	RFID	Radio Frequency Identification
IR	Indian Railway	SMS	Short Message Service
IRCA	Indian Railway Conference Association	TCP/IP	Transmission Control Protocol/Internet Protocol
IRPWM	Indian Railways Permanent Way Manual	UPS	Uninterruptible Power Supply

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**1.0 Introduction:**

- 1.1. This specification covers requirements for design, development and supply of all-weather Machine Vision Based Inspection System, hereinafter referred as MVIS installed on trackside for inspection of Rolling Stock.
- 1.2. Currently Indian Railways runs a wide variety of Rolling Stock in its system. Developing a system to monitor all the existing stock types shall become extremely complicated and shall require several different standard libraries corresponding to each Rolling Stock with very high data processing requirements.
- 1.3. To obtain optimal benefit of the MVIS System, the present specification shall cater to the following high population rolling stock for the purpose of defect identification and detection. The raw data/images for other Rolling Stock crossing the Machine Vision Inspection site shall however be recorded and image processed as and when requested by the consignees to assist failure investigation and Indian Railways shall be at liberty to request additional software development to cover new Rolling Stock/Defects as mutually agreed between IR and bidder.
- 1.4. The system shall cater the following rolling stock and their sub-assemblies for the purpose of defect identification.

Stock Type	Specific Stocks	Defects to be Monitored
Coaching	LHB and ICF Coaches	Wheel (Including Profile) defects, Bogies, Brake System, Under Gear, Couplers
Freight	BOXN, BOXNHL, BOXNHS BCNA, BCNHL, BCNAHS BOBYN, BOBRN, BOBRNHS BLC, BLL BVZI	Wheel (Including Profile) defects, Bogie, Brake System, Under Gear, Couplers
Locomotives	WAG9, WAG7, WAP7, WAP5, WDG4, WAG12B, WDG6G	Wheel (Including Profile) defects, Bogie, Brake System, Under Gear, Couplers, Pantographs
EMU/ DPRS	Vande Bharat I and II EMU Trains	Wheel (Including Profile) defects, Couplers, Bogie, Pantograph

- 1.5. The specification is generic in nature and describes the technical and functional requirements of the system.
- 1.6. Machine vision based inspection technology is being introduced for the first time on Indian Railway. The tendering agency/ procurement agency may define suitable eligibility criteria for bidders. However, Supply schedules may be planned to ensure that bulk supply shall be permitted only after satisfactory commissioning of Prototype System.

**2.0 Scope of supply:**

The MVIS system shall be installed on turnkey basis. The scope of supply shall include design, development, supply, installation & commissioning of the complete MVIS site equipment along-with concomitant accessories, maintenance toolkit, testing and calibration

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equipment etc. to make the system fully functional. It shall also include all equipment by the side of the track, electric cables, server computer, website, audio-visual alarm display, client computer/laptop, modem, SMS delivery and data transmission channels, software for the track-side equipment and software for the central server, cabin/hut and any other element necessary for optimal functioning of the system.

Apart from the details mentioned above, any other accessory/component/system(s) essentially required for proper functionality of the MVIS system, shall also fall under the scope of supply of the tenderer.

### **3.0 Operational and Functional requirements:**

It should conform to following operational and functional requirements:

S.N	Parameters	Requirements
1.	Operating speed	Upto 100 Kmph
2.	Train length	upto 600 Axles
3.	Train headway	5 minutes between two consecutive trains
4.	Degree of protection for enclosures containing electronics	IP 66
5.	Degree of protection for optics	
6.	Wheel detector (trigger) sensors	IP 67
7.	Ambient temperature range	-5°C to 70°C
8.	Relative humidity	upto 100%

### **4.0 Defects Categorization:**

Machine vision based inspection system should be able to identify defects for different types of rolling stocks as specified in **Annexure-I** through suitable Machine learning software to achieve a level of confidence as prescribed in Para 12.2.3.

### **5.0 Technical and other requirements:**

- 5.1 It shall be the responsibility of the bidder to acquaint himself with various types of rolling stocks operational on IR along-with the types of defects as per Annexure-I, as required to be detected by proposed MVIS system. The defect and limit specified in the IRCA conference rules part III (for Freight stock) & part IV (for Coaching stock) should be referred for specifying limits and alerts subject to additional graded alerts prescribed by consignee.
- 5.2 The MVIS system should be capable of automatic detection of approaching train, automatic switching-on of relevant sensors, data/image capturing while the train is in motion, on site processing of data, automatic transmission of data, alarms & reports and automatic switching-off of relevant sensors to conserve electrical power.
- 5.3 It should function in either direction of movement of train.
- 5.4 The system should be capable of automatic identification of type of rolling stock (Locomotives, Wagons, ICF or LHB Coaches, Brake Vans, EMU/DPRS)
- 5.5 System should be able to flag alerts within 20 minutes of the passage of train and the complete/comprehensive report within 30 minutes after passing of train. All type of alerts

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- (Multiple Alerts– Maintenance Alert or Critical Alert) should be user Settable and will be decided by consignee/IR.
- 5.6 System should have character recognition feature to extract details painted on side walls of rolling stock for use in automatic report generation through OCR photo tag based automatic vehicle identification module till proliferation of RFID on IR.
  - 5.7 The system should have provision for interfacing with RFID based automatic vehicle identification module.
  - 5.8 Supply, installation and commissioning of suitable illumination as necessary for round-the-clock working of equipment shall be provided by the bidder.
  - 5.9 The bidder should refer typical track profile – As per IRPWM 2019 or latest amended from time to time for necessary safeguard for non-infringement of tracks.
  - 5.10 The MVIS system shall not infringe the IRSOD (Indian Railway Schedule of Dimensions) and shall be installed in consultation with consignee/IR. IRSOD (BG) 2022 approved by Indian Railway may be referred.
  - 5.11 The system should be modular with self-diagnostic features and should be remotely maintainable.
  - 5.12 The MVIS should run 24x7 without any human intervention. The system should be programmed for self-checks periodically at least once every month. The result of self-tests shall be indicated on central server.
  - 5.13 Full TCP/IP (Transmission Control Protocol/Internet Protocol) support should be inbuilt into the system to facilitate smooth integration into all existing railway data networks.
  - 5.14 System should have capability to integrate with 3rd party system for which Interface control document (ICD) will be provided by Indian railways. Firm shall also supply the ICD for the MVIS system to the Indian railways.
  - 5.15 The system shall have suitable self-cleaning/purging arrangement for camera/sensor to get optimum results in case of dust, moisture entrapment, and ice/snow buildup or any other environmental situation.

**6.0 Standards and norms applicable:**

- 6.1 Image sensor and cameras used in machine vision based inspection system should follow latest applicable National/International standards to meet technical and functional requirements. The bidder shall submit data sheet of sensor/cameras along-with relevant standards at the bidding stage.
- 6.2 Some of indicative relevant standards as applicable for the reference of bidder are as under:

S.N	Standard	
i.	EMVA 1288	Standard for Characterization of Image Sensors and Cameras
ii.	EN 50121-4:2015	Railway applications - Electromagnetic compatibility - Part 4: Emission and immunity of the signaling and telecommunications apparatus.
iii.	2014/35/EU	Low Voltage Directive - Electrical equipment designed for use within certain voltage limits

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iv.	IEC 61000-6-4:2019	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards - Emission standard for industrial environments
v.	EN 50125-3	Railway applications - Environmental conditions for equipment Part 3: Equipment for signalling and telecommunications
vi.	EN 50128:20011+A2:2020	Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems

**7.0 Installation requirements:**

- 7.1. The MVIS systems shall be installed in such a way that it does not hamper train traffic.
- 7.2. In case the cameras are mounted on the specially designed sleeper by tenderer, then the sleeper should be non-load bearing and should be placed between two PRC (Pre-stressed concrete) sleepers.
- 7.3. The bidder shall ensure proper illumination during installation of MVIS system. It should have proper mounting arrangement that can be easily disassembled/ reassembled.
- 7.4. AC power 230V, 50 +/-3Hz. shall be made available at main power distribution box by consignee. From this point the tenderer shall bring power supply to the site of installation by laying suitable power cable. The maximum load on the power supply system should not exceed 60 KVA.
- 7.5. There should be a provision of UPS system for having at least 2 hours backup power.
- 7.6. Area under zone of installation should be maintained with proper marking under the guidance of Track maintenance department of Indian Railway. The site should be reasonably protected against inadvertent transgression through suitable fencing to protect equipments.
- 7.7. In case, equipment needs to be dismantled for track maintenance. The bidder should dismantle and reassemble the equipment within 3 hours following completion of maintenance work. Zonal railways/ consignee shall provide prior information for this activity to the firm at least 48 hours before to such planned maintenance.

**8.0 Site Selection Guidelines:**

- 8.1. The site for MVIS system should be selected in consultation with DRM/Mechanical.
- 8.2. Straight and level track on either side of equipment easily accessible by road vehicle.
- 8.3. At least 20 meter of level ground within railway boundary should be available at the MVIS site.
- 8.4. At least 100 meter away from any grade crossings and preferably away from heavy human habitation.
- 8.5. Track structure should be stable and well maintained with proper drainage system
- 8.6. Site should be preferably within 1 km from the main power distribution box.

**9.0 Web server and Software Requirement:**

- 9.1. The supplier shall launch and maintain an internet based web –server at any location (in India) with following features-
  - 9.1.1. Multiple User password protected log-in

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- 9.1.2. Differential access and usage rights to multiple levels of users' e.g. write-only, read-only, administrator rights.
- 9.2. Adequate capacity to handle data transfer for all authorized users (to be controlled by providing username and password) who shall access through public internet.
- 9.3. All the data/reports being generated by the MVIS equipment, website, servers etc. with respect to Indian Railway operations shall be the property of Indian Railways.
- 9.4. The data shall be compiled, stored, transferred and made available in a format as finally decided by Indian Railways in consultation with supplier in suitable database (exportable to MS-Excel & XML formats for data and the images should be extracted in JPEG/PNG/GIF or any suitable retrievable formats). Firm shall also provide ICD (Interface control document) for system database. Data Localization rules of the government of India shall be applicable for the system.
- 9.5. Data Base management and suitable data archiving system for adequate trending and retrieval of fault progression for upto 1 year may be maintained. Data older than 1 year may be indexed and achieved. The data/ images older than 5 years may be deleted unless a specific request for retention is made the consignee within 5 years of capture.
- 9.6. The trackside equipment shall have the capability to record and locally store raw captured data/images for last 500 trains and processed reports for upto 5000 trains.
- 9.7. The supplier shall be responsible for providing required software for collecting data, storage and presentation of reports sent by the trackside equipment. The final images should not be encrypted.
- 9.8. The system should have self-learning capability to improve its performance as it acquires different types of defects passing over it during warranty period of the system.
- 9.9. The system should have inbuilt standard libraries of rolling stock defects being used worldwide such as bogie defects, under-frame defects, wheel defect and brake gear defects, etc. However, standard component templates applicable to IR shall be provided to successful bidder. It shall be the responsibility of the bidder to acquaint himself with the components/assemblies of rolling stocks and various defects available in Railway yards/workshops/depots/sheds etc. before offering the system.
- 9.10. System should be capable of integrating with FMM (Freight Maintenance Management)/CMM (Coaching Maintenance Management)/SLAM (Software for Loco Asset Management) for reflecting the measurements done by MVIS system with respective rolling stock. For this purpose, successful bidder shall be required to send processed data in JSON format using restful API with token based authentication. The details of the API shall be provided by CRIS and JSON format will be decided based on the data generated by MVIS systems.

**10.0 Safety Requirements:**

- 10.1. The system should have provision of self fault detection and isolation to prevent cascading component failure.
- 10.2. Adequate signage to be provided at the MVIS site to deter trespassers and avoid accidental injury.
- 10.3. The system shall be protected from external EMI/RFI interferences & electrified OHE (Over Head Equipment).
- 10.4. The system shall be so designed that it does not hamper signalling, track, communication, electrical systems, etc. in service over IR.

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- 10.5. The functioning of the system shall remain unaffected by the environmental and site conditions like vibrations from passing trains, track maintenance vehicles/equipments, heavy rain and water, lightning, animal trespassing, direct sunlight on the sensors/cameras.
- 10.6. The system should be adequately protected from waste discharge from the coaches.
- 10.7. Train passing events are often associated with dust laden environments. Therefore, the system should be adequately protected and designed to faithfully collect images/information in dusty environment.
- 10.8. System shall have provision of anti-pilferage mechanism as per good industry practices.

**11.0 Output requirement:**

- 11.1. The supplier shall launch, operate and maintain an internet-based website during warranty and during comprehensive maintenance period for making available the train reports. The web server and its accessories including reporting software shall be owned by IR.
- 11.2. The website shall have the following features: -
  - 11.2.1. Password based access so that only authorized personnel of consignee/ DRM (Mech.) can enter/edit/view/download data and reports
  - 11.2.2. Differential privileges to different levels of users to access the resources of the website
- 11.3. The system output shall consist of data reports. Data acquired by the system shall be sent to a web server and the following reports should be available to the users on demand for train/site/type of defect.
  - 11.3.1. Exception report: - This report shall be an abridged version of the detailed report showing only the list of axles where defects have been detected or beyond limit. The system shall generate alarms based on the interpretation of the data.
  - 11.3.2. Detailed report: - This report shall be in detail showing all parameters acquired by the system for parameters/defects mentioned in Annexure I and shall be saved for review/ reference.
  - 11.3.3. Analysis of residual life of selected components.
  - 11.3.4. Bidder shall submit the sample templates of dashboard report for each type of defects mentioned in this specification, as generated by the proposed system along-with offer. Reports/ messages shall convey the following minimum data.
    - 11.3.4.1. Date / time of train
    - 11.3.4.2. Direction of movement
    - 11.3.4.3. Vehicle position from start of train
    - 11.3.4.4. Vehicle type
    - 11.3.4.5. Rolling Stock Number (if legible/recognizable by the system)
    - 11.3.4.6. Vehicle RFID identification (if available/ provided on the Rolling Stock)
    - 11.3.4.7. Short description / error code (should be easily understandable without need of referring to a table)
    - 11.3.4.8. The image of defective portion in the rolling stock shall be uploaded on web report.
  - 11.3.5. Alarms report through SMS: - System shall have the capability to send SMS to upto 4 mobile numbers for alerts on real time basis within 20 minutes from the passage of last axle of the train.



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- 11.3.6. Alarms report through App: - The firm should develop a mobile application for the user to get various alerts along with relevant positions through push notifications.
- 11.3.7. Diagnostic reports: - The system shall be capable of running self-diagnosis programs and should report the result through website and by SMS.
- 11.3.8. Trending Report: The system should have provision for reporting the defects history and progression of fault of same vehicle on demand.
- 11.4. In case, IR decides to include new types of alarms in the system, then supplier shall modify the software within a reasonable time at no extra cost to Indian Railways during AMC/Warranty.
- 11.5. The backend server systems shall be maintained and operated in India by the system provider. These servers shall be capable of storing and displaying (on demand) reports for up to last 5 years to reflect fault growth and propagation through successive time stamped images.
- 11.6. The access to these reports shall be provided by web based clients suitable for use from desktops / laptops / netbooks and smart phones. Users of the systems shall be provided logins / passwords for accessing the data.
- 11.7. In case IR decides to get access to the reports anytime, same shall be facilitated by the successful bidder, duly providing relevant restful JSON based APIs.

**12.0 Type of Tests:**

Inspection and testing of the equipment shall include all inspections, tests, checks, procedures etc., whether mechanical, electrical or software related as required to ensure that the equipment supplied meets the technical & functional requirements stipulated in the specification. The tenderer shall submit details of test plan for proposed system for each level of testing. However any addition/deletion/ modification in the test plan can be considered on mutually agreeable basis. The successful bidder shall depute team of engineers to perform all level of testing and ensure availability of testing facilities, typing tools and spare parts in adequate quantity for these tests. All the instruments, apparatus, devices, sensors, cameras, lighting etc. used during all levels of inspection and testing should have valid calibration certificate issued by an independent authority/component supplier/ institute approved by NABL/IR or accredited lab.

**12.1 Factory Acceptance Test:**

All technical and design features shall be inspected and witnessed by nominated inspection agency at the firm's premises. During the factory acceptance test, firm shall also demonstrate the capability of the system to identify and flag defects at designated speed mentioned in the specification. Test scheme shall be finalized by inspecting/ tendering agency jointly with the successful bidder. All necessary equipments, accessories etc. which are required for FAT shall be provided by firm at its premises.

**12.2 Proving-out test at site:**

Technical and functional requirements will be checked at installation site of IR by consignee/ Zonal Railway as per proving out validation site test protocol finalized in consultation with the supplier. The successful bidder shall submit details of proving out test plan for proposed system. The supplier and consignee shall conduct the proving out tests after commissioning. This test is intended to establish the following performance parameters:

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- 12.2.1 All the trains should be correctly recorded with regard to direction of motion, type of rolling stock (wagon/LHB coach/ICF coach/Locomotive etc), date and time of passing, speed of train, no. of axles, no of locomotives, no of vehicles other than locomotives under repeated running of test train/commercial train without any miss (100%).
- 12.2.2 The system should be able to demonstrate reports and alerts for each defect listed in Annexure-I.
- 12.2.3 Few fault-seeded rolling stocks (faults selected from list in Annexure-I) shall be passed through the system at different speed starting from 30 Kmph (incremental of 10 Kmph) upto operational speed. The system should be able to demonstrate the reliability and consistency of fault detection in the tolerances as under:
  - 12.2.3.1 False positive alarms should not be more than 20% per train per defect during prove out and less than 10% after passage of six month from the date of commissioning through Machine Learning Algorithm.
  - 12.2.3.2 False negative alarms should not be more than 5% per train per defect.
  - 12.2.3.3 Reporting should match the seeded test condition
- 12.2.4 Calibration of the system shall be demonstrated at site after commissioning of equipment. Calibration methodology and frequency of the system/subsystem/sub-assembly shall be submitted along-with the offer.
- 12.2.5 Any other test as suggested by the supplier and agreed to by consignee. The tenderer shall provide details in the offer.
- 12.3 If in IR's opinion, instruments, apparatus, devices, etc. used by the supplier need calibration or re-calibration, then such instruments, apparatus, devices, etc. shall be calibrated by an independent authority or institute approved by NABL/Govt. or accredited labs.
- 13.0 Warranty:**

The supplier shall confirm warranty of complete system for a period of at least 24 months from date of successful commissioning i.e date of start of field trial.
- 14.0 Comprehensive Annual Maintenance Contract (CAMC):**

The bidder shall also submit the offer for comprehensive annual maintenance contract (CAMC) of the system for 03 years. The period of CAMC of the system will start after completion of warranty period.
- 15.0 Training:**

The supplier shall provide training for minimum 30 man days per installation at factory premises and training for minimum 60 man days per system installed at different locations in the premises of consignee or mutually agreed location/ facility in following areas.

  - 15.1. Operation
  - 15.2. Calibration
  - 15.3. Trouble shooting and Maintenance
  - 15.4. Reading and interpretation of reports, alarms and SMS's, etc.
- 16.0 Submission of documents:**
  - 16.1 **Test certificates:** Test certificates for conformance of relevant EN standards, IP ratings, camera & sensor's data sheet and it's warranty etc., of all inspections and tests, whether or not witnessed by IR personnel, shall be supplied as soon as practicable after performance of each inspection or tests. One sets of above mentioned documents shall be supplied

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properly bound in books. The softcopies of the said documents should also be provided by the firm.

16.2 **Literature:** The supplier shall provide following literature in soft and hard copies to consignee along with the delivery of MVIS equipment.

16.2.1 Complete drawings of the system

16.2.2 Operating manual

16.2.3 Maintenance manual

16.2.4 Spare part catalogue

All the literature and data sheets of bought out items like cameras/ sensors may be transferred to the consignee in original alongwith their warranty details. Apart from above documents, any other document required to maintain the system shall be provided by the tenderer.

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Annexure I

SN	Defect	Locomotive	ICF Coach	LHB Coach	Wagons	Train Sets/ DPRS	Suggested View	Limit/ Reporting Criterion to be prescribed
	<b>Specific Stocks Selected</b>	WAG9, WAG7, WAP7, WAP5, WDG4, WAG12B, WDG6G	All ICF Coaches with all coil Bogies	All LHB Coaches with FIAT Bogies with All Coil/ Pneumatic Secondary Suspension	BOXN, BOXNHL, BOXNHS, BCNA, BCNHL, BCNAHS, BOBYN, BOBRN, BOBRNHS, BLC, BLL & BVZI	Vande Bharat I & II, EMU		
<b>A Wheel Defects</b>								
1	Wheel Diameter	✓		✓	✓	✓		Yes. As per Stock in Question
2	Profile Defects (6 Defects)	✓	✓	✓	✓	✓	In Gauge Line Scan	Yes. As per Wheel Defect Gauge
3	Tread Defects CMI K-003	✓	✓	✓	✓	✓		No
4	Wheel Gauge 4 location	✓	✓	✓	✓	✓		Yes. Limit of difference and average
<b>B Axle Box Defects</b>								
1	Cover Intact	✓		✓			Track Side Camera	No
2	End Cover Bolt Visible	✓	✓	✓			Track Side Camera	No
3	Primary Spring Displaced Broken	✓	✓	✓			Track Side Camera	No
4	Primary vertical Damper	✓		✓			Track Side Camera	No
5	Side Frame Key				✓		Track Side Camera	No
6	Elastomeric Pad height				✓		Track Side Camera	Yes. Condemning Limit
7	Jaw Gap Width				✓		Track Side Camera	Yes. In mm
8	Adapter Shift (Degrees)				✓		Track Side Camera	Yes (In Degrees)
9	Control Arm Locking Plate & Fixing Block with Bolt			✓			Track Side Camera	No
10	Corner Rolls			✓			Track Side Camera	No
<b>C Secondary Suspension</b>								
1	Suspension Bolt Missing		✓				Track Side Camera	No
2	Suspension Hanger		✓				Track side and In Track Camera	No
3	Shock Absorber/ Damper	✓	✓	✓		✓	Track Side Camera	No
4	Equalising Stay Rod Bracket and Bolts		✓				Intrack Camera	No
5	Centre Pivot Cotter and Bush		✓	✓			Intrack Camera	No
6	Anchor link with Bracket Bolt and Locking Plate		✓				Intrack Camera	No
7	Secondary Spring Displaced/ Broken	✓	✓	✓	✓		Track side and In Track Camera	No
8	Anti Roll bar			✓			In Track Camera	No
9	Roll Link with Bearing Condition			✓			In Track Camera	No
10	Traction Centre and Traction Lever			✓			Track Side Camera	No
11	Secondary Damper including Bolt	✓	✓	✓			Track Side Camera	No
12	Yaw Damper	✓		✓		✓	Track Side Camera	No
<b>D Brake Gearing</b>								
1	Brake block thickness and intactness	✓	✓		✓		Track Side Camera	Yes In mm
2	Brake pad thickness	✓		✓		✓	Intrack Camera	Yes In mm
3	Brake Disc Breakage/ Crack	✓		✓		✓	Intrack Camera	No
4	Missing Broken or Misaligned brake beams	✓	✓		✓		Intrack Camera	Yes (In Degrees)
5	Brake Shoe with Key	✓	✓		✓		Track Side Camera	No
6	Broken/ Disconnected Steel pipes FP/ BP	✓	✓	✓	✓	✓	Intrack Camera	No
7	Air Reservoir	✓	✓	✓	✓	✓	Intrack Camera	No
<b>E CBC and Under frame</b>								
1	Missing coupler pin plate	✓	✓	✓	✓	✓	Intrack Camera	No
2	Damaged or Leaning Yoke pin support plate	✓	✓	✓	✓	✓	Intrack Camera	No
3	Missing fasteners for yoke Support plate	✓	✓	✓	✓	✓	Intrack Camera	Yes. Count of Visible fasteners
4	Buffer/ CBC Drooping	✓	✓	✓	✓	✓	Track Side Camera	Yes. (In Degrees)
5	Centre Sill Damage				✓		Intrack Camera	No
6	Cross Member/ Body Bolster Damage/ Broken	✓	✓	✓		✓	Intrack Camera	No
7	Head Stock Damage	✓	✓	✓			Intrack Camera	No
8	Missing CBC Operating Handle	✓	✓	✓				No
<b>F Other Critical Subassemblies</b>								
1	Battery Box	✓	✓	✓		✓	Track Side Camera	Yes. Count of Visible fasteners
2	Gear Case with Torque arm	✓				✓	In Track Camera	No
3	Bio digester tank and Safety Sling/ Rope		✓				Track Side Camera	No
4	Motor/ Alternator Support Arm/ Bracket	✓	✓				In Track Camera	No
5	Pulse Generator/ Phonic Wheel Cable	✓		✓			Track Side Camera	No
6	APM				✓		Track Side Camera	No
7	Inter Vehicle Coupler Clearance from rail level	✓	✓	✓		✓	Track Side Camera	Yes. Count of Visible Bolts
8	FP BP Hose Clearance from rail level	✓	✓	✓	✓	✓	Track Side Camera	Yes. Minimum Clearance prescribed
9	Axle Pulley & V Belt		✓	✓				No
10	Open/ hanging Doors		✓	✓	✓	✓		No
<b>G Body &amp; Other Defects</b>								
1	Foreign Material on roof/ Pantograph	✓				✓	Top View Camera	No
2	Missing/ Grooved Carbon Strip	✓				✓	Top View Camera	Yes. Depth of Groove required
3	Squareness of Top Coping				✓		Top View Camera	Yes. Out of Squareness to be specified
4	RMPU Condition		✓	✓		✓	Top View Camera	No
5	Load Profile				✓		Top View Camera	Yes. Clearance from OHE Wire specified
6	Hand Brakes Wheel				✓		Track Side Camera	No
7	Ladders and Hand hold		✓	✓		✓	Track Side Camera	No
8	Body Bulge				✓		Top View Camera	No