GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Document Content	Technical Specification	Yes
	Schedule of Technical Requirement	Yes
Description of item	Dampers For LHB Coaches and Vande Bharat Coaches.	
Remarks	Nil.	

S. No.	Month / Year of Issue	Revision / Amendment	Page No	Reason For Amendment
1	May, 2019	Nil	---	New Specification
2.	April, 2023	Rev. 01	----	---------.
3	February, 2025	Rev. 02	----	1) Include drawings of dampers for LHB coaches and Vande Bharat Coaches. 2) Include the details of dampers for Vande Bharat Coaches. 3) Include priming tests of dampers and paint fire resistance test. 4) Includes testing facility & testing of critical items for dampers. 5) Including quality improvements para for dampers.

Issued By

Carriage Directorate
Research Design and Standard Organisation
Manak Nagar Lucknow`-226011

Signature			
Name & Designation	Prepared By: Sameer Kumar/ SSE/D(VDG)	Checked By: Satyendra Kumar/ADE/VDG	Approved By: Shobhit Pratap Singh/Dir./VDG

Price :Rs……/

~~Amendment Slip~~

~~S. No.~~	~~Description~~	~~Clause No.~~	~~Page No. of earlier Spec.~~	~~Reason for amendment~~
~~1.~~	~~Clause no. renumbered~~	~~1.3 – 1.5~~	~~7~~	~~At 1.2 and 1.3 new clauses regarding applicability of RDSO policy for vendor status upgradation and make I n India policy included.~~
~~2.~~	~~Drawings~~	~~1.3.1~~	~~7~~	~~RDSO's drawings issued for FIAT Dampers.~~
~~3.~~	~~Applicable standards~~	~~1.5~~	~~7~~	~~Specified the EN 25817 & EN 10204 in list as both ENs are used for testing.~~
~~4.~~	~~Condition of use.~~	~~2.1~~	~~7~~	~~Minor Correction.~~
~~5.~~	~~Acceleration~~	~~2.3.2~~	~~9~~	~~Reference specification for testing specified.~~
~~6.~~	~~Marking~~	~~2.7~~	~~10~~	~~Minor updation as RDSO's drawings issued for FIAT Dampers.~~
~~7.~~	~~Colour~~	~~2.8.4~~	~~12~~	~~Colour of FIAT Dampers updated as per RDSO drawings.~~
~~8.~~	~~Demands for the Force/Velocity Characteristics~~	~~3.2~~	~~13~~	~~Tolerances elaborated and provide the tolerance during service condition. Minor updation also under graph.~~
~~9.~~	~~Test temperature~~	~~4.1.2~~	~~15~~	~~Since same temperature has been mentioned in the drawings of Dampers issued by RDSO, line "It will supersede the testing temperature requirement mentioned in drawing" has been removed.~~
~~10.~~	~~Dimension of the geometry~~	~~4.2.1~~	~~15~~	~~Length of dust cover removes from list as suggested by vendors.~~
~~11.~~	~~Production test.~~	~~4.3.1~~	~~16~~	~~One test velocity specified in production test.~~
~~12.~~	~~Remove the sample size for testing from the row of "Test conditions" and acceptance criteria elaborated.~~	~~4.3.3 (Table 3)~~	~~16~~	~~Sample sizes for testing during purchase inspection are already mention in clause no. 4.3.8 (Table 14) and sample size during first article testing are mentioned in para. 7~~
~~13.~~	~~Remove the sample size for testing from the row of "Test conditions" and acceptance criteria~~	~~4.3.4 (Table 5)~~	~~18~~	

	elaborated.			
14.	Remove the sample size for testing from the row of "Test conditions" and minor updation.	4.3.6 (Table 11)	21	
15.	Leakage test	4.3.7	New Clause	New clause added as per EN 13802.
16.	Fatigue test	4.3.7	22	Renumbered as 4.3.8 and requirement of approval of test specification removed.
17.	Dynamic testing	4.3.7.2	23	Renumbered as 4.3.8.2 and specify the test velocity and amplitude for dynamic fatigue test.
18.	Dynamic testing	Table 13	23	Renumbered as Table 14 and on the basis of RLDA test offset of PVD for fatigue test modified.
19.	Specifications for the Final Acceptance	4.3.8 (Table 14)	24	• Renumbered as 4.3.9. • Clause no. against weight has been corrected. • Specify the clause no. for acceptance test against "Surface Protection" • Elaborate the remarks in table. • Leakage test added. • Clause no. against fatigue test modified.
20.	Procedure for Testing of Prototype Dampers	7	26	• Sample size for various testing during prototype testing (first article testing) has been elaborated.
21.	Special conditions	15.a	30	In the list of facilities available with company, availability of manufacturing facility has been added.
22.	Special conditions	15.f	31	Para modified in line of extant ISO guidelines.
23.	Special conditions	15.h	31	Para. 15.k merged and some minor modification made.
24.	Special conditions	15.j	32	Action taken in case of design change has been elaborated.
25.	Special conditions	15.k	32	Para. merged with 15.h.
26.	Appendix No. corrected	----------	35 - 38	Error corrected.
27.	Appendix-I	----------	34	In place of RCF drawings, RDSO drawings have been specified.
27.	Appendix-II & Appendix- III	----------	35, 36	Heading change as firm's submitted the QAP as per extant format of QAP.
28	Appendix - IV	----------	37	Removed and merged in Appendix- III
29	New Appendix – IV added	----------	----------	STR for manufacturing, testing, quality control has been added.

CONTENTS

FOREWORD

1. This Specification spells out the technical requirements of Dampers for LHB coaches and Vande Bharat Coaches.

2. Specification is concerned with the Dampers for LHB coaches and Vande Bharat Coaches along with the details of the requirements and tests for same.

3. The specification shall not be altered /modified or reproduced in any form without the written permission of the Director General (Carriage), RDSO, Lucknow.

ABREVIATIONS

RDSO	Research Designs and Standards Organisation
IR	Indian Railways
LHB coaches	Linke Hofmann Busch coaches
VB Coaches	Vande Bharat Coaches
ISO	International Organization for Standardization

SPECIFICATION FOR MANUFACTURE AND SUPPLY OF DAMPERS FOR LHB COACHES AND VANDE BHARAT COACHES

1. GENERAL

1.1 SCOPE

This specification covers the requirements of all types of Dampers currently used in LHB coaches/ VB Coaches. Scope of this specification is related to following types of hydraulic Dampers:

Dampers for LHB coaches	Dampers for Vande Bharat Coaches
• Primary Vertical Dampers • Secondary Vertical Damper • Secondary Lateral Damper • Yaw Damper • Secondary Lateral Damper for Air Spring Bogie • Secondary Vertical Damper for Non AC Coaches	• Primary Vertical Dampers • Secondary Vertical Damper • Secondary Lateral Damper • Yaw Damper

- ~~Primary Vertical Dampers~~
- ~~Secondary Vertical Damper~~
- ~~Secondary Lateral Damper~~
- ~~Yaw Damper~~
- ~~Secondary Lateral Damper for Air Spring Bogie~~
- ~~Secondary Vertical Damper for Non AC Coaches~~

This specification is to define:

- Performance, envelop, qualification and inspection requirement
- Maintenance requirement
- Any other technical and quality assurance requirements in association to other technical documents (drawings, other specification etc.).

Hereafter, this part will be referred to as dampers for LHB coaches/ VB Coaches. and attachment elements. The terms shock absorbers and damper can be interchangeably used in this specification.

This Specification covers the supply of damping unit with end fitting/mounting as an assembly termed as Dampers for LHB coaches and Vande Bharat Coaches.

1.2 Applicability

This specification applies when recalled by the purchaser orders and/ or by the associated drawings issued by RDSO or any other agency authorized by IR for the purpose.

When conflict arises between the requirements of this specification and the associated drawings, the drawing requirements shall apply. When conflict arises between the requirements of this specification and those of other specification, discrepancies shall be solved by mutual agreement between the purchaser and supplier.

Departures from this specification will be possible only following a written agreement between the supplier and purchaser.

1.3 All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11 Version 2.5 or latest (titled "Vendor-Changes 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 products supplied to Railways.

1.4 The Government of India policy on "Make in India" shall be apply.

1.5 DRAWINGS

1.5.1 The damper shall generally conform to RDSO drawing(s) or the manufacturer's duly approved by the RDSO. RDSO's reference drawings are as under-

1.5.1.1 For LHB Coaches:

S. No.	Item	RDSO drawing no.
1	Primary Vertical Dampers for all type of LHB Coaches.	RDSO/CG/DRG/21047 Alt. 2 or latest.
2	Secondary Vertical Damper for LHB AC Coaches	RDSO/CG/DRG/21046 Alt. 2 or latest.
3	Secondary Lateral Damper for all coil FIAT Bogie	RDSO/CG/DRG/21045 Alt. 2 or latest.
4	Yaw Damper for all type of LHB Coaches.	RDSO/CG/DRG/21048 Alt. 2 or latest.
5	Secondary Lateral Damper for Air Spring Bogie`	RDSO/CG/DRG/21049 Alt. 2 or latest.
6	Secondary Vertical Damper for Non AC Coaches	RDSO/CG/DRG/21018 Alt. 2 or latest.

1.5.1.2 For Vande Bharat Version – 2 Coaches:

S. No.	Item	RDSO drawing no.
1	Primary Vertical Damper	RDSO/CG/DRG/DRAFT-1
2	Secondary Vertical Damper	RDSO/CG/DRG/ DRAFT-2
3	Secondary Lateral Damper	RDSO/CG/DRG/ DRAFT-3
4	Yaw Damper	RDSO/CG/DRG/ DRAFT-4

1.5.2 The manufacturers desirous of being considered for RDSO's approval for manufacture & supply of damper shall submit application in prescribed form along with assembly drawings and sectional drawings with installation dimensions.

1.6 End mountings and methods of dampers attachment

Dimensions, orientation and performance of end mountings are to be as per RDSO drawings. Any change in this will require RDSO approval.

1.7 Applicable standards/Reference Standards

i) ISO 23277
ii) ISO 23278
iii) ISO 17638
iv) ISO 5817
v) ISO 2409
vi) ISO 9227
vii) EN 25817
viii) EN 10204
ix) IEC:61373

2. Performance specification and Instructions for Construction

2.1 Conditions of use

The dampers for LHB coaches/ VB Coaches. are likely to be exposed to the following operating conditions:

- Change in temperature from -40^{0}C to +70^{0}C
- Relative humidity from 30% to 100%
- Both acidic and basic cleaning product
- Urine, feces, and kitchen waste (restaurant cars)
- Rain, snow, ice

- Sand, brake and ferric oxide dust (abrasion of wheel and tracks)
- Damage from flying stones raised from the ballast track bed.
- Flying pieces of ice
- Salty air (coastal area)

The conditions of use appear normally in any conceivable combination (independent of weather conditions, speed, etc.)

2.1.1 Installation

The dampers must be designed for trouble-free operation in the assembly positions on LHB coaches and VB coaches.

In particular, for anti-yaw dampers, the supplier shall take into account each of the operation positions specified in the relative assembly drawing and anti-yaw connection to the body for a maximum negative angle and with the end shield at highest connection.

2.2 Cleaning of the bogie

The bogies and superstructure are washed following varying periods, at the most every 2-5 days. As a result, the dampers come into contact with acidic and alkaline cleaning products, against which it must be resistant for the defined service life. The appearance of under layer rust, material out breaks, leaks, changes in rigidity etc. is not allowed.

2.3 Endurance

2.3.1 Load

The dampers shall be able to resist the forces listed below (unless otherwise specified). Appearance of fractures or leakage of oil as well as reduction of life time of the dampers is not permitted. This includes the dampers and also the attachment elements.

The complete installed dampers should resist the following static forces along the longitudinal axis.

In the compressed position	20kN (unless otherwise specified)
In expanded position	20kN (unless otherwise specified)

2.3.2 Acceleration

Dampers and their attachment can be temporarily exposed to very great accelerations, which affect the longitudinal axis of the shock absorber at a 90^0 angle.

During type test qualification the supplier has to conduct the vibration test for 1 no. of each type damper as per vibration level given in table 1.

The dampers along with end mountings have to be mounted in vibration shaker in as installed condition on vehicle.

The damper shall be subjected to a total conditioning time of 15 hrs. This shall be divided into periods of 5 hrs testing in each of the three axis i.e. in X, Y & Z axis as per IEC:61373.

The dampers should have no loss of functionality at the end of test.

Table 1:

	dynamic
Primary dampers	±25g vertical
	±3g Longitudinal
	±3g Lateral direction
Vertical dampers	±10g Vertical
	±0.5g Longitudinal direction
	±1.5g Lateral direction
Lateral dampers	±10g Vertical
	±0.5g Longitudinal direction
	±1.5g Lateral direction
Anti-yaw dampers	±10g Vertical
	±0.5g Longitudinal direction
	±1.5g Lateral direction

2.3.3 Weight

The weight of the dampers with clamping elements (including surface protection) must be measured and recorded. A low tare weight is of great importance. The weight of damper shall be indicated on the supplier drawing.

2.4 STORAGE AND TRANSPORT

The dampers must be packaged in a way that damaging of the paint coating is not possible.

- The dampers attachment points are preserved.

On the Packaging the following indication shall be present as a minimum:

- Identification of the supplier
- Contract number or purchase order number

- Quantity of articles in the package
- Description of the articles.

2.5 Materials

In making the choice of material for the dampers components, it must be noted that at the end of their service life it must be possible to recycle or dispose of them without need for any particular measures. Should materials be used which, according to valid instructions, require special disposal, these materials together with their weight proportion must be communicated in written form to the RDSO.

2.6 Hydraulic Liquid

The type/ grade of oil and its make to be specified on suppliers drawing. Supplier to submit technical data sheet stating the characteristics, quantity of the oil (per damper) and material safety data sheet (MSDS) during type test approval. Compliance to environmental and other statuary requirements should be mentioned in data sheet.

2.7 Marking

The following data is to be punched on number plate and this number plate is to be riveted properly on bottom side of dust cover in recognizable way:

- Name of the manufacturer
- Month and year of manufacturing
- Manufacturer part number
- Serial number of the damper
- Nominal force and nominal velocity
- Name/Type of damper as mentioned in RDSO's drawing along with drawing number.

The marking should remain legible with the naked eye for the entire service life of the dampers.

Besides above the damper shall be marked in 10 mm height letters by punch mark / engraving and minimum depth of 0.25 mm on the main body (Casing tube sub assembly) with following details:

- Name of the manufacturer or code
- Month and year of manufacturing
- Manufacturer part number
- Nominal force and nominal velocity
- Name/Type of damper as mentioned in RDSO's drawing

Alternatively, the above information can be marked on dust cover, diagonally opposite to number plate.

Firm shall ensure traceability of damper right from raw material stage to the finished product stage with their internal system. Same shall be verified by RDSO during initial registration / periodic quality audit.

For Lateral, Anti-Yaw dampers, clear mounting indications need to be fixed as per relevant RDSO drawing on the main body (Casing tube sub assembly) to indicate the side to face the ground.

2.8 Surface protection/varnishing

2.8.1 Dampers finishing

Non-polluting lacquer/ paint should be used for the dampers finishing. All support surfaces meant for mounting bolts and screws must be unlacquered/ unpainted and have a galvanic coating. Any lacquer/ paint on the rubber bearings will be not accepted.

All parts of the dampers which are exposed to ambient air must be protected against corrosion. The Manufacturer shall describe, and suitably document, the painting process it intends to apply for all visible parts of the dampers.

All these details shall be included in QAP which shall be submitted to RDSO for approval.

2.8.2 Resistance of the paint

To be performed at the type approval stage:

Check bond according to ISO 2409: the paint must not come off any of the squares.

2.8.3 Resistance to salt environment

The manufacturer demonstrates the aging stability of the surface protection by a salt spray test according to ISO 9227.

The testing time for all dampers must not remain under: 720 hours

The specimen shouldn't have any "Red Rust" on the outside as well as internal surfaces exposed to air.

2.8.4 Colour

2.8.4.1 For LHB Coaches

The colour of the coating lacquer will be as under:

S. No.	Type of Damper	RDSO Drg. No.	Colour
1	Primary Vertical Dampers for all type of LHB Coaches.	RDSO/CG/DRG/21047 Alt. 1	RAL 7012: Basalt Grey
2	Secondary Vertical Damper for LHB AC Coaches	RDSO/CG/DRG/21046 Alt. 1	RAL 6027: Light Green
3	Secondary Lateral Damper for all coil FIAT Bogie	RDSO/CG/DRG/21045 Alt. 1	RAL 7012: Basalt Grey
4	Yaw Damper for all type of LHB Coaches.	RDSO/CG/DRG/21048 Alt. 1	RAL 7012: Basalt Grey
5	Secondary Lateral Damper for Air Spring Bogie`	RDSO/CG/DRG/21049 Alt. 1	RAL 9005: Jet Black
6	Secondary Vertical Damper for Non AC Coaches	RDSO/CG/DRG/21018 Alt. 1	RAL 3011: Brown Red

2.8.4.2 For VB Coaches:

S. No.	Type of Damper	RDSO drawing no.	Colour
1	Primary Vertical Damper	RDSO/CG/DRG/DRAFT-1	RAL 7012: Basalt Grey
2	Secondary Vertical Damper	RDSO/CG/DRG/ DRAFT-2	
3	Secondary Lateral Damper	RDSO/CG/DRG/ DRAFT-3	
4	Yaw Damper	RDSO/CG/DRG/ DRAFT-4	

2.8.5 Thickness of the layer

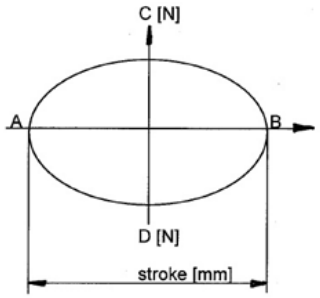
Thickness of the paint layer shall be a minimum of 50 microns (DFT)

3 DEMANDS ON THE CHARACTERSTICS

3.1 Demands for Force/ Displacement characteristics

If a damper is stimulated with a sinusoidal force, diagram looks like the following graph:

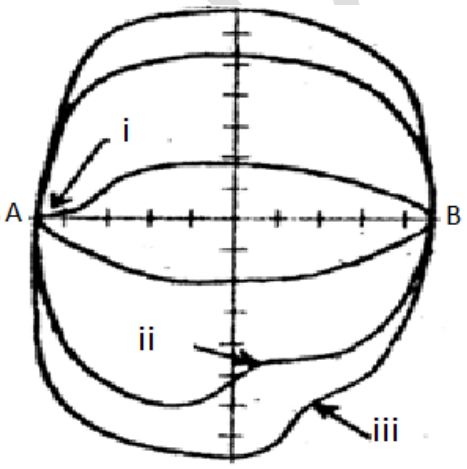
Figure 1: Force v/s displacement diagram



Ideal - Thoraticaly Perfect Curve

Correctly working dampers show the following characteristics in every diagram with different velocities:

- The curve is continuous and free from local vibrational phenomena
- The diagram should be free from jumps (angular intersection at points A or B)
- There should be no sudden changes in the shape of the curve i.e. 'i', 'ii' or 'iii' in loop below



3.2 **Demands for the Force/Velocity Characteristics**

There are two different Damper Force/ velocity characteristic, one for each direction of travel

With this configuration compression and tension result in two different graphs. The force/velocity characteristics must fall within limits which are specified below:

S. No.	Condition	Tolerance Range from nominal
1	In new condition (without attachment elements)	± 15%
2	In new condition (with attachment elements)	± 20%
3	After completion of service trials as per specification during vendor development (with attachment elements)	± 22%
4	In service condition (with attachment elements) during testing by Zonal Railways upto 4 years from date of manufacturing.	± 25%
5	In service condition (with attachment elements) during testing by Zonal Railways beyond 4 years from date of manufacturing	± 30%

4 QUALIFICATION AND INSPECTION REQUIREMENTS

4.1 Test Method

Each test has to fulfill the following conditions

4.1.1 Test Machine

- The test machine should be computer controlled capable of storing and receiving data with facility to take printouts.
- The test machine is integrated in the quality system concerning calibration
- The stiffness of the test machine must not influence the measurement conditions.
- The test machine is able to measure both the compression and the tension forces.
- The test velocity is showing the following formula:

$$V(t) = V.\sin(\omega t)$$

4.1.2 Test Temperature

- All tests should be proceeded at temperature ~~(23±5)^0 C~~ (26±5)^0 C.

4.2 Design conditions

4.2.1 Dimension of the geometry

The manufacturer confirms at the first article testing, that the minimum and maximum lengths of the dampers are kept as specified.

Overall dimensions:

The dimensions showed in the drawings must be recorded by the manufacturer and compared with the specified dimensions.

The following dimensions must be measured:

- Maximum and minimum length of the dampers
- diameter of the dust tube
- Dimension and position of the external housing if existing
- Diameter of the dampers body
- Dimensions of the dampers bearing and its attachment elements

4.2.2 Welding seams at dampers

Only those welding seams which are visible from outside are considered.

The quality of welding seam has to be according to

EN 15085 / EN 25817/ ISO 5817 class B with the following exception:

No. 11: Undercutting is not allowed.

Vendor/sub vendor must have EN 15085-2 CL-1 certification for plant/works (if welding work is required on damper/parts).

At the type approval stage, the manufacturer shall hand over to RDSO necessary documentation for records.

4.2.3 Testing of welding seams

The welding seams have to be checked by non-destructive methods via PT (Penetrant Test) or MT (Magnetic Particle Test)

PT as per ISO 23277

MT as per ISO 17638 and ISO 23278

The test has to be done with two samples per each type of dampers. The test results have to be recorded and sent to RDSO.

4.3 **Testing of dampers**

4.3.1 Production tests

Production test shall be carried out on every damper and record of the same should be kept. The test will be carried out at a stroke of 50 mm (unless is otherwise specified in drawing or purchase order) and at two different velocities.

For LHB Coaches, one velocity should be the same as mentioned in RDSO's Drawings at which damping force is specified and second velocity shall be decided by manufacturer.

For Vande Bharat Coaches, production test should be carried out at two velocities mentioned in RDSO's Drawings at which damping forces are specified.

4.3.2 Visual Check

All the dampers must undergo visual inspection before they are dispatched to make sure there are no signs of:

- Failure
- Indentations
- Damages on the coating or damper itself
- Paint on Rubber bearings and support surfaces of the screws
- Detachment of laceration (deep cut or tear) of the rubber parts of the articulated joints and elastic blocks
- Fluid/oil leakages

4.3.3 Routine Testing

This measurement serves for drawing up the graph described in section 3.1

Table 3: Force velocity characteristics test

General conditions	The test method described in section 4.1 is to apply
Test position	The dampers must be tested in the position according to the real position in the bogie / at angle specified in RDSO's drawings.
Test length	Installation length of the damper in the bogie / mid position
Test amplitude	At specified length and travel. Default travel =+/-25mm
Test velocity	According to table 4
Test conditions	• Measurement with and without attachment elements during first article testing / type test stage. • Measurement with attachment elements during acceptance testing (purchase inspection).
Number of cycles before measuring	10 complete cycles

Measurement	The eleventh cycle is used in order to ascertain for each velocity • The maximum extension force • The maximum compression force
Diagram	• A diagram (force/ displacement) must be recorded for each measurement. • According to this force/ displacement diagram a force/velocity diagram should be draw up • All relevant data must be obvious on the diagram i.e. velocity, force, stroke (amplitude) axis etc.
Analysis / Acceptance Criteria	• The diagram should be in compliance with section 3.1 and 3.2. • Damping forces at the particular velocity should be in tolerance limits mentioned in RDSO's drawing of particular damper.

Table 4: Velocity's for the force/velocity characteristics test

	V (m/s)					
Primary dampers	0.05	0.1	0.15	0.2	0.25	0.3
Vertical dampers	0.05	0.1	0.15	0.2	0.25	0.3
Lateral dampers	0.05	0.1	0.15	0.2	0.25	0.3
Yaw damper	0.005	0.01	~~0.02~~ 0.03	0.05	0.1	0.15

4.3.4 Measurement of the dynamic stiffness

Table 5: Dynamical Stiffness test (Graphical representation should not be much differ at lower amplitude & higher amplitude.)

General conditions	The test method described in section 4.1 is to apply
Test position	The dampers must be tested in the position according to the real position in the bogie / at angle specified in RDSO's drawings.
Test Length	Installation length of the damper in the bogie / mid position
Test amplitude	According to table 6-9

Test velocity	According to table 6-9
Test conditions	• Measurement without attachment elements.
Number of cycles before measuring	10 complete cycles
Measurement	The eleventh cycle is used in order to ascertain for each velocity • The maximum extension force • The maximum compression force
Diagram	• A diagram (force/ displacement) must be recorded for each measurement. • According to this force/ displacement diagram a force/velocity diagram should be drawn • All relevant data must be obvious on the diagram i.e. velocity, force, stroke (amplitude) axis etc.
Analysis / Acceptance Criteria	• The diagram will be in compliance with section 3.1 and 3.2. • Damping forces at amplitudes mentioned in table 6 to 9, under the velocity which is mentioned in RDSO's drawing of particular damper should be in tolerance limits mentioned in RDSO's drawing of particular damper.

Table: 6

Primary dampers :								
	Frequency {Hz} at v_{damper} {m/s}							
Amplitude (mm)	0.02 m/s	0.03 m/s	0.05 m/s	0.07 m/s	0.1 m/s	0.15 m/s	0.2 m/s	0.3 m/s
2	1.59	2.39	3.98	5.57	7.96	11.94	15.92	23.87
4	0.80	1.19	1.99	2.79	3.98	5.97	7.96	11.93
6	0.53	0.80	1.33	1.86	2.65	3.98	5.31	7.95

Table 7:

Vertical dampers :								
	Frequency {Hz} at v_{damper} {m/s}							
Amplitude (mm)	0.02 m/s	0.03 m/s	0.05 m/s	0.07 m/s	0.1 m/s	0.15 m/s	0.2 m/s	0.3 m/s
2	1.59	2.39	3.98	5.57	7.96	11.94	15.92	23.87
4	0.80	1.19	1.99	2.79	3.98	5.97	7.96	11.93
8	0.40	0.60	1.00	1.39	1.99	2.99	3.98	5.96
12	0.27	0.40	0.66	0.93	1.33	1.99	2.65	3.97
16	0.20	0.30	0.50	0.70	1.00	1.49	1.99	2.98

Table 8:

Lateral dampers :								
	Frequency {Hz} at v_{damper} {m/s}							
Amplitude (mm)	0.02 m/s	0.03 m/s	0.05 m/s	0.07 m/s	0.1 m/s	0.15 m/s	0.2 m/s	0.3 m/s
2	1.59	2.39	3.98	5.57	7.96	11.94	15.92	23.87
4	0.80	1.19	1.99	2.79	3.98	5.97	7.96	11.93
8	0.40	0.60	1.00	1.39	1.99	2.99	3.98	5.96
12	0.27	0.40	0.66	0.93	1.33	1.99	2.65	3.97
16	0.20	0.30	0.50	0.70	1.00	1.49	1.99	2.98

Table 9:

Side motion dampers :								
	Frequency {Hz} at v_{damper} {m/s}							
Amplitude (mm)	0.005 m/s	0.01 m/s	0.02 m/s	0.03 m/s	0.05 m/s	0.07 m/s	0.1 m/s	0.15 m/s
2	0.39	0.80	1.59	2.39	3.98	5.57	7.96	11.94
4	0.20	0.40	0.80	1.19	1.99	2.79	3.98	5.97
6	0.13	0.27	0.53	0.80	1.33	1.86	2.65	3.98
20	0.04	0.08	0.16	0.24	0.40	0.56	0.80	1.19
30	0.026	0.05	0.11	0.16	0.27	0.37	0.53	0.80

4.3.5 Measurement of Series stiffness and Damping coefficient (for LHB damper only)

At the type-approval stage the manufacturer shall calculate and ensure the value of series stiffness and the damping coefficient of the damper -articulated joint system or of the dampers alone in the case of particularly flexible articulated joints.

The dampers must be tested in its working position (see assembly drawing) and over the range of displacements and frequencies specified in the table 10.

Table 10

Type	Frequency {Hz}	Amplitude {mm}
Primary suspension	From 4 to 12	± 2.5
Secondary suspension	From 0.5 to 2	± 10
Anti-yaw	From 0 to 9	± 2.6

The dampers must be activated by means of sinusoidal displacements of constant amplitude (see table) and of variable frequency over the entire specified range.

The activation displacement u(t) must be measured in a suitable manner in order to correct it for the components, such as Deformation of the supporting structures and the like, if any, which might alter its value.

At the same time, measure the force delivered by the dampers F(t).

Both quantities, u(t) and F(t) must then be subjected to a Fourier analysis in order to determine the frequency components.

For each frequency, determine the u/F ratio as imaginary number. From the real part of this ratio, determine the value of series stiffness, and from the imaginary part, determine the damping coefficient according to “receptance” theory.

$$\frac{u}{F} = \frac{1}{k} - \frac{1}{\omega d}$$

where k = series stiffness

d = damping coefficient

$\omega = 2\pi f$

$$\mathrm{Re}\left\{\frac{u}{F}\right\} = \frac{1}{k} \qquad i\omega\,\mathrm{Im}\left\{\frac{u}{F}\right\} = \frac{1}{d}$$

The value of the damping coefficient over the entire frequency range specified must not deteriorate beyond 20% of the nominal value which must be observed at the lowest frequency values (1 to 2 Hz).

4.3.6 Measurement at extreme temperature

Table 11

General conditions	The test method described in section 4.1 is to apply.
Test position	The dampers must be tested in the position according to the real position in the bogie / at angle specified in RDSO's drawings.
Test length	Medium installation length
Test amplitude	According to table 12
Test velocity	To be calculated from table 12.
Test conditions	• Measurement with attachment elements. • The test performed after removal of dust cover.
Measurement	1. Measure the dampers at room temperature according to 4.3.3. 2. Cool the complete damper to the specified temperature (-40˚C) and keep it in this condition for 24h then measure the characteristic according to the table below (Table 12). 3. Fit immediately (Loading and unloading time for testing of damper should be lowest possible to minimize the temperature loss upto -30^{0}C) the dampers onto the testing machine prepared for the execution of the test according to the amplitude listed in the table 12 and a frequency corresponding to ¼ the value given in the table 12. Carry on the test until you reach a temperature of -20° C as measured on the body in the proximity of the sealing gasket. 4. Measure the characteristic (Damping Forces) at -20° C with the values given in the table 4. 5. Start the test again as per s. no. 3 above until they have reached the temperature of 0° C. The cycle must be carried on at the frequency given in the table below until a temperature of 40° C is reached. The characteristics (Damping Forces) of dampers have to be measured again at this temperature as per table 4. 6. Start the test again until a temperature of 80° C is reached or until the temperature becomes stable, if lower than 80° C 7. Let the dampers cool down to the room temperature 8. Measure the characteristics (Damping Forces) of dampers at the room temperature as per table 4.

Diagram	• A diagram (force/displacement) must be recorded for each measurement. • According to this force/ displacement diagram a force/velocity diagram should be drawn • All relevant data must be obvious on the diagram velocity, force, stroke (amplitude) axis etc.
Analysis	• The diagram will be in compliance with section 3.1 and 3.2 • There should be no oil leakage at the dampers • There shall be no damages at the rubber bearings (collar, skin) • The diagrams (force/ displacement) of point 1 and point 8 above of the measurement vary only in a range of 5%. • The diagrams (force/ displacement of point 3 and point 5 above of the measurement vary only in a range of 30%.

Table 12

Type	Frequency {Hz}	Amplitude {mm}	Temperature { ° C}	
			T Min	T Max
Primary suspension	7	2.5	-40	80
Secondary suspension	1.6	10	-40	80
Anti-yaw	6	2	-40	80

4.3.7 Leakage Test

Table 13

General conditions	The test method described in section 4.1 is to apply.
Test position	The dampers must be tested in the position according to the real position in the bogie / at angle specified in RDSO's drawings.
Test length	Minimum test length = Compressed Length + 5mm Maximum test length = Compressed Length + 5mm + 75 % of stroke (for information)
Test Stroke	75 % of stroke with a maximum of 100 mm.

Test velocity	Nominal velocity as mentioned in drawing issued by RDSO.
Test conditions	Measurement with attachment elements.
Number of cycles before inspection	20 complete cycles
Inspection	Remove the covers and examine for any oil leakage. There should not be any leakage of oil after completion of test.

4.3.8 Fatigue Test

During the Type Test approval stage following tests shall be done-

- Static test
- Dynamic test

4.3.8.1 Static test

The damper has to be loaded (compressed and expanded) with a static force of 20KN according to section 2.3.1. No damage on the dampers and its attachment elements is allowed after this test.

4.3.8.2 Dynamic Testing of dampers.

The supplier has to prove the specified life of about 1.2 million kilometers with a long-time test as specified below: -

- Test the damper according to section 4.3.3 & as per the following conditions shall be considered for dynamic fatigue test

Item	Velocity (m/s)	Amplitude	Cycles
Primary Vertical Dampers for all type of LHB Coaches.	0.30	± 9.5 mm	minimum $1x10^7$ cycles
Secondary Vertical Damper for LHB AC Coaches	0.20	± 9.5 mm	minimum $1x10^7$ cycles
Secondary Lateral Damper for all coil FIAT Bogie	0.30	± 9.5 mm	minimum $1x10^7$ cycles
Yaw Damper for all type of LHB Coaches.	0.10	± 9.5 mm	minimum $1x10^7$ cycles
Secondary Lateral Damper for Air Spring Bogie` (for LHB coaches)	0.30	± 9.5 mm	minimum $1x10^7$ cycles
Secondary Vertical Damper for Non AC Coaches (for LHB coaches)	0.10	± 9.5 mm	minimum $1x10^7$ cycles

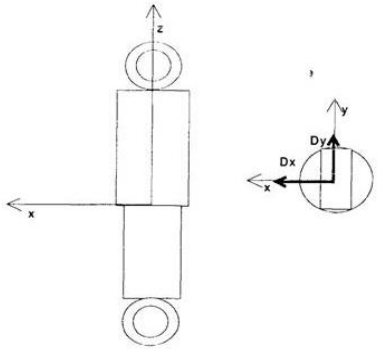
Primary Vertical Dampers (Vande Bharat Coaches)	0.30	± 9.5 mm	minimum $1x10^7$ cycles
Secondary Vertical Damper (Vande Bharat Coaches)	0.30	± 9.5 mm	minimum $1x10^7$ cycles
Secondary Lateral Damper (Vande Bharat Coaches)	0.30	± 9.5 mm	minimum $1x10^7$ cycles
Yaw Damper (Vande Bharat Coaches)	0.10	± 9.5 mm	minimum $1x10^7$ cycles

- The table 14 shows the offset between the dampers and the eyelet's as a example.
- The damper is tested according to the real positioning in the bogie.
- At the end of the tests the damper has to be measured according to section 4.3.3 and damping characteristics (with attachment) should be in tolerance limit of +20 % to - 30% from nominal value.

The characteristics have to be still in the specified figures. The full functionality is still guaranteed. No replacements of any parts allowed during the test.

Table14

Type of dampers	Offset Dx {mm}	Offset Dy {mm}
Primary suspension dampers	5	10
Secondary suspension dampers	13	38
Anti-yaw dampers (if fitted with ball joints)	0	0



4.3.8.3 Dynamic test of silent block

Endurence test of silent block should be done as per EN-13913. Test protocal shall be proposed by the vendor & approved by the RDSO.

4.3.9 Priming Test:

Table: 15

Purpose	To verify the correct function of the damper after the self-priming is done, under normal ambient conditions.
Equipment	Computer Controlled Testing Machine
Test Position	As per RDSO approved drawings of dampers
Test Stroke	As per respective drawing
Test velocity	0.1 m/s
Test conditions	Measurement with attachment elements.
Test Procedure	• At first damper shall be aerated by moving the damper “upright down”. • Mounted the damper in test machine. • Provide stroke & velocity as mentioned in drawing. • Test the damper until the diagram shown no sign of air in the cylinder.
Measurement	Damping force at 0.1 m/s.
Analysis	Damping force should be within the tolerance limit specified in drawing and damping force vs displacement graph shows no sign of air / free stroke.

4.3.10 Paint Fire Resistance Test (On test pieces):

Paint should comply the requirements of EN 45545 (fire protection: Hazard level – HL3 – R7).

4.3.11 Specifications for the Final Acceptance

Table 16

Test	Clause	First Article Testing Homologation	Acceptance Testing (Purchase inspection)	Remarks
Weight	2.3.3	Yes	Yes	Minimum 2 or 2 % samples whichever is more (for acceptance testing).
Surface protection	2.8.1 to 2.8.5	Yes	Yes (2.8.1, 2.8.4 & 2.8.5)	
Dimension of the geometry	4.2.1	Yes	Yes	
Production tests	4.3.1	----	Yes	
Visual check	4.3.2	Yes	Yes	
Routine testing	4.3.3	Yes	Yes	
Welding seams	4.2.2 4.2.3	Yes	Yes	Welding Certificate Visual for 2 nos.
Dynamical stiffness	4.3.4	Yes	----	2 nos. chosen at random in a lot upto lot size of 500 nos. and 3 nos. for 500 <Lot size <1000 and 4 nos. for 1000 <Lot size <2000 and 5 nos. beyond that (Except First Article Testing, test only if it is specially mentioned in order).
Series stiffness and Damping coefficient	4.3.5	Yes	----	----
Extreme temperature	4.3.6	Yes	----	----
Leakage Test	4.3.7	Yes	----	----
Fatigue test	4.3.8	Yes	----	----
Vibrational Qualification	2.3.2	Yes	----	----
Priming Test	4.3.9	Yes	Yes	02 nos during purchase inspection.
Paint Fire Resistance Test	4.3.10	Yes	----	----

NOTE: The quantity and other details on first article testing are given under para 7.

5 QUALITY ASSURANCE, TESTING, FINAL ACCEPTANCE

5.1 Acceptability testing

As indicated in clause 4.3.11

5.2 Product Audit

The manufacturer undertakes to ensure that the manufacturing process produces a series part which corresponds to the type-tested part. Particular attention is given to the conformity with the test criteria.

5.2.1 Quality Records

All testing carried out is to be certified by the manufacturer with an acceptance Certificate according to EN 10204 3. 1B and delivered with the product.

The recorded individual test results will be kept by the manufacturer/supplier for a period of 7 years following delivery and can be viewed upon demand.

5.2.2 Qualification of the lots

For each lot of dampers, the supplier, working in Quality Assurance conditions, shall supply:

- The declaration of the conformity
- The safe data sheets for the materials
- A statement signed by the suppliers' quality control manager

and whatever else is necessary, according to the instructions of the customer as per tender.

5.3 Auditing

RDSO is authorized, following prior notification or otherwise, to audit the final testing by the manufacturer.

6 ORGANISATIONAL AND ADMINISTRATIVE PROVISIONS

6.1 Maintenance instructions

Service and maintenance instructions, together with a list of replacement parts, are to be included in delivery by the manufacturer, containing all data necessary for service and maintenance of the dampers. Do/ not do and probable failures along with their reasons and remedial action/ trouble shooting during the train service/ maintenance also to be mentioned in manual. Each Zonal Railway shall

be supplied with soft copy of these manual where dampers are supplied by a manufacturer of damper.

6.2 Modifications

Modifications which result in the loss of ability to replace the dampers or replacement parts may be carried out only after authorization by IR/RDSO.

7 Procedure for Testing of Prototype Dampers

The vendor shall offer a lot of min. 10 dampers of a particular type for prototype testing at the time of registration. The inspector shall select random 5 dampers from this lot for prototype testing as per para 4.3.11. Sample size for various testing during prototype testing (first article testing) shall be as under:

Test	Clause	Sample size for testing	Remarks
Weight	2.3.3	05 nos.	On 05 nos. selected dampers.
Surface protection	2.8.1	05 nos. (visual)	On 05 nos. selected dampers.
	2.8.2	02 nos.	Out of 05 nos. selected dampers.
	2.8.3	01 nos.	Out of 05 nos. remaining samples.
	2.8.4	05 nos. (visual)	On 05 nos. selected dampers.
Thickness of the paint layer (DFT)	2.8.5	05 nos.	On 05 nos. selected dampers.
Dimension of the geometry	4.2.1	02 nos.	Out of 05 nos. selected dampers.
Visual check	4.3.2	05 nos.	On 5 nos. selected dampers.
Routine testing	4.3.3	05 nos.	On 5 nos. selected dampers.
Welding seams	4.2.2 4.2.3	02 nos.	Out of 05 nos. remaining samples after removing the paint from welding area or 02 nos. unpainted parts may be taken.
Dynamical stiffness	4.3.4	03 Nos.	On 5 nos. selected dampers.
Series stiffness and Damping coefficient	4.3.5	01 nos.	Out of 05 nos. selected dampers.

Extreme temperature	4.3.6	01 nos.	Out of 05 nos. selected dampers.
Leakage Test	4.3.7	01 nos.	Out of 05 nos. selected dampers.
Fatigue test (Static and Dynamic)	4.3.8.1 and 4.3.8.2	01 nos.	Out of 05 nos. selected dampers.
Vibrational Qualification	2.3.2	01 nos.	Out of 05 nos. selected dampers.
Priming Test	4.3.9	02 nos.	Out of 05 nos. selected dampers.
Paint Fire Resistance Test:	4.3.10	Min. 03 Nos.	On test pieces.

8 Regular Procedure for Inspection and Testing of Production Dampers

8.1 Purchase inspection shall be carried out at the premises of manufacturer who are cleared for the regular manufacture of production damper. The following procedure shall be followed for the purchase inspection.

8.1.1 The inspecting authority shall make audit checks of the manufacturing procedure/Internal Quality Assurance System to ensure that the lot offered for inspection is manufactured strictly as per Internal Quality Assurance System and the manufacturer has carried out all tests/inspection during manufacturing stage to ensure that damper offered are strictly to the specification. During such audit checks, the inspecting authority shall also see from the records of 'Internal Quality Assurance' that the raw materials used for the manufacturer of damper is as per approved QAP.

8.1.2 The inspecting authority shall conduct the checks from the offered lot of dampers as per para 4.3.11.

8.1.3 In case any of the samples picked up fail in any of the tests indicated in para 4.3.9, manufacturer shall find out the reason for such failure to the satisfaction of inspecting authority. In case inspecting authority is convinced that the failure was on account of non-implementation of 'Internal Quality Assurance System', the entire lot of dampers shall be rejected. In case, the failure is on account of reasons other than non-implementation or Internal Quality Assurance System, the manufacturer may re-offer the lot after rectifying the defects. However, in such cases double the quantity of sample shall be picked up and tests/checks conducted as per para 4.3.11. In case any of the samples again fails in any of the tests/checks, the entire lot shall be rejected.

8.1.4 In the event of a dispute between the inspecting authority and the manufacturer, the decision of purchaser/RDSO shall be final and binding.

8.1.5 In normal course, testing of production damper offered by the manufacturer shall form part of the 'Internal Quality Assurance System' for which proper record shall be maintained and presented to the inspecting authority on demand.

8.1.6 To ensure consistency in quality of damper, one damper of each type shall be subject to fatigue test in every five years as part of the quality assurance programme. Test shall be conducted by vendors and report shall be submitted to RDSO. Plan and schedule of fatigue test shall be communicated to RDSO. RDSO might depute its personnel to witness the test by suitable means including video call.

8.1.7 Leakage testing of weld parts of dampers (100%) & stiffness/load testing of springs, stiffness testing of silent block/rubber bush used in dampers should be check at specified value/parameter decided by the OEM's before assembly of dampers (sampling plan will be decided by the OEM's & it should be maximum) & record of the same should be kept for verification of RDSO official/inspection official at least warranty period.

9 PARTICULAR REQUIREMENTS

9.1 Manufacturer willing to supply damper for the use of Indian Railways shall register themselves with RDSO.

9.2 The manufacturer shall have adequate facilities for the manufacture and testing of damper conforming to this specification.

9.3 The manufacturers shall have a well-documented 'Internal Quality Assurance System' to ensure sustained quality of product being manufactured and shall submit his internal Q.A.P. in triplicate. 'Quality Assurance System' Shall generally cover the following: -

9.3.1 System to ensure that correct raw material is being used.

9.3.2 System to ensure that components having manufacturing defects are identified and destroyed so that such components are not used during assembly.

9.3.3 System to ensure that bought out components are strictly as per requirements laid down in the specification / drawing.

9.3.4 System to maintain strict control of dimensions and workmanship of components and assembled products.

9.3.5 System to test and establish that the damper manufactured by the firm meets all the requirements laid down is the specification/drawings.

9.3.6 System of periodical calibration of equipment/gauges to ensure accuracy of product.

9.3.7 System to ensure that the quality of bought out hardware items are as per the relevant specifications.

9.4 Manufacturers should have the ISO 9001-2015 Certificate & IRIS certificate for manufacture of dampers.

10 GUARANTEE / WARRANTY

10.1 The supplier shall ensure the efficiency of the dampers over 06 years from the date supply or 05 years from the date of fitment or 1.2 million kilometers in service, whichever is earlier.

During the warranty period if the dampers display any inefficiency they shall be replaced/attended at the expenses of the supplier.

By inefficiency of the dampers it is meant:

- A problem detected in service conditions
- A defect undermining its functionality
- Oil leak or infiltration in the sealing gaskets.
- The rubber of the elastic joints undergoes a deterioration process that undermines its functionality.
- The values of the characteristic do not remain within the tolerance limits specified in section 3.2

10.2 The manufacturer shall furnish a guarantee that each new damper supplied, shall function satisfactorily without attention and in accordance with the requirements of this specification over 06 years from the date supply or 05 years from the date of fitment or 1.2 million kilometers in service, whichever is earlier. A format of the certificate is given at **Appendix-V.**

10.3 The warranty shall survive inspection, payment for and acceptance of the goods, but shall expire over 06 years from the date supply or 05 years from the date of fitment or 1.2 million kilometers in service (whichever is earlier), except in respect of complaints, defects, inefficiency and/or claims, notified to the contractor within 3 months of such date. Any approval or acceptance by the purchaser of the stores of the material incorporated herein shall not in any way limit the contractor's liability.

11 GENERAL

11.1 All welded joints of the damper shall be free from welding defects and shall be sufficiently strong to withstand the loads.

11.2 The damper shall be assembled in such a manner that the damping shall be uniform throughout the stroke.

11.3 The external dimensions, design, construction, characteristics or materials used in the manufacture of the damper shall not be altered by the manufacturer without the prior written consent of RDSO. Unless otherwise specified in the respective drawing, the tolerance in compressed and extended length of all types of dampers shall be within ±3 mm of the specified dimension.

11.4 The damper shall be manufactured and assembled at the manufacturer's own works.

11.5 Damper found to be defective after delivery within the warranty period will be returned to the manufacturer for replacement at his own expenses, not with standing that they may have passed the tests required by this specification and have been accepted by the Inspector.

11.6 Damper shall not be dispatched from the manufacturers works before dispatch memo certificate has been obtained from the Inspector and this certificate shall be forwarded to the office from which the order was issued attached to the invoice as evidence that the dampers have been duly inspected.

11.7 Any minor deviation from drawings/design/testing parameters mentioned in this specification shall be permitted only after approval by Carriage Directorate RDSO.

12 GENERAL INSPECTION

12.1 All the materials or fittings used in dampers shall be subjected to inspection by the Inspecting Authority and shall be compliant to the specification.

12.2 The manufacturer shall supply the necessary man power and appliances for testing and inspection of the dampers and mountings and shall supply to inspector a copy of the test results signed by manufacturer or his representative.

12.3 The Inspecting Authority shall have right to: -

12.3.1 Adopt any means he may think advisable to satisfy himself that the materials or fittings as per the specifications are actually used in the construction.

12.3.2 Take samples of components/parts for such tests, as he may consider necessary by an approved metallurgist selected by him whose report shall be final and binding on the manufacturer.

12.3.3 Reject any material or fittings, which do not conform the relevant specifications or good practice. These shall be marked in a distinguishable manner and shall be disposed of in such a manner as the inspecting authority directs. Such rejected parts shall be replaced by the manufacturer without extra charges.

12.3.4 In the event of a dispute between the inspecting authority and the manufacturer the decision of the purchaser shall be final and binding.

13 TRAINING AND INFRASTRUCTURAL FACILITIES.

Whenever required, the manufacturer shall provide the requisite training to the staff of purchaser to use, repair and overhaul the dampers. He shall also supply 25 set of maintenance/instruction manuals in soft (in pen drive)/ hard copy indicating dimension of critical items and its permissible wear, specification and quantity of oil etc. to RDSO. In addition to this, firm will provide maintenance/ instruction manual to any consignee who demands it. In event of any change in manual/ instruction, it will be intimated to RDSO and all the consignees with updated soft/ hard copy of maintenance/ instruction manual.

14 PACKING

The manufacturer shall ensure that dampers are suitably packed in wooden / corrugated boxes/ polyethylene covers/ bubble sheet using suitable cartons to prevent ingress of foreign matter and damage during handling and storage.

15 SPECIAL CONDITIONS:

a) LHB damper & VB Damper for Passenger coaches require higher reliability. As these components are critical for reliable performance of Bogie and its sub-assemblies, Vendors will be required to source the critical parts (i.e Oil seal/O-ring, piston rod, piston valve, silent block/rubber disc etc.) from OEMs/suppliers who have supplied the critical parts (i.e Oil seal/O-ring, piston rod, piston valve, silent block/rubber disc etc.)) to Railway Industries / Automobiles / Defence Sector and the components have completed satisfactory performance for minimum three years (proof to be enclosed by firm). The same details to be incorporated in the QAP.

b) Moreover, vendor is also permitted to have collaboration with a OEM having 3-year experience for supply of dampers to Railway Industries / Automobiles / Defence Sector. In such case vendor shall entering into a valid technical MOU / agreement with OEM. The MOU should clearly state that the OEM undertakes to fulfill support obligation with respect to technology up-gradations as and when required for the LHB dampers & VB dampers, even in case the MOU is rescinded at some later stage.

c) Vendor along with their OEM (if applicable) or principal / allied /sister concern / group company shall have adequate facilities / infrastructure for manufacturing, designing, and testing and quality control requirements of LHB dampers & VB dampers as stipulated in "APPENDIX IV" of this specification.

d) If any test outsourced from outside agency same should be clearly specified in QAP and got approved.

e) Since Dampers for LHB Coaches/ VB coaches are a safety related item, in-service trials shall be necessary for each design before full clearance is given for vendor registration as "Vendors for Developmental Order" status for manufacture and supply of Dampers for LHB coaches/ VB coaches.

f) The Dampers for LHB Coaches/ VB coaches of a particular design shall be subjected to field trials on a minimum of ten coach sets on IR's system for vendor registration as "Vendors for Developmental Order" status for manufacture and supply of **Dampers for LHB coaches & VB coaches.** The field trial period shall be as follows:

- For LHB coach dampers: 12 months from the date of coach commissioning/the actual period in the field.
- For VB coach dampers: 18 months from the date of coach commissioning/the actual period in the field.

g) In case of any failure during field trials attributable to poor design or material, **one additional chance may be given to repeat the service trail subject to submission of details analysis report for causes of failure & corrective action taken and accepted by RDSO.**

h) After completion of service trial period, two samples of the Dampers for LHB Coaches/VB coaches shall be subjected to the tests in RDSO/Rly/Firm/NABL approved lab to verify the properties laid down in Appendix-I of this Specification/ Approved drawing. In case these values are beyond permissible limits, the design of that type of Dampers for LHB coaches/ VB coaches shall be deemed to have failed the service trials. Replacement of dampers removed for testing to verify the properties shall be made by the

respective firms. In case of any failure during service trials attributable to poor design or material, the service trials shall be repeated. RDSO shall decide the cause of failure after investigation in this regard.

i) A Vendor shall be considered eligible for upgradation to "Approved Vendors" status on completing successful supply of a minimum of 250 coach sets of the particular type of Dampers for LHB Coaches/ VB coaches as a 'list of RDSO vendors for developmental order' along with the fulfillment of conditions mention in latest apex ISO document of RDSO for "Vendor-Changes in approved status" (document no. QO-D-8.1-11 latest).

j) After type tests of a particular design are approved by RDSO, vendors shall ensure that Dampers for LHB Coaches/ VB coaches to the particular specification are supplied with components manufactured from the sources as indicated at the time of design approval and included in QAP. However, in case of change of sub vendor or source of any component of Dampers for LHB Coaches/ VB coaches is changed or any additional new source is introduced, the firm shall get approval of their modified QAP from RDSO before manufacturing and supply of Dampers for LHB coaches/ VB coaches. The vendor should provide the detailed information of the source changed/ additional source introduced along with the documentary evidences for the record of this office. Firm shall validate the source in all respects i.e. material, manufacturing process, quality control and inspection & testing etc. to conform to originally approved design and process. Compliance to all obligations including guarantee/warrantee shall remain the responsibility of vendor.

k) The type test shall be witnessed by authorized representative of RDSO at the time of design approval of the vendor at their own test facility.

Any additional tests if considered necessary shall also be arranged by vendor free of cost. All necessary arrangements for witnessing the type test of Dampers for LHB Coaches/ VB coaches at firm's premises shall be done by the vendor. RDSO reserves the right to witness the type test again if changes in approved design/drawings are carried out which are likely to alter design / performance characteristics of the Dampers for LHB Coaches/ VB coaches.

l) In case design of any component of a damper changed, prior information given to RDSO with details of changes to be made. On the basis of reasons for change and extent of modification, RDSO will decide whether afresh service trials / type testing of damper is required or not. Status of registered vendor will not be changed if, there is any design up-gradation / improvement in approved design / drawing of damper to meet the upgraded requirements of Indian Railways, with approval of Competent Authority.

m) **In case design/source of critical components (i.e. silent block, piston rod, oil seal, O-rings & end mounting rubber bush of primary vertical damper etc.) of damper is changed. Fresh Type test shall be required except surface protection test & welding seams test.**

16 SUBMISSION OF OFFER:

16.1 Vendors desirous of seeking approval from RDSO for supply of dampers for LHB coaches/ VB coaches as per this specification, shall apply online and submit their proposal as per ISO guidelines and also accompanied by the documents containing the following information to RDSO:-

1) Dimensional drawing of Dampers for LHB Coaches/ VB coaches.

2) Weight of one Dampers for LHB Coaches/ VB coaches.

3) Whether proposed Dampers for LHB Coaches/ VB coaches is being used by any other rail-road system? If yes, details regarding quantity, type of stock, max. operating speed, type of service, average annual running kilometers, life cycle obtained by the user rail-road and maintenance cycle followed by them shall be furnished.

4) Details of deviation from the specification.

5) Content of indigenous and imported items in offered Dampers for LHB Coaches/ VB coaches.

6) Expected life cycle in operating and environmental conditions enumerated in this specification.

7) A write-up giving broadly the maintenance requirements on time/distance basis along with the facilities that would be needed for proper maintenance/upkeep of the offered Dampers for LHB Coaches/ VB coaches.

8) A detailed write-up giving the details of "Quality Assurance System" being followed for manufacture of the offered items.

9) Details of manufacturing and testing facilities available with the manufacturer.

16.2 New Vendor must apply for all types of dampers of LHB coaches or VB coaches in a single application. Application for individual/partial dampers of LHB or VB dampers shall not be entertained.

16.3 The information as received above shall be used for preliminary evaluation of the firm's capability in meeting with the requirements of this specification.

16.4 The firm shall be required to submit a internal Type Test Report of a proposed design after the preliminary evaluation carried out found satisfactory.

16.5 RDSO reserves complete right in granting approval or otherwise to a firm.

Appendix-I

REQUIREMENTS OF DAMPERS FOR LHB COACHES-

1) Requirements of dampers for LHB coaches are as under-

i) **Primary Vertical Dampers**

Requirements of Primary Vertical Dampers shall be as per RDSO drawing no. RDSO/CG/DRG/21047 Alt. 2 or latest.

ii) **Secondary Vertical Damper for LHB AC Coaches**

Requirements of Secondary Vertical Dampers shall be as per RDSO drawing no. RDSO/CG/DRG/21046 Alt. 2 or latest.

iii) **Secondary Lateral Damper for all coil FIAT Bogie**

Requirements of Secondary Lateral Dampers shall be as per RDSO drawing no. RDSO/CG/DRG/21045 Alt. 2 or latest.

iv) **Yaw Damper**

Requirements of Yaw Dampers shall be as per RDSO drawing no. RDSO/CG/DRG/21048 Alt. 2 or latest.

v) **Secondary Lateral Damper for Air Spring Bogie**

Requirements of Secondary Lateral Dampers shall be as per RDSO drawing no. RDSO/CG/DRG/21049 Alt. 2 or latest.

vi) **Secondary Vertical Damper for Non AC Coaches**

Requirements of Secondary Vertical Dampers shall be as per RDSO drawing no. RDSO/CG/DRG/21018 Alt. 2 or latest.

2) Requirements of dampers for VB coaches are as under:

i) **Primary Vertical Dampers**

Requirements of Primary Vertical Dampers shall be as per RDSO drawing no. RDSO/CG/DRG/DRAFT-1.

ii) **Secondary Vertical Damper**

Requirements of Secondary Vertical Dampers shall be as per RDSO drawing no. RDSO/CG/DRG/ DRAFT-2.

iii) Secondary Lateral Damper

Requirements of Secondary Lateral Dampers shall be as per RDSO drawing no. RDSO/CG/DRG/ DRAFT-3.

iv) **Yaw Damper**

Requirements of Yaw Dampers shall be as per RDSO drawing no. RDSO/CG/DRG/ DRAFT-4.

APPENDIX-II

Details of acceptance criteria of various tests during Prototype Testing (First article testing) of dampers

S. No.	Test Parameters	Specifications	Mode of Inspection	Acceptance Criteria	Remarks
1	Dynamic Stiffness	Measurement as per clause 4.3.4 of this specification	Computer Controlled machine	As per Specification	(Graphical representation will not be much differ at lower amplitude & higher amplitude.)
2	Series Stiffness & Damping Co-Efficient	Measurement of series stiffness and damping coefficient as per clause 4.3.5 of this specification	Actuator Testing Machine	As per Specification	
3	Extreme temperature	Measurement of extreme temperature as per clause 4.3.6 of this specification for velocity specified on drawings.	$\frac{F_{(-20°C)} - F_{(+40°C)}}{F_{(-20°C)}} \leq 30\%$ $\frac{F_{(+20°C\ after)} - F_{(+20°C\ before)}}{F_{(+20°C\ after)}} \leq 5\%$	**Force denoted as** / **Force measured at** F(-20˚C) / At -20°C for test parameters specified on drawing F(+40˚C) / At +40°C for test parameters specified on drawing F(+20˚C), before / At +20°C for test parameters specified on drawing, before starting the test process F(+20˚C), after / At +20°C for test parameters specified on drawing, after completion of test	
4	Fatigue test	Static Load test-20KN in compression & extension as per clause 4.3.8.1of this specification	Computer Controlled Testing Machine	No Structural Damage. Damping force after test should be as per respective RDSO drawing.	
		Dynamic/endurance test as per clause 4.3.8.2 of this specification for ten million cycles	Computer Controlled / Hydraulic / Crank type Testing Machine	As per para. 4.3.8.2 of Specification	Test procedure as per para. 4.3.8.2.of this specification.
	Vibration test	Vibration Testing as per clause 2.3.2 of this specification	Computerized Vibration Shaker	No Structural Damage. Damping force after test should be as per respective RDSO drawing.	
5	Coating	Paint adhesion test as per ISO2409	Standard tape test	No peel off	
		Resistance to salt environment as IS0:9227 for 720 hrs	Salt spray testing machine	No red rust after 720 hrs.	
6	Leakage test	As per para. 4.3.7 of this spec	Computer Controlled Testing Machine	No oil leakage after test.	
7	Priming Test	As per para. 4.3.9 of this spec		Damping force within tolerance limit specified in drawing.	
8	Paint Fire resistance Test	As per para. 4.3.10 of this spec	As per EN 45545	As per EN 45545 (HL3-R7)	

Note: Sample quantity shall be as per clause 7 of this specification

Signature			
Name & Designation	Prepared By: Sameer Kumar/ SSE/D(VDG)	Checked By: Satyendra Kumar/ADE/VDG	Approved By: Shobhit Pratap Singh/Dir./VDG

APPENDIX-III

Details of acceptance criteria of various tests during Prototype Testing (First article testing) / Routine Testing of Dampers (Acceptance testing)

S. No.	Test Parameters	Specifications	Mode of Inspection	Acceptance Criteria	Remarks
1	Appearance	No Dents ,Cracks, Pitting, Sharp Edges, Leakage of Oil, uniform coating & no damage on coating etc.	Visual	As per specification	
2	Production Testing	Damping Force to be recorded at two different frequencies as per spec.	Damper Testing Machine	Force to be within specified values	
3	Routine Testing	Measurement as per clause 4.3.3 of this specification	Damper Testing Machine	As per specification	
4	Dimension	As per approved drawing	Steel scale/ vernier	To be within tolerance	
5	Weight	Weight of complete damper	Electronic weighing machine	As per drawing/ QAP approved	
6	Hydraulic Oil	Type and viscosity of hydraulic oil	----------	As per approved QAP / Drawing	
7	Packing	Packing to ensure no damage during transit	visual	As per clause 2.4 & 14 of this specification	
8	Welding	Welding seam non-destructive test	ISO 5817/ EN25817/ EN15085	Under cutting is not allowed"	
			ISO 23277, ISO 17638 & ISO 23278	WPS/ PQR Records for the lot	
9	Coating	DFT of paint as per clause 2.8.5 of this specification	DFT tester	Should confirm	
		Colour shade as per clause 2.8.4 of this specification	Visual	Should confirm	
10	Priming Test	Measurement as per clause 4.3.9 of this specification	Damper Testing Machine	Damping force within tolerance specified in drawing.	
11	Marking of Damper	As per clause 2.7 of this specification	Visual	Should confirm	

Note: Sample quantity shall be as per clause 4.3.9 of this specification for Acceptance Testing and as per clause 7 for first article testing.

Signature			
Name & Designation	Prepared By: Sameer Kumar/ SSE/D(VDG)	Checked By: Satyendra Kumar/ADE/VDG	Approved By: Shobhit Pratap Singh/Dir./VDG

APPENDIX-IV

Schedule of the Technical Requirement (STR) for manufacturing, testing and quality control of Dampers for LHB Coaches/ VB coaches.

1) GENERAL INFRASTRUCTURES:

The manufacturer shall have adequate space and covered area with material handling facility of adequate capacity covering the following activities:

- Raw Material Storage.
- Laboratories for material testing.
- Machining Facilities as per Quality Assurance Plan.
- Manufacturing facilities along with assembly line.
- Dust free enclosed environment for assembly and testing.
- Painting facility.

2) MANUFACTURING FACILITIES:

2.1 The following manufacturing facilities shall be available with the firm:

S. No.	Facility	Remarks
1	**Welding machine**	The firm shall have the availability of special purpose welding machine / robotic welding machine and fixture for welding work on the main shell (casing tube), protection covers, damper eye etc.
2	**Machining facilities**	The firm shall have following machining facilities in-house or at Sister / Allied concern for manufacturing / machining of child parts of dampers: • Grinding Machine • CNC Machine • Lapping / Buffing Machine (if required, as per manufacturing process) • Drilling OR Tapping Machine • Power saw machine for cutting of shaft and tubes Outsourcing of machining facilities with experienced sub-vendors under quality control of vendor (who supply dampers to IR) is permitted. However, same shall be intimated by vendor during initial registration.
3	**Identification Marking Machine**	The firm shall have identification marking machine for identification marking on the dampers as per the specification.

		Outsourcing of marking facility is permitted. However, same shall be intimated by vendor during registration.
4	**Oil filling machine**	The firm shall have PLC based oil filling machine, capable of oil filling in the dampers during assembly to minimise manual intervention.
5	**Component Cleaning Machine**	The firm shall have pressurised water jet component cleaning machine to clean the damper components with suitable cleaning agent.
6	**Ultrasonic Cleaning Machine**	The firm shall have ultrasonic cleaning machine of adequate capacity for cleaning of the critical components of damper before assembly.
7	**Painting Facility**	The firm shall have the environment friendly painting facility for damper components which shall consists of a painting line covering all the processes/requirements involved and suitable system for drying of the paint in a sequential manner so that the dirt and dust does not get embedded with paint. In case, the firm is not having painting facilities in-house, the firm shall take prior approval to outsource the painting process.
8	**Hydraulic / Hydro pneumatic Press**	The firm shall have hydraulic press of suitable capacity along with required fixtures to press the silent block / end mountings in the eye-ring of dampers and other small job works during assembly of dampers.
9	**Assembly Line**	The firm shall have required number of jig/ fixtures along with tooling of suitable size & capacity and these shall be installed in proper sequence for the assembly of damper.
10	**Leakage testing facility for the weld parts of dampers.**	The firm shall have leakage testing machine/arrangement for welded parts of dampers with suitable facility.

3) INSPECTION & TESTING FACILITIES

The firm shall have the following inspection & testing facilities:

S. No.	Facility	Remarks
1	**Laboratory for material testing**	The firm shall have laboratory facilities of material testing for metallic as well as rubber components as per the requirements of the drawings & specification(s).

		In case, the firm is not having complete laboratory facilities in-house, the firm shall take prior approval to carry out the test from NABL accredited testing laboratory / Govt. Lab having capability to get the tests done as per the requirement of specification / approved drawing.
2	**Damping force testing machine**	The firm shall have a computer controlled servo hydraulic testing machine, to check the damping force of the dampers on variable frequency at different strokes in accordance to specification.
3	**Testing machine for twisting and cardanic angles**	The firm shall have testing facilities with suitable fixtures for testing of twisting and cardanic angles of the dampers in assembled condition as per the requirements of the drawings / specification.
4	**Endurance test machine**	The firm shall have a separate computer controlled/ servo hydraulic / crank type machine endurance testing machine with suitable fixtures for endurance testing of dampers inhouse OR at Sister / Allied concern OR at original works (in case of approval as additional unit) as per the requirements of the specification.
5	**Vibration testing machine**	The firm shall have a vibration testing machine with suitable fixtures for vibration testing of dampers as per the requirements of the specification. In case, the firm is not having Vibration Testing Machine, the firm shall take prior approval to carry out the test from 'International Centre for Automotive Technology (ICAT), Manesar' or 'Automotive Research Association of India (ARAI), Pune' or any other government accredited testing laboratory having capability to get the test done as per the requirement of specification.
6	**Surface roughness tester**	The firm shall have surface roughness tester for surface finish of cylinder & piston rod of dampers as per the requirements.
7	**Elcometer**	The firm shall have Elcometer/ dry film thickness gauge to check the paint thickness, as per the requirements of specification.
8	**Measuring Instruments/ Gauges**	Vernier, micrometer, bore gauge, bevel protector, dial indicator, inner caliper, thread ring & plug gauge, radius gauge, filler gauge, pitch gauge, angle gauge etc. The firm shall maintain the above said instruments duly calibrated

		for inspection / checking of the components, as per the requirement.
9	**Salt Spray test**	~~The firm shall have a Salt Spray test testing machine with suitable fixtures for Salt Spray test of dampers as per the requirements of the specification~~. ~~In case, the firm is not having Salt Spray test facility in-house, the firm shall take prior approval to carry out the test from NABL accredited testing laboratory / Govt. Lab having capability to get the tests done as per the requirement of specification.~~ Salt Spray test shall be carry out from NABL accredited testing laboratory / Govt. Lab having capability to get the tests done as per the requirement of specification.
10	**Environment Chamber**	The firm shall have an environment chamber in-house OR at Sister / Allied concern OR at original works (in case of approval as additional unit) for Measurement of damping forces at extreme temperature as per the requirements of the specification.
11	**Stiffness/Load testing machine**	**The firm shall have stiffness/load testing machine facility for the spring used in dampers as per the requirements.**
12	**Millipore test apparatus**	**The firm shall have Millipore testing facility to verify any contamination on cleaned parts before assembly of dampers.**

4) Quality control requirements:

4.1 Firm shall have an internal system of checking of chemical properties of the steel as well as rubber components or through NABL accredited laboratory.

4.2 The firm shall have a system of component level traceability right from raw material to the finished product stage.

4.3 There shall be proper stacking of raw material and their record. FIFO system should be implemented, especially for non-metallic components. Non-metallic components shall be kept in proper dust & moisture free atmosphere.

4.4 The firm shall submit a Quality Assurance Plan (QAP) in the standard format, for the product detailing various manufacturing aspects for approval.

5) Qualification of Man Power

5.1 The Quality Control Section shall be separately headed by a full time technical expert having a minimum bachelor's degree in Mechanical/ Automobile/ Mechatronics with at least 5 years of experience or diploma in Mechanical/ Automobile/ Mechatronics with at least 8 years of experience. He shall be free from day-to-day production & testing responsibilities. He shall be mainly responsible for development for product, failure analysis, planning corrective and preventive action, control over raw material, devising actions in case of difficulties in achieving the parameters etc.

5.2 Production/ inspection activities shall be headed by a graduate engineer with at least 5 years of experience or a diploma holder with at least 8 years of experience. He shall be actively involved in day-to-day activities of stage inspection / compliance of QAP etc.

5.3 ~~Welders shall be qualified in accordance with prevalent National / International standard.~~

6) General

Requirements of infrastructure & facilities for type testing & manufacturing in clause 1, 2 and 3 of this Annexure are bare minimum requirements. Any other facilities required to comply this specification or required for fully functional performance of dampers shall also be ensured by the vendor.

However, vendor may also propose for alternate methodology/ processes for manufacturing / type testing, which might require different set of M&P and tools. For such alternate of methodology & process, vendor shall establish that such M&P and facilities are adequate for manufacturing & testing of dampers and compliance of this specification.

APPENDIX-V

QUALITY ASSURANCE & GUARANTEE CERTIFICATE

(Reference – Clause 10 of specification)

No :. …… Dated ……

Railway : ……..

P.O. No. : …… Dated ……

Quantity : …… Consignee ……

Damper Description & S. Nos.

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i) THIS IS TO CERTIFY THAT THE DAMPERS INDICATED IN THIS PURCHASE ORDER HAVE BEEN SUBJECTED TO OUR INSPECTION AND TEST PROCEDURES AND ARE FOUND TO CONFORM TO THE ORDER/ DRAWING/ SPECIFICATION REQUIREMENTS.

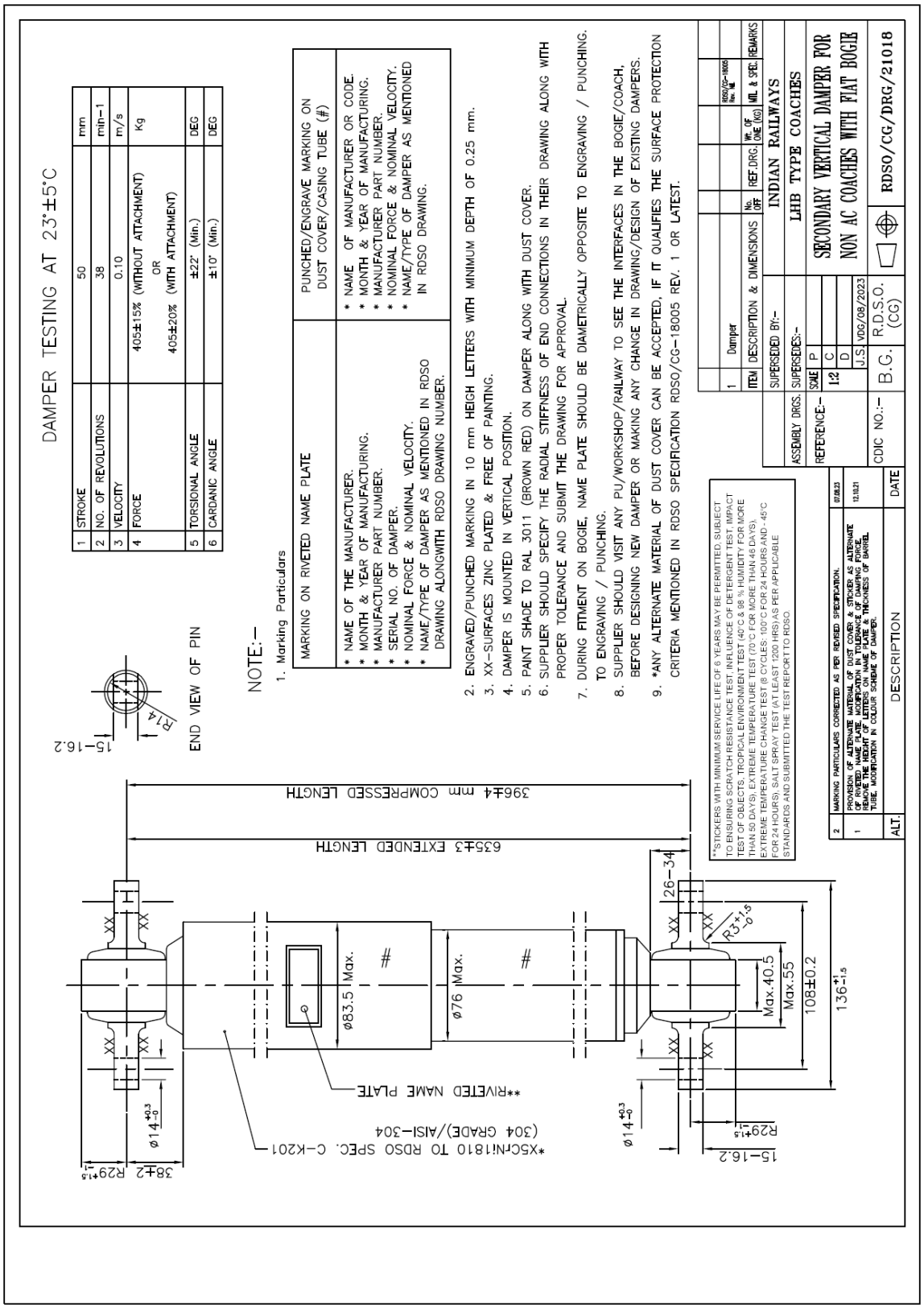
ii) THE QUALITY CONTROL PROCEDURES IN RESPECT OF THIS SUPPLY ARE IN ACCORDANCE WITH OUR QUALITY MANUAL.

iii) THIS IS TO CERTIFY THAT EACH DAMPER SUPPLIED AGAINST THIS PURCHASE ORDER SHALL FUNCTION SATISFACTORILY AS PER CLAUSE 10 OF SPECIFICATION NO. RDSO/CG-18005 (LATEST ISSUE).

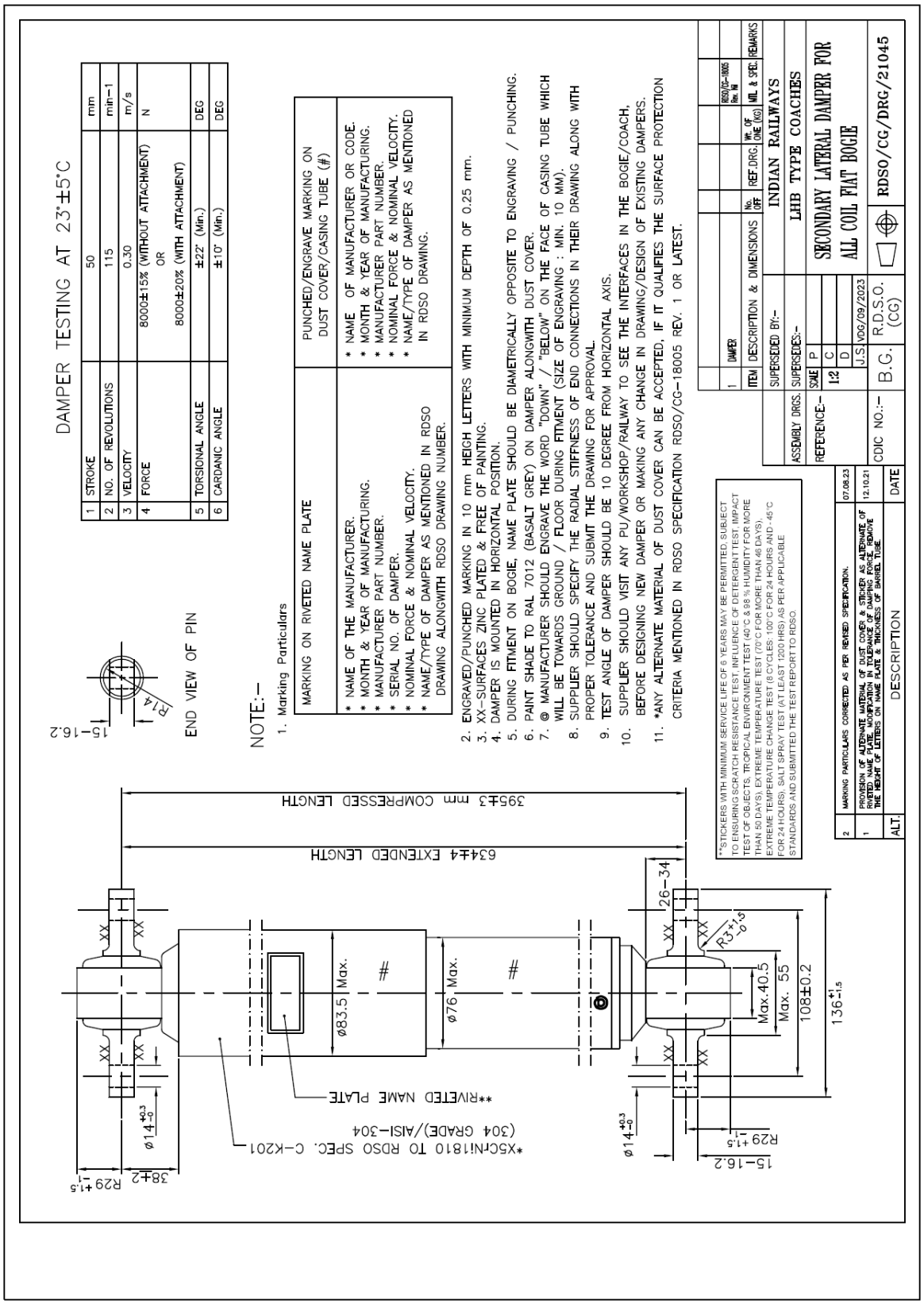
Q.C. INCHARGE

(SIGNATURE & SEAL OF THE MANUFACTURER)

DATED:



Signature			
Name & Designation	Prepared By: Sameer Kumar/ SSE/D(VDG)	Checked By: Satyendra Kumar/ADE/VDG	Approved By: Shobhit Pratap Singh/Dir./VDG



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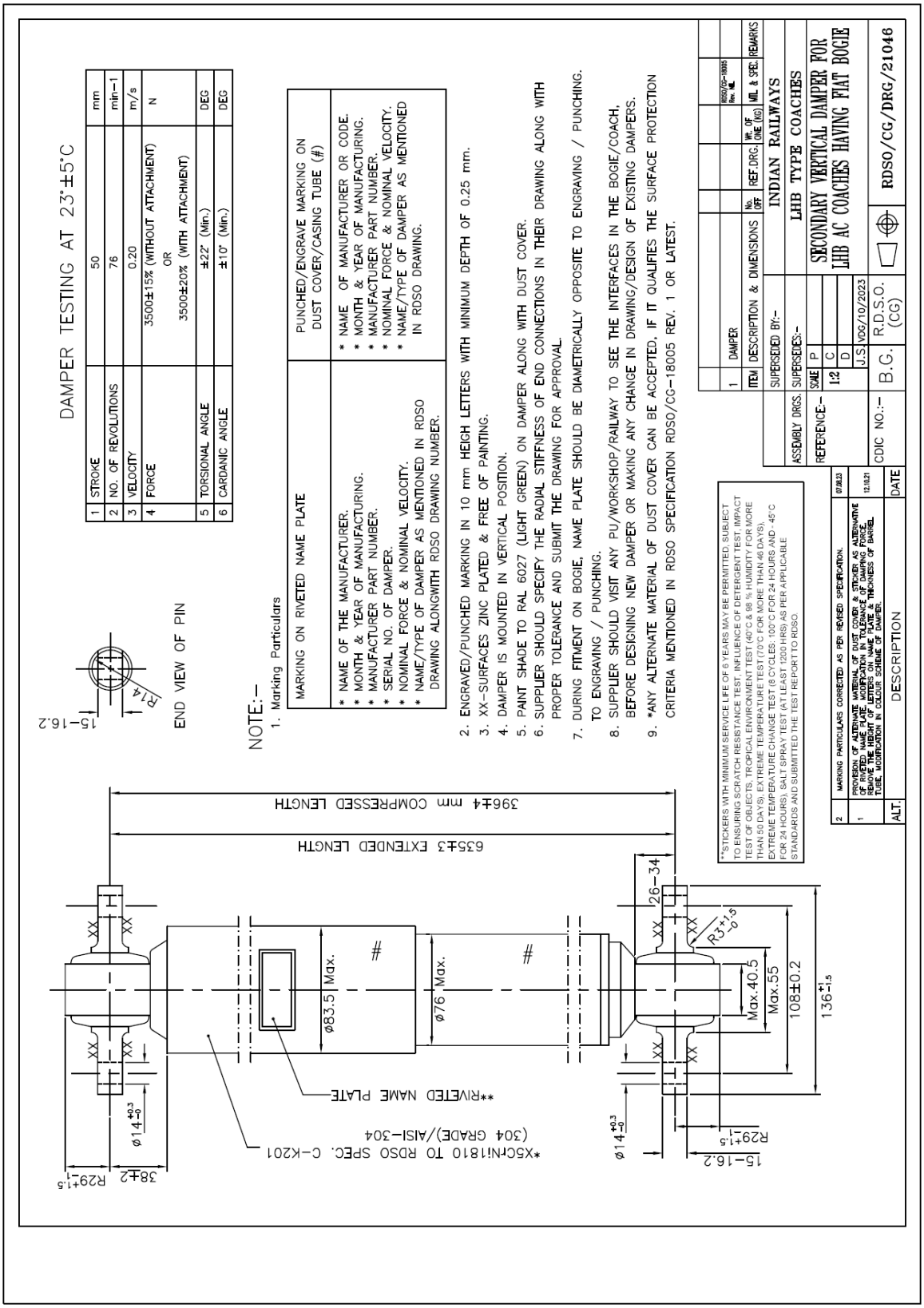

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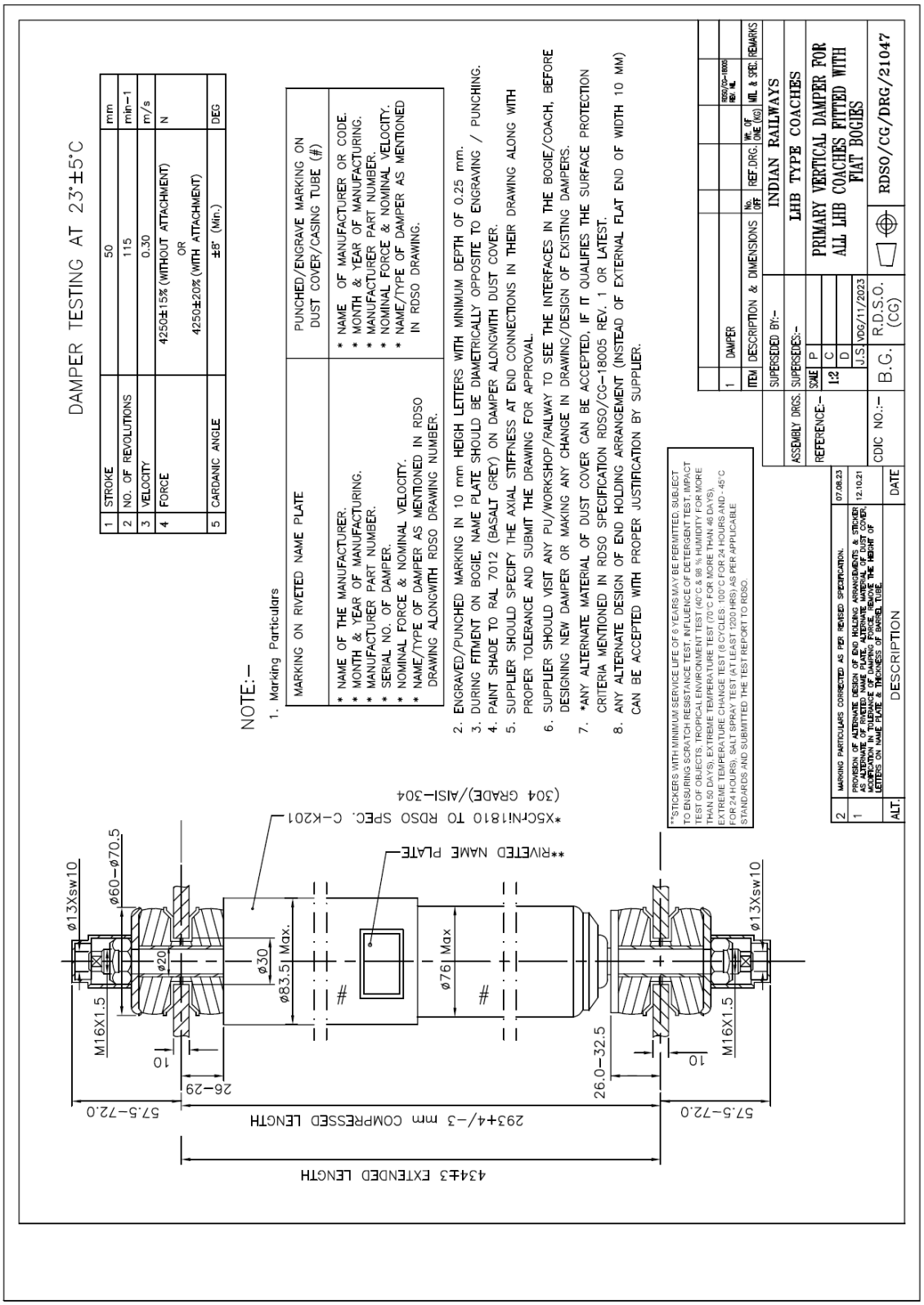

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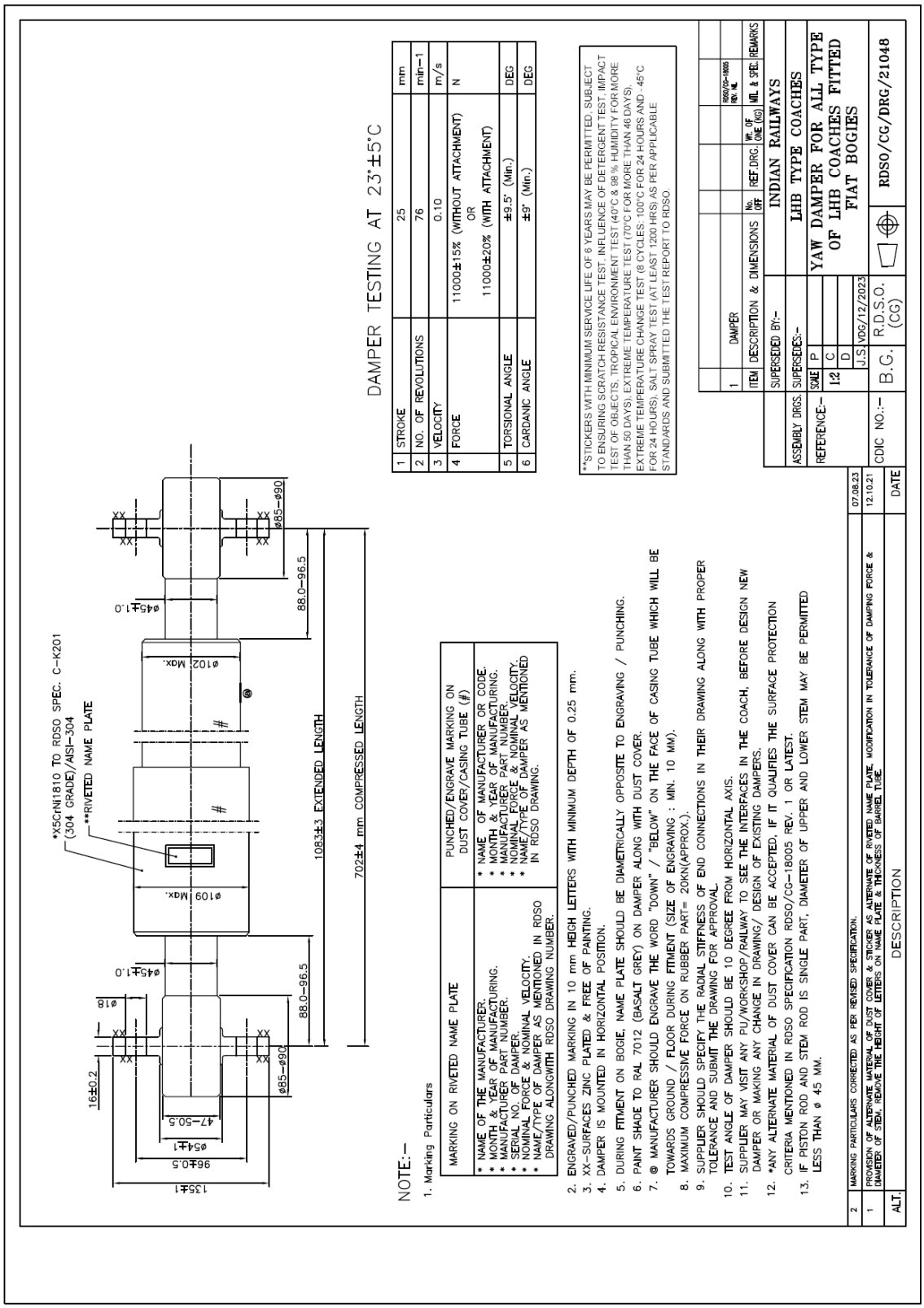

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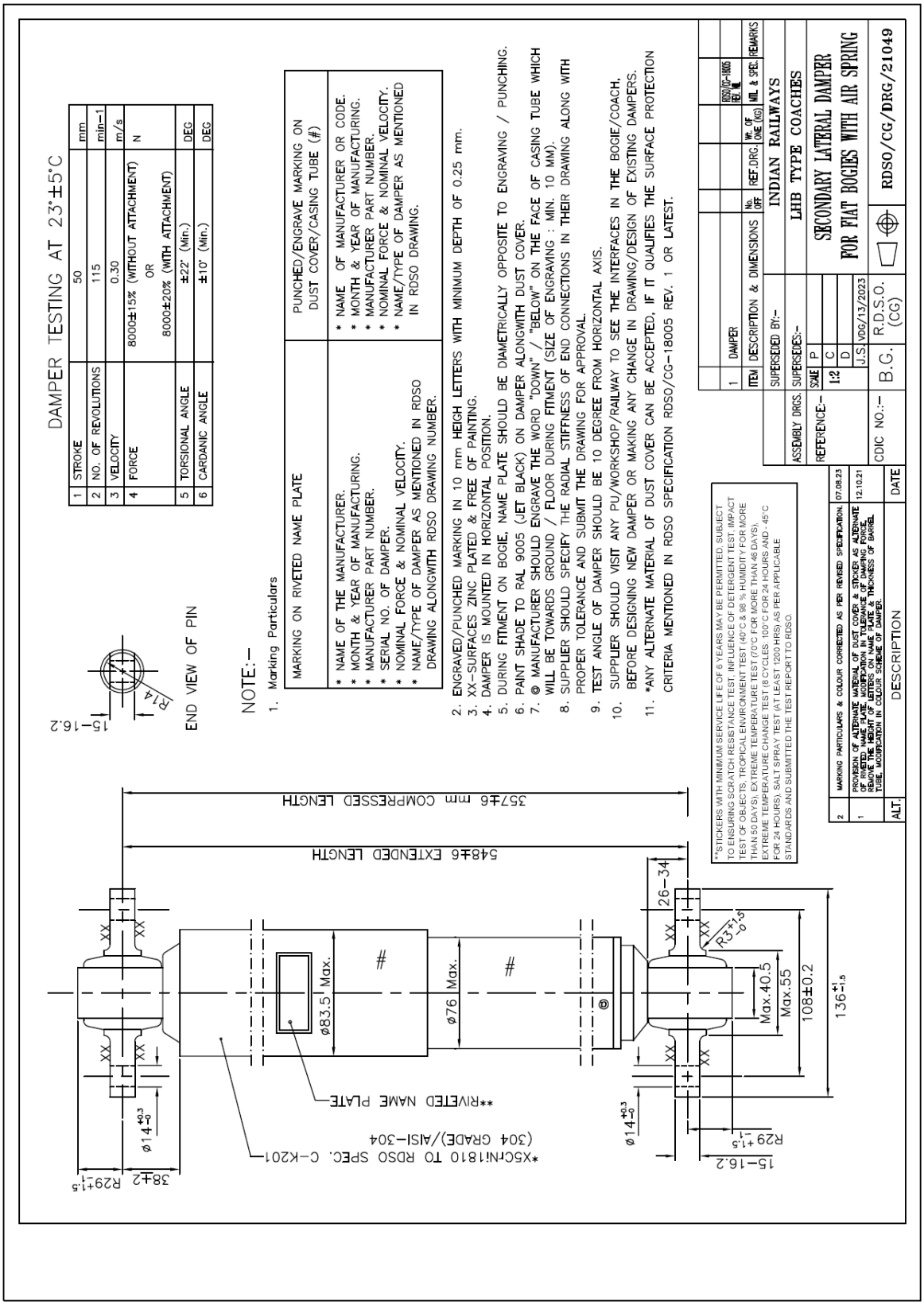

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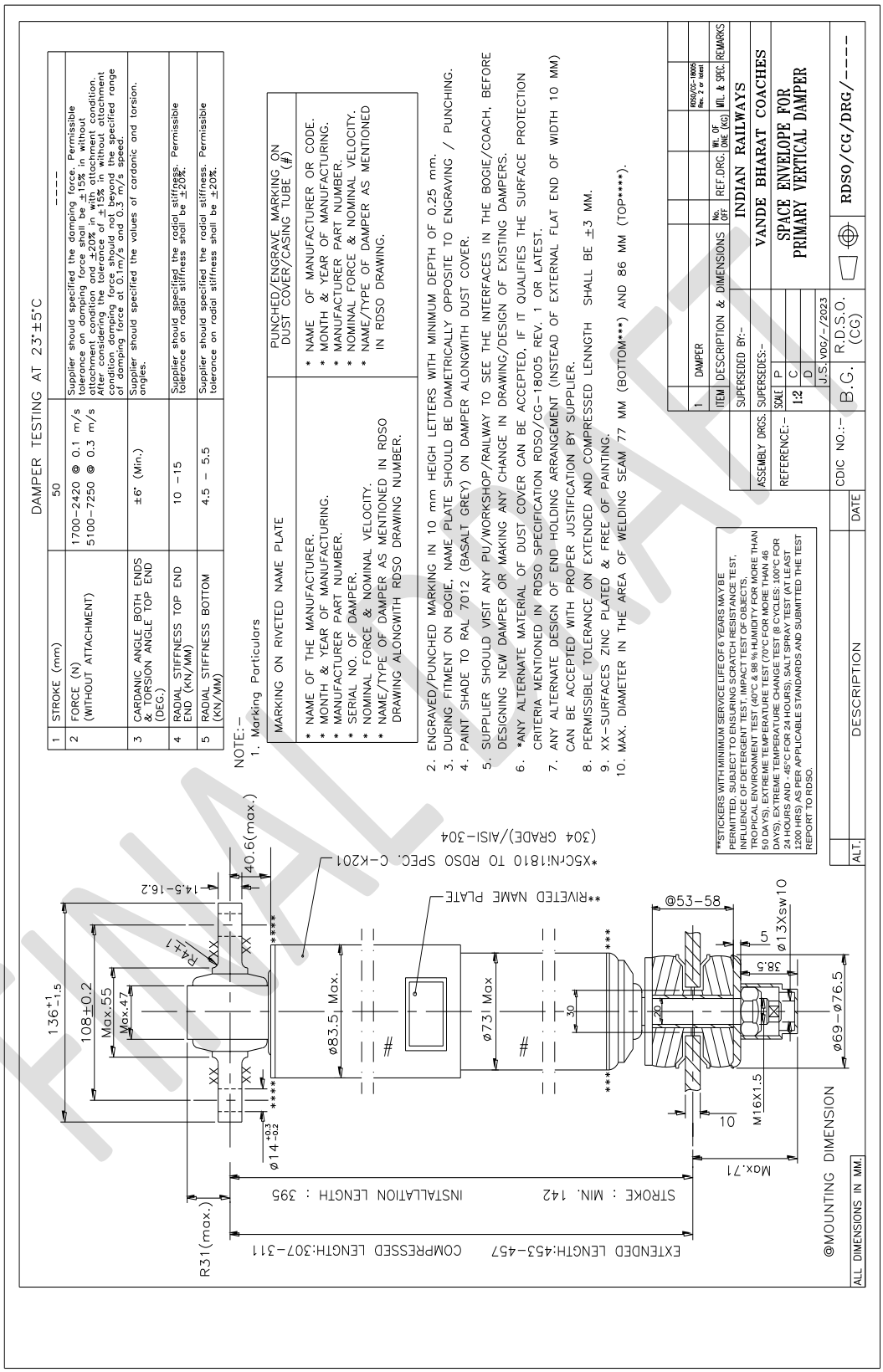

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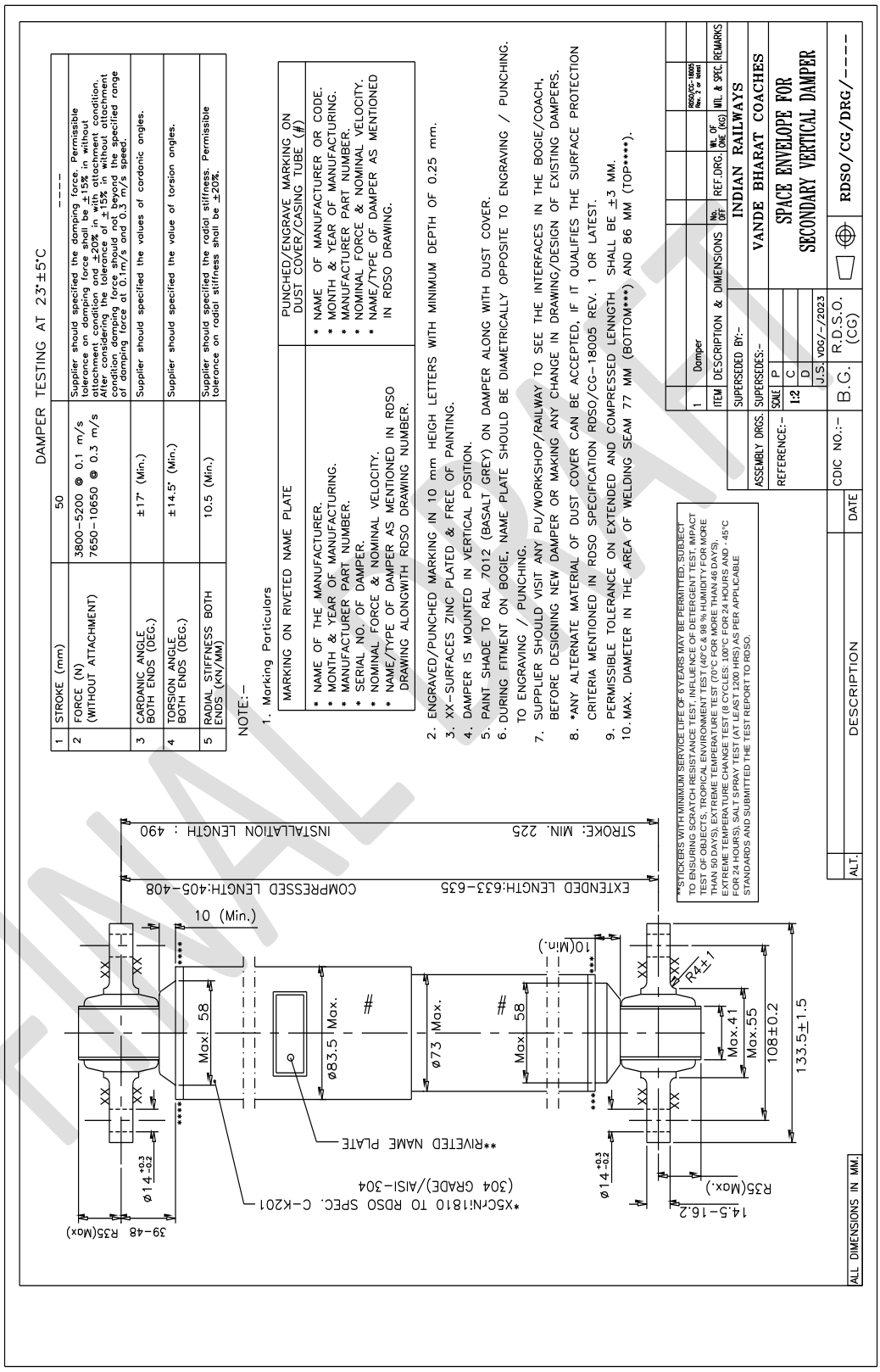
Name & Designation	Prepared By: Sameer Kumar/ SSE/D(VDG)	Checked By: Satyendra Kumar/ADE/VDG	Approved By: Shobhit Pratap Singh/Dir./VDG

*0.3 velocity only for reference for Secondary vertical & secondary lateral damper (for Vande Bharat).



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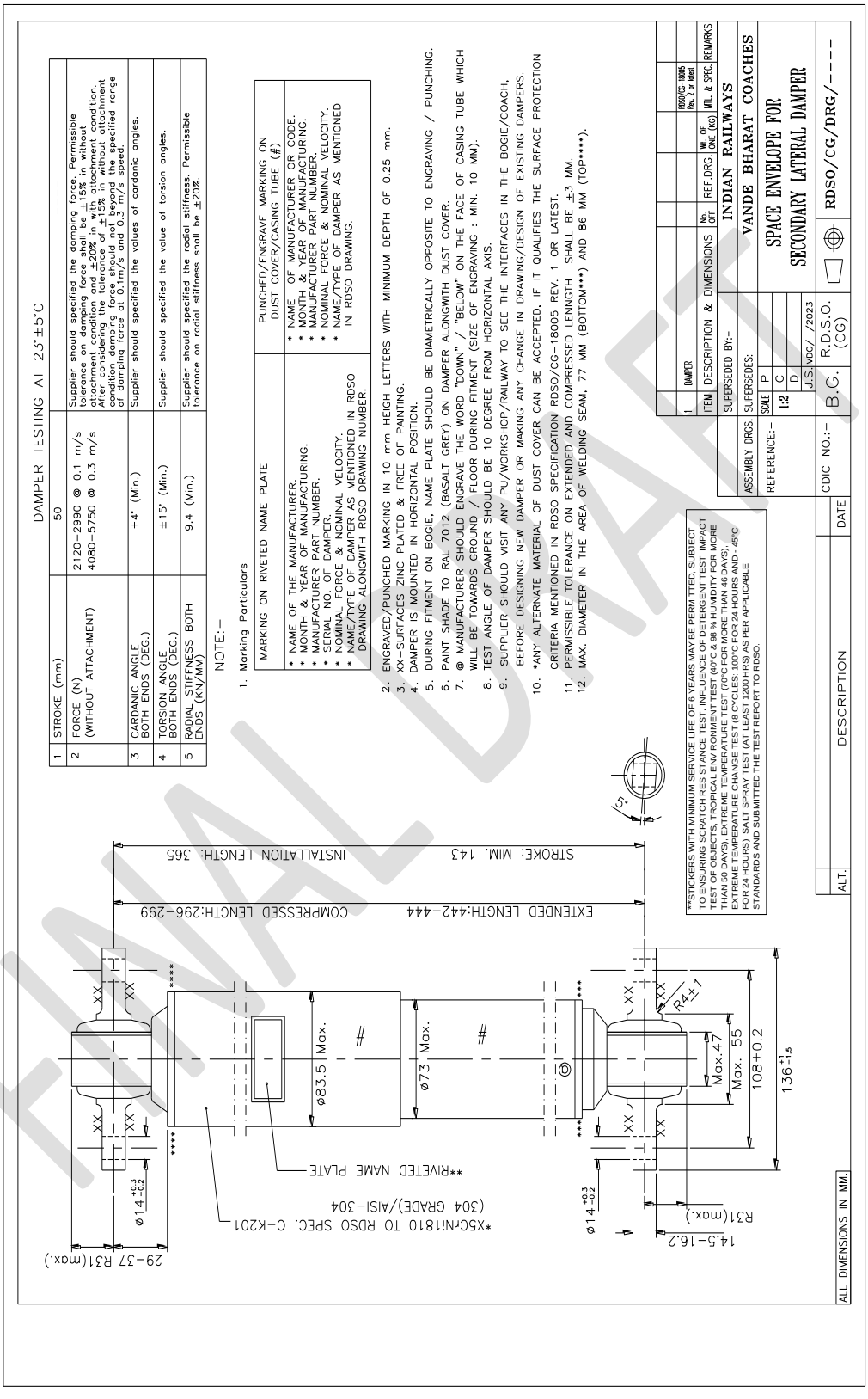

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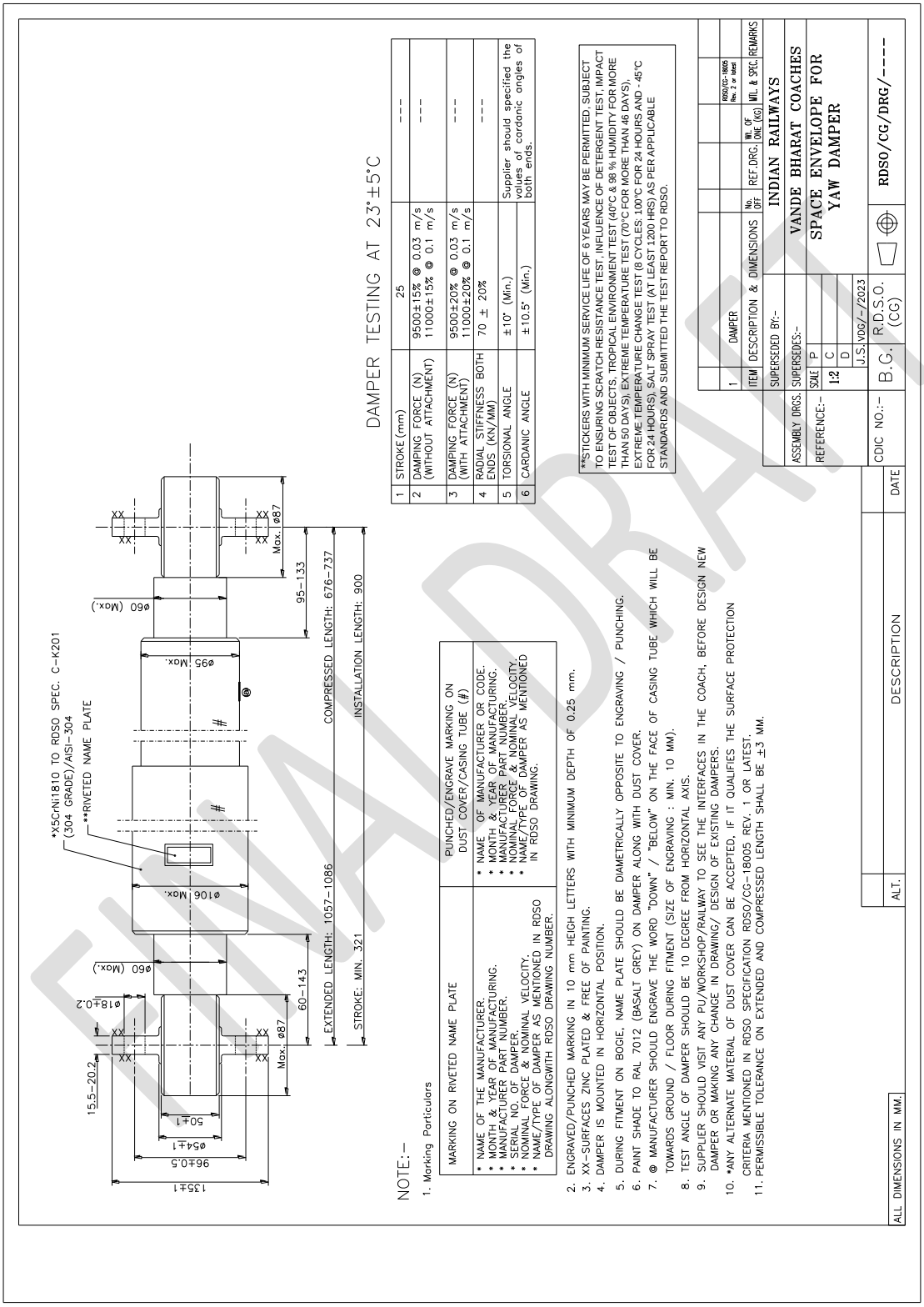

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