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INDIAN RAILWAYS



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SCHEDULE OF TECHNICAL REQUIREMENTS FOR SUPPLY, INSTALLATION AND COMMISSIONING OF HIGH CAPACITY DEAD END ENERGY ABSORPTION SYSTEM FOR STATION/YARD FOR PASSENGERS COACHES & LOCOMOTIVES IN INDIAN RAILWAYS

S.N	Month / Year of Issue	Revision/ Amendment	Page No.	Reasons for Amendment

(BROAD GAUGE – 1676 mm)

ISSUED BY

RESEARCH DESIGNS AND STANDARDS ORGANISATION MINISTRY OF
RAILWAYS MANAK NAGAR, LUCKNOW –226011

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IMPORTANT

Vendors are advised to go through this schedule carefully. In case they need clarification regarding any of the clauses of this schedule they should contact Director General (Carriage), RDSO, Manak Nagar, Lucknow-226 011.

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Schedule of Technical Requirements for Supply, Installation and Commissioning of High Capacity Dead End Energy Absorption System for Station/Yard for Passengers Coaches & Locomotives in Indian Railways.

0. Foreword

- 0.1 This schedule is intended to cover the technical requirements/provisions relating to the design, development and supply of High Capacity Energy Dead End Absorption Buffer-Stops for Station/Yard for passenger coaches/ Locomotives in Indian Railways. (ie. both having side buffers as well as having center buffer coupler)
- 0.2 The offer shall be considered from OEMs or from companies entering into valid MOU/Agreement with OEMs as defined. The MOU should clearly state that the OEMs undertake to fulfil the warranty and support obligation with respect to technology up-gradation as and when required for the system, even in case the MOU is rescinded at some later stage. Further, in order to promote "Make in India" initiative of Govt. of India, indigenous manufacturer ~~vendor~~ Indian vendors will be allowed to design & develop these High Capacity Dead End Energy Absorption System after approval of design documents by RDSO. Such vendors to have in-house facility for computer simulation so that 3D modelling, crash simulation etc can be carried out in-house or the firm can have valid tie up with internationally reputed organisation with proven experience in this field (tie up to be valid for 20 years duration). Minimum 10 set quantity will be put in service trials for a period of not less than 12 months and subsequently clearance by RDSO before being considered for bulk quantity.
- 0.3 This schedule for placement of High Capacity Dead End Energy Absorption System shall associate Indian Railway officials for guidance while determining buffer stop location and type.
- 0.4 This schedule draws references to some of the relevant UIC, ~~German Standard DS800-01~~, British Standard; GC/RT5033; Terminal Tracks requirements for Buffer Stops, arresting Devices and Impact Walls, Issue 2, December 2007, ~~DIN-18200, DIN-18800T7 for Design, Develop Manufacturing, Installation, Commissioning, and Testing~~. Unless otherwise stated, the latest version of the relevant specification shall be taken as reference. ~~The abovementioned standards are indicative only and everything required may not have been mentioned.~~
- 0.5 In this specification, due consideration has been given to the developments in the field of Energy absorption and stopping safely without serious injury to crew and passengers of the train of the Indian Railways and the practices followed in advanced countries in the field. This specification is intended to include everything

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requisite to the manufacturing of the ~~couplers~~, High Capacity Dead End Energy Absorption System not withstanding that everything required may not be mentioned herein. The item(s) required to make the system fully functional without any additional add on will be in the scope of supply.

- 0.6 This schedule pertains to manufacture, supply, installation and commissioning of High Capacity Dead End Energy Absorption System to be installed on track. The ~~vendor~~ OEM (Or their TOT partner) / Indian Vendors shall be completely responsible for the execution of the contract strictly in accordance with the term of this specification and the condition of contract, notwithstanding any approval which purchaser or the inspecting officer may have given for the detailed drawing prepared by ~~vendor~~ OEM (Or their TOT partner) / Indian Vendors and his sub-contractor for material.
- 0.7 High Capacity Dead End Energy Absorption System are placed at the end of steel tracks for:
- Marking of tracks ends (terminus).
 - Prevention of railroad car derailment and rolling.
 - Stopping of trains in order to prevent injury, protect nearby structure and prevent damage to rolling stock.

High Capacity Dead End Energy Absorption System are not designed to replace the normal braking process of trains. The braking work of buffer stops is limited due to technical and economic reasons. Buffer stops must be designed such that they are able to absorb the kinetic energy of the train running in to them at a maximum pre-decided speed.

1. Scope

This section prescribes the technical specifications, requirements and methods of testing pertaining to the design, manufacture, supply and installation, including performance respectively of buffer stop with different working mechanism methods and different amount of energy absorption for arresting rolling stock vehicles, rail bound construction and maintenance machines (EN14033) with axle load in the range of 16.25 T – 20. 32 T (Indian Railways is designing ballast less track up to Axle loads of 22.5T & up to 25T and this should be the latest norms / standard/ reference) emergency cases stopping without injury to the driver and passengers and without structural deformation of rolling stock or derailment for use with UIC 60 kg and 52 kg Rails as per IRS T-12 with latest amendment.

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2. Performance and Design Requirement.

2.1 The High Capacity Dead End Energy Absorption System shall be designed for use on broad gauge 1676 mm RAILWAY TRACK to enable Railway rolling stock to stop safely at speeds up to maximum 15kmph. The buffer stops shall be designed to install on ballasted track or non-ballasted track on track ends with concrete sleepers or wooden sleeper (maximum clear distance between consecutive sleepers 510mm). The buffer stop be designed with hydraulic or mechanical device or in combination of both to absorb the impact energy of:

(a) Passenger train:

Weight (T)	Max. Length of Coach	Max. Width of Coach	Max. Height of Coach	Axle Load
< (1186+117)	24000mm	3660mm	4381mm	16.25 T to 20.32T

As per matrix hereunder:

Type of coaches	Gross Weight	As per RDSO Case 2 (Ideal)	Total Gross T
1st A/c	51.15	1	51.15
2nd A/c	52.78	4	211.12
3 Tier A/c	57.65	4	230.6
3 Tier Sleeper	43.79	8	350.32
Pantry Car	47.34	1	47.34
GC Coach	48.69	4	194.76
SLR	50.30	2	100.6
Locomotive	117.00	1	117
		25	1302.89

Coach Type

- (i) BG passenger coach fitted with CBC (LHB coaches).
Length of CBC from End of Coach: 230 mm.
Length of Side Buffer (In Power Car) from End of Coach – 230 mm.
Length of SPC from End of coach of Vande Bharat: 450 mm.
Length of side buffers from End of coach of (EMU, MEMU, DMU Coaches) 560 mm
- (ii) BG Locomotives

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Length of CBC: :641 mm.

Length of Side Buffer : 635 mm.

(iii) BG passenger coach fitted with CBC (ICF coaches)

Length of CBC from End of Coach – 480 mm.

Length of Side Buffers (In 1st & last Coach) from End of Coach – 480 mm.

(iv) BG passenger coach fitted with Screw coupling and side buffer (ICF coaches)

(v) Length of Side Buffers of ICF coaches (In End Car) from End of Coach – 480 mm.

Maximum stopping distance to be 05 meters however in case stopping of 05 meters leads to loss of berthing capacity or Zonal Railway may require so otherwise **must be limited to those mentioned in the table in section 3.18 for designated impact speeds. these** There should be provision in the system for catering to lesser speed impacts with reduced stopping distance. **Further, the system may be designed in such a way that length of Lw is reduced to the minimum by increasing the friction strength so that it may absorb all kinetic energy of the without moving much backward up to the back speed of 15 KMPH.**

3. Common Parameters:

- 3.1 Wheel diameter from 915 mm (new) to 825mm (old) and locomotive wheel dia 1092 as (new) and 1016 (worn out).
- 3.2 The High Capacity Dead End Energy Absorption System should have buffer head to absorb impact at a buffer height of 1105^{+0/-15}mm to 1030^{+0/-15}mm from rail level for coaches and locos included (1090mm) and gives a minimum service life of 20 years and should be made of a material which has low wear rate. Maximum Buffer/CBC drop under full load to be considered 75mm. The buffer stops should not only be compatible with Center Buffer Coupler but also with the Side Buffer fitted currently on Indian Railway coaches. The distance between side buffers is 1956 mm. The face plate and buffer plunger should be replaceable in service once wear limits specified by vendor are exceeded. However, the design of buffer stops both should be such as not to require any maintenance before 36 months under Indian Railways operating conditions except in case of an accident.
- 3.3 To stop the train, there should be no permanent damage or deformation to the coach structure. The train should stop without serious jerk so that passengers are not injured during stoppage. Coach strength and locomotives strength satisfy end load requirement as per UIC 566/ EN12663.
- 3.4 The nature and main characteristics of the material and chemical composition shall be stated by the vendor and after approval of RDSO, the **vendor OEM (Or their TOT partner) / Indian Vendors** cannot modify or change the specification of any of the approved specification unless it is better in all respects, after due approval from RDSO for such design change.

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- 3.5 The dimension and design of the High Capacity Dead End Energy Absorption System shall be in accordance with the General Arrangement Drawings (Functional features) submitted by the ~~vendor~~ OEM (Or their TOT partner) / Indian Vendors and approved by RDSO. The General Arrangement Drawing should encompass all features, functions and parameters mentioned within this specification for final approval by concerned purchasing authority/ Consignee/ authorized person/ concerned authority, depending on the actual site & track conditions where the buffer stop is to be installed.
- 3.6 The environmental conditions in which High Capacity Dead End Energy Absorption System is required to function are listed as under:

Maximum temperature in sun	70°C
Maximum temperature in shade	45°C
Minimum Temperature	(-)5°C
Humidity	100% saturation during rainy season
Rainfall	Fairly heavy
Environment	Dusty during hot weather, saline and corrosive in coastal areas

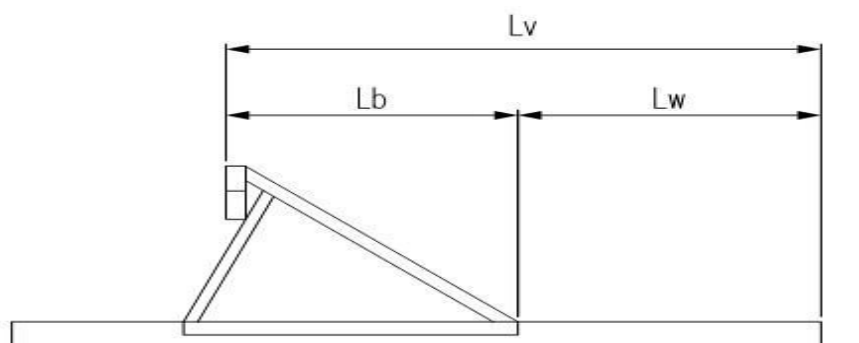
- 3.7 The ~~vendor~~ OEM (Or their TOT partner) / Indian Vendors shall submit prototype or equivalent testing report with detailed calculations and limitations.
- 3.8 The High Capacity Dead End Energy Absorption System should be able to protect the Loco/ coach body from any deformation or damage due to impact up to the designed & designated speed. IR coaches are designed as per UIC 566 and are load tested under static condition for a load of 2000 kN at the ends, i.e. 1000 kN at each Side Buffer or 2000 kN at Center Buffer Coupler (CBC). The High Capacity Dead End Energy Absorption System shall be so designed that the coach structure should not start collapsing before the total stroke of Buffer Stop plunger / capsule and the maximum stopping distance due to the friction while it slides over the rail is reached". Details can be collected from relevant specifications.
- 3.9 The life cycle of buffer stop should not be less than 20 years. All parts which are metallic and nonmetallic shall be made of weather resistant corrosion resistance and suitable under maximum temperature + 70°C, -5°C and plastic parts if any should be UV protected.
- 3.10 ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors should paint the High Capacity Dead End Energy Absorption System superior type RETRO

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REFRACTIVE paint in RED and WHITE band /patches. The final coat paint should be high resistance to the environment condition including UV radiation and resistance to corrosion and wear. Maximum three coat of paint should be used.

- 3.11 The High Capacity Dead End Energy Absorption System has to be capable of negotiating the sharpest track curve of 175 m radius (10 degrees) and 1 in 8.5 turn out, Gradient 1 in 37 max present on IR network, when such requirement arises for the Buffer Stop to be installed on such a location/ site/ condition. Vertical level difference of 75 mm between adjacent coaches is allowed in service over Indian Railways. The buffer stop should be able to absorb the change in kinetic energy / momentum thereby created on such conditions.
- 3.12 ~~Maximum operating speed is not a factor for buffer stops.~~
- 3.13 The High Capacity Dead End Energy Absorption System should be designed to accommodate the CBC of the locomotive at the time of impact during contraction of Buffer plunger of both the coach/ locomotive and buffer stop thereby ensuring that it does not infringe any part of the system nor be damaged itself. The distance of projection of CBC from Head-stock to be mentioned.
- 3.14 The High Capacity Dead End Energy Absorption System may be Fixed or Friction type with or without additional friction/ braking elements to suit the technical parameters and functional requirements as described in this specification.
- 3.15 The High Capacity Dead End Energy Absorption System shall be able to stop the train and protect the Coaches from any kind of permanent damage of the full train up to a speed of 15 kmph. The above protection should be available whether or not locomotive is attached with the train. The tenderer shall provide full train simulations/ calculations to substantiate the claim. The data as per Annex –A shall be used as input for the simulations.
- 3.16 The High Capacity Dead End Energy Absorption System should be mounted on tracks by K-Fastening or similar globally proven arrangement for quick easy and firm fixation to withstand the impact.
- 3.17 There should be a visual indication provided on High Capacity Dead End Energy Absorption System to indicate - being good for service after an impact. This visual indication should not be ambiguous in nature.
- 3.18



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Braking Distance

Where

L_w = Maximum breaking distance

L_b = Dead End Energy Absorption Systems length

L_v = Track Occupancy

Above is a tentative drawing, actual design may vary from OEM to OEM. The friction elements/ additional friction elements used should follow the rules of leading Rail Road Companies as per the standards mentioned in clause 0.3. It should be possible to change the number of the friction elements during installation or for the adaptation a later date for any modification required.

The friction elements should be developed for any type of rail. Additional friction elements may be provided on running rail or additional rails between the gauges.

The following table specifies the type of High Capacity Dead End Energy Absorption Systems recommended by RDSO on the basis of the above and the requirements of the Indian Railways, keeping in mind the collision speed, train mass and stopping distance:

Speed	Mass*	Track Occupancy **	Type of High Capacity Dead End Energy Absorption Systems
5	1310MT	<5 Meters	Friction with Hydraulic Device Friction or Hydraulic Or friction with Hydraulic Device
10	1310MT	<10 Meters	Friction with Hydraulic Device
15	1310MT	<15 Meters	Friction with Hydraulic Device

* 24 Coaches Rake,

**Space as per availability at Stations/Yards

3.19 Track Requirements

Since the High Capacity Dead End Energy Absorption Systems would be arresting a moving train at high speed and gradually decreasing it with a combination of friction and hydraulic device, sliding over the track reinforcement is necessary to ensure proper functioning of the High Capacity Dead End Energy Absorption Systems. Such reinforcement can be either in concrete or steel and not to disturb the existing sleeper/fastening/rail arrangements of the Indian Railways. Additional rail may be

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developed for friction elements with space/area constraints.

The vendor to suggest the most appropriate types at the time of quoting the tender, also dependent on the type of existing track, its conditions and other factors.

4. Qualifying Requirements

- 4.1 The vendor should have experience in designing, manufacturing and supplying High Capacity Dead End Energy Absorption Systems for passenger rail application and should have supplied to major Railway systems in the developed countries. Documentary evidence to this effect shall be provided. Based on technical requirement on simulation of actual field data vendor can propose its standard manufacturing type, design, specification of materials keeping all other specified performance, service reliability & life and condition in accordance to the RDSO's specification.
- 4.2 The vendor shall have capacity to carry out simulation studies using simulation software for the complete rakes either in house or through internationally reputed organizations with proven experience in Railway for such use.
- 4.3 The vendor should have possibility to carry out the required tests including dynamic testing either in-house or through internationally reputed agencies with proven experience in such testing. **If performance will be carried out in IR, the absolute liability will be borne by OEM (Or their TOT partner) / Indian Vendors.**
- 4.4 The vendor must have a valid ISO or similar certificate and should have mention of the standards as per clause 0.3 above.

5. Particular Requirements

- 5.1 The vendor shall submit a detailed simulation of full train to indicate the maximum speed at which there will be no damage to the coach body.
- 5.2 The working design of the High Capacity Dead End Energy Absorption Systems shall be a proven one and in service over International Railway systems for similar applications. Documentary evidence to this effect must be submitted along with the proposed design.
- 5.3 **~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors** Technical Drawings.
The **~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors** shall submit together with proposal technical drawings and description with Bill of Materials and Specification for Indian Railway track

- i) Assembled High Capacity, clamping components for the track and any other installation components.

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- ii) Necessary Civil Engineering drawing or requirement for installation of buffer stops should be furnished by the vendor.

5.4 MANUFACTURING

The High Capacity Dead End Energy Absorption System and all other concomitant accessories must be manufactured and weather proof painted as per RDSO'S specification and guide line. The vendors Mark, year of manufacture, product type and traceability identification mark. The plungers and capsules or any other metallic components should be chrome painted to marine standard for extended life in humid condition.

5.5 MANUFACTURING TESTS

Impact test reports, High Capacity Dead End Energy Absorption System and braking / stopping distance test reports and other calculations should be submitted by the vendor. Source of material and tests certificate, result of mechanical and chemical tests conducted by an accredited Laboratory to be submitted. Material traceability should be provided by the vendor. The vendor shall submit their proposal together with general information about factory, quality management system process in accordance with all the requirement of RDSO.

6.0 Testing and Acceptance

- 6.1 The Vendor shall submit a detailed Prototype and Production Test Protocol and acceptance criteria for approval to RDSO.
- 6.2 Mock Test shall be carried out once for each numbering of the High Capacity Dead End Energy Absorption Systems after installation and commissioning at the required site as per RDSO approved test plan.
- 6.3 As the High Capacity Dead End Energy Absorption Systems are designed to work for impacts where deformation may take place, the High Capacity Dead End Energy Absorption Systems shall be approved based on the Test results, Simulation and design calculations provided by the Firm. This should be subsequently verified by means of the mock test.
- 6.4 Working test certificate of the buffer plungers should accompany the High Capacity Dead End Energy Absorption Systems.
- 6.5 The vendors considered suitable for trials order, type test as mentioned in clause

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5.5 will be carried out in presence of RDSO official.

7. Maintenance and Service.

- 7.1 The High Capacity Dead End Energy Absorption Systems should be easy to install, bolted/ placed on tracks where downtime is minimal and does not affect day to day operations on the platform/site. In case extra friction elements are to be installed on additional tracks, such arrangement may also be done within minimal period of time.
- 7.2 The ~~Vendor~~ **OEM (Or their TOT partner) / Indian Vendors** shall provide detailed instructions for day to day/periodic maintenance.
- 7.3 The High Capacity Dead End Energy Absorption Systems shall not require any maintenance within 36 months from date of placing in service except in case of an accident.
- 7.4 The material of High Capacity Dead End Energy Absorption Systems and its mating face with reclamation/replacement process shall be provided with the offer.
- 7.4.1 Detailed work content of various inspection / maintenance practices, including procedure for assembly and fitment on track to be submitted. The work content of each schedule shall also be intimated.
- 7.4.2 A list of technical specification (for procurement purpose) of all special purpose tools, gauges and testing/measuring instruments required for examination, repair and over- hauling / reconditioning of High Capacity Dead End Energy Absorption Systems to be submitted.
- 7.4.3 Price proposal for these tools, gauges and testing / measuring instruments as well as for spares (as OEM's maintenance guidelines) shall also be submitted with the offer separately.
- 7.4.4 Copy of Maintenance Manual which details the maintenance procedures to be submitted.
- 7.4.5 ~~The Vendor~~ **OEM (Or their TOT partner) / Indian Vendors** should provide Maintenance support including technical support and supply of spares for maintaining for the High Capacity Dead End Energy Absorption Systems for a period of 20 years.
- 7.4.6 All the provisions contained in RDSO's ISO procedures laid down in document No. QO-D-7.1.11 dated 24-10-2017 (titled "Vendor –Change in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of

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products supplied to Railways.

8. Guarantee

- 8.1 The High Capacity Dead End Energy Absorption Systems failing or proving unsatisfactory in service due to defective design, material or workmanship within 48 months from the date of delivery or 36 months from the date of placing in service, whichever is earlier, shall be replaced at firms own cost. This warranty shall survive, notwithstanding the fact that the buffer stops may have been inspected, accepted and payment thereof made by the PURCHASER for the replaced/ repaired/ corrected buffer, the period of 36 months shall commence when the replaced System is commissioned in service. The sole judge in this case shall be the PURCHASER.

9. LIST OF DOCUMENT TOBE SUBMITTED BY THE FIRM

- 9.1 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors should submit names and document of authorization of his partner/ dealer for the High Capacity Dead End Energy Absorption Systems and the vendor shall not replace their Authorized partner/ dealer without the RDSO'S approval.
- 9.2 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors shall submit manufacturing process, Quality Assurance Plan. Testing procedure of raw material, stage inspection and performance certificate in accordance with their specification and EN ISO 9001:2008 or any other specification.
- 9.3 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors shall submit certificate of test reports for impact test and other calculation data.
- 9.4 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors shall submit technical drawing of clamping components dimension to confirm the design which has no interface with fastening system components as per EN 13481-4: 2002 +A1:2006
- 9.5 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors shall submit a signed declared document in regard to the High Capacity Dead End Energy Absorption Systems life cycle in years, based onthe requirements in this technical specification.
- 9.6 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors should submit process and procedure of painting andcorrosion protection.
- 9.7 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors should submit environmental protection certificate conforming relevant EN compliance.
- 9.8 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors shall submit the names of material (metallic / non -metallic) with the reference of Specification and description of galvanization process.
- 9.9 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors should submit signed and approved manuals for installation, maintenance and safety. The vendor should

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specify the instruction needed to guaranty safe operation during the product life cycle.

9.10 Each equipment shall be supplied with certificate that the equipment has been manufactured according to technical drawings, specification, testing certificates of dimensions, material, material and structure.

9.11 For each type equipment packing list should be submitted.

10. PACKING

10.1 Each High Capacity Dead End Energy Absorption Systems shall be packed in wooden boxes/pallets. The wooden box/pallets arrangement shall be easy and safe transportable, handle able can easily be unpackaged and storage.

10.2 Each package list should include the following details.

10.2.1 Components name, type and model quantity wise.

10.2.2 Production batch number.

10.2.3 Date of manufacture and vendor initial and name.

10.2.4 Gross and net weight and total quantity in a box.

10.2.5 RDSO approval Number.

10.2.6 Purchase order number and ordinal number labelling in **BLACK BOLD LETTERS** shall be on top and on two other sides.

11. INSTALLATION AND TRAINING

11.1 The weight and dimensions of the High Capacity Dead End Energy Absorption Systems should be such that it is easily transported in and out of the platforms/ stations/ yards with minimal time and hindrance to the overhead electrical and civil installations.

11.2 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors to make all arrangements for any additional requirements for installation of the Dead End Energy Absorption Systems. If any preparation at site is required, the same should be done by Railways based on the drawings and recommendations/ instructions provided by the vendor.

11.3 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors should impart training to the nominated representative of the Railways. A certificate towards satisfactory training should be provided by Railways to the vendor.

11.4 The ~~Vendor~~ OEM (Or their TOT partner) / Indian Vendors shall also provide the testing equipment's required for the testing of system periodically @1 set per station along with installation.

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ANNEXURE-A

OPERATING CONDITIONS FOR HIGH CAPACITY DEAD END ENERGY ABSORPTION SYSTEM

- 1. Coach Type**
 - i) BG passenger coach fitted with Centre Buffer Coupler (LHB coaches)
 - ii) BG passenger coach fitted with Semi-permanent coupler (EMU, MEMU, DMU coaches)
 - iii) BG passenger coach fitted with screw coupling and side buffer (ICF Coaches)
 - iv) Goods wagons of mixed type (BCN, BOXN etc.)
- 2. Mass**
 - i) Passenger train – 2000 t. Goods train - 5200 t.
 - ii) Impact speed -- 05 kmph
 - iii) Maximum permitted shunting speed -- 15 kmph
- 3. Side Buffer Type**
 - i) Height - $1105^{+0/-15}$ mm -- $1030^{+0/-15}$ mm. (center line from rail level)
 - ii) Distance between Side Buffers – 1956 mm.
- 4. Centre Buffer Coupler type**
 - i) Height -- $1105^{+0/-15}$ mm. (Centre line from rail level)
 - ii) Distance between center lines of the side buffers
(End coaches are equipped with side buffers) -- 1956 mm
- 5. Wheel diameter** - 915 mm (new), 825 mm (condemning)
- 6. Maximum length of coach** – 24000 mm,
Maximum width of coach – 3660 mm.
Maximum height of coach – 4381 mm.
- 7. Axle load** – 16.25 t. to 20.32 t.
- 8. Gauge** – 1676 mm. (Broad Gauge)
- 9. Environmental conditions** –

Signature			
Name & Designation	Prepared By S K Pandey/SSE	Checked By A S Dugtal/ADE(CD)	Approved By S.S.Raypa Dir/ Carriage

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Climatic & Environmental Conditions

Maximum Temperature : 70⁰ C
(Under the sun)

Maximum Temperature :45⁰C
(Under shade)

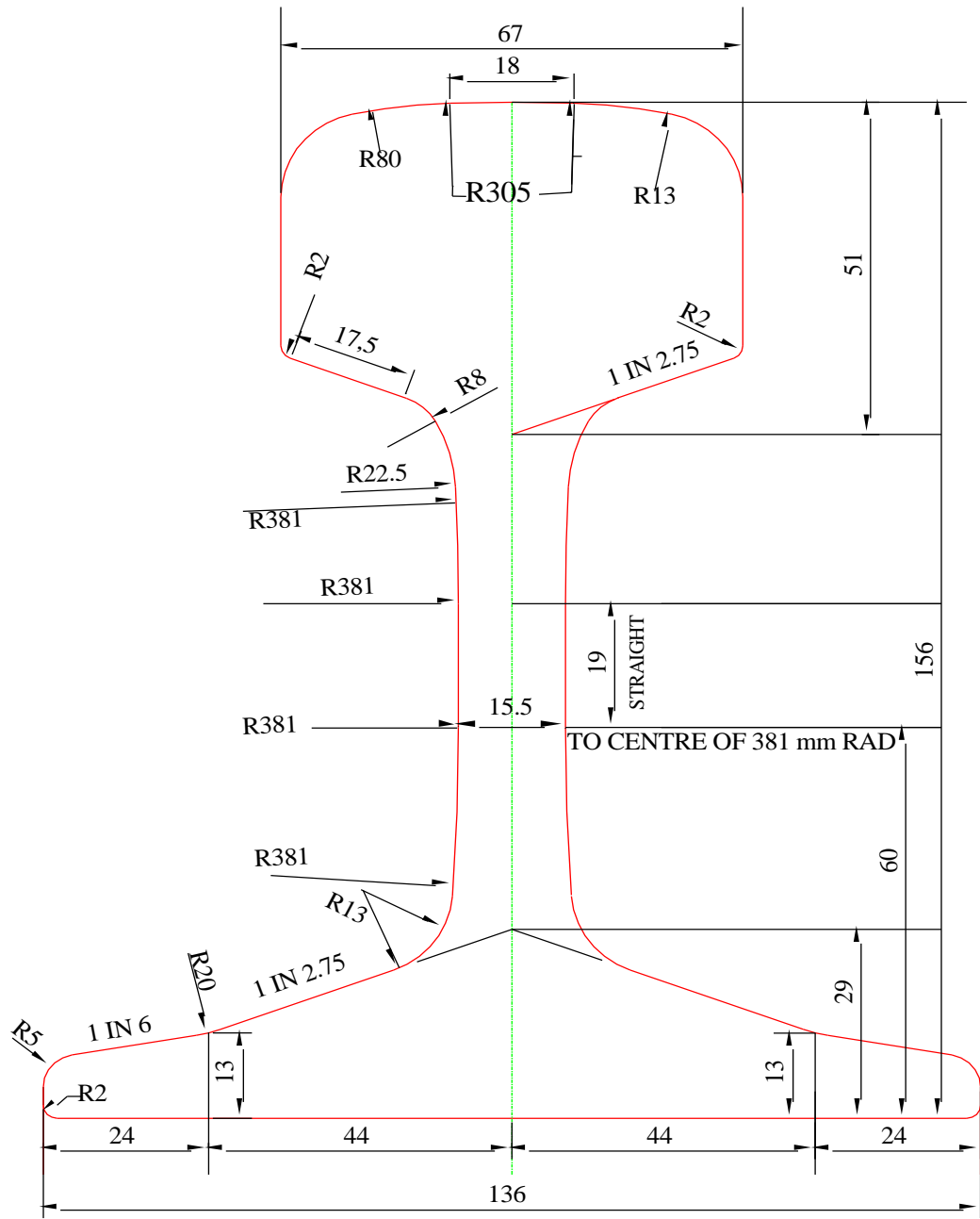
Minimum Temperature : -5⁰
(at night)

- Rainfall : Fairly Heavy
- Humidity : 100% saturation
- Environment : Dusty during hot weather and saline in coastal areas

10. **Maximum stopping distance** – 5 meters. However, in case stopping distance of 5 meters leads to loss of berthing capacity, there should be provision in the system for catering to lesser speed impacts with reduced stopping distance.
11. **Maximum Buffer/CBC drop under full load** – 75 mm.
12. **Maximum operational speed** – 160 kmph
13. **Maximum gradient** – 1 in 37 (Down gradient)
14. **Radius of sharpest curve** – 175 M (10⁰ curve)
15. **Brake System** –
 - i) Coach – Twin pipe air brake system and Electro pneumatic brake system
 - ii) Wagon - Single pipe air brake system.
16. **Coach strength** - Satisfies end load requirements as per UIC 566.
Wagon strength - Satisfies end load requirements as per UIC 566.
17. Track is maintained as per permission of Indian Railway Permanent Way Manual.
18. System should be capable of accommodating the variations in gradient /and curvature for the platforms / sidings where it is installed.

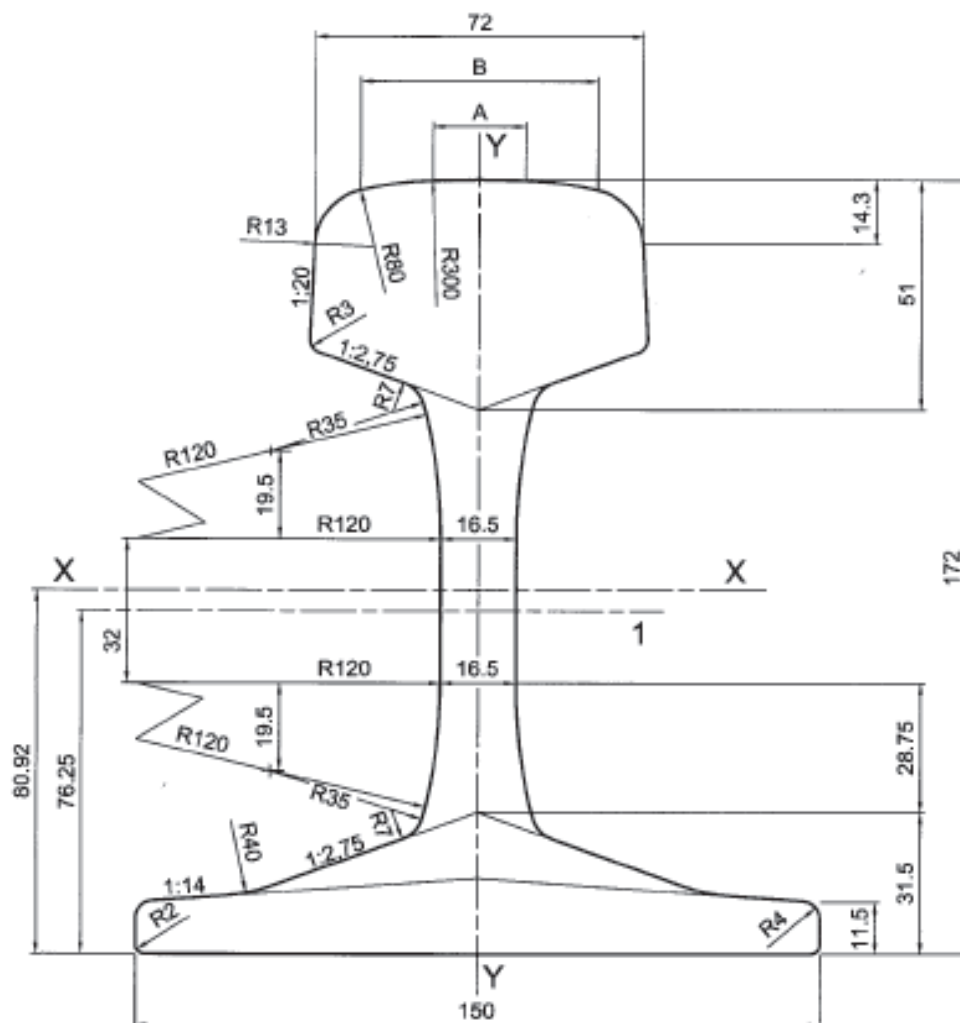
Signature			
Name & Designation	Prepared By S K Pandey/SSE	Checked By A S Dugtal/ADE(CD)	Approved By S.S.Raypa Dir/ Carriage

IRS- 52 kg/m APPENDIX-I



CALCULATED WEIGHT 51.89 kg per metre
CROSS SECTION AREA 66.15 sqcm

Appendix II (Revised)
60E1 (as per EN 13674-1:2011+A1:2017(E))



Key

1 centre line of branding

cross-sectional area	:	76,70	cm ²
mass per metre	:	60,21	kg/m
moment of inertia x-x axis	:	3 038,3	cm ⁴
section modulus - Head	:	333,6	cm ³
section modulus - Base	:	375,5	cm ³
moment of inertia y-y axis	:	512,3	cm ⁴
section modulus y-y axis	:	68,3	cm ³
indicative dimensions:		A = 20,456 mm	
		B = 52,053 mm	