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**GOVERNMENT OF INDIA**  
**MINISTRY OF RAILWAYS**

**TECHNICAL SPECIFICATION OF  
HYDRAULIC DAMPERS FOR CONVENTIONAL LOCOMOTIVES  
EXCEPT WDM3D (EQUALISER LESS BOGIE) LOCOMOTIVE**

**No. MP.0.49.00.16  
(Revision - 02)**

**October' 2018**

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## TECHNICAL SPECIFICATION OF HYDRAULIC DAMPERS FOR CONVENTIONAL LOCOMOTIVES EXCEPT WDM3D (EQUALISER LESS BOGIE) LOCOMOTIVE

### 1. SCOPE

This document covers the technical specifications for vertical & lateral hydraulic dampers for Conventional locomotives except WDM3D locomotive (With equalizer less bogies).

### 2. DEVIATION(s)

If deviations from original design, dimensions etc. are desired by tenderer, specific proposals with reasons shall be submitted to the purchaser. Commencement of manufacture shall not be done till the purchaser grants clear authorization for acceptance of the deviation(s).

### 3. MINIMUM GENERAL REQUIREMENTS OF THE FIRM

The firm shall be met minimum testing & manufacturing infrastructure to RDSO STR No. MP.STR.VL-01.01.16 (Revision-01 or Latest).

### 4. TECHNICAL REQUIREMENTS

#### 4.1 Dimensions & Damping Capacities

The Hydraulic Damper shall conform to the latest version of the concerned RDSO Drawing including dimensions, damping capacities at room temperature condition. The damper shall be easy to overhaul and adjustable as per requirements.

#### 4.2 Operating environmental conditions:

4.2.1 The damper shall be resistant to the following operating environmental conditions to which it may be exposed during service:

- Projection of ballast
- Exposure to oil or petroleum
- Exposure to organic waste
- Wind, rain, snow, coal dust, sand storms
- Sand, brake and ferric oxide dust (abrasion of wheels, brake blocks and tracks)
- Saline spray
- washing plant agent (both acids and alkalis)
- 100% humidity

4.2.2 The damper shall be required to function safely at operating temperature in the range from - 10°C to 70 °C. After operating in these extremes, the damper shall be required to fully recover its functionality. Furthermore, the damper shall not display any fluid leaks or any sign of failure or cracking in the damper components.

Salt spray test (Saline spray) to be done as per ISO-9227/ASTM B-117 and remaining environmental conditions shall be monitored in the field.

#### 4.3 Surface protection

All the parts of the damper in contact with the ambient air shall be protected from corrosion. The protection shall be ensured either by the nature of materials used or by suitable painting / surface treatments.

Damper material shall be compatible with following paints:

Primer: High solid epoxy primers, High solid alkyd primers

Paint: Aliphatic polyurethane enamels or two part epoxy paint

#### 4.4 Strength

The construction of Hydraulic Damper shall be such as to withstand the static compressive axial load of 3 tonnes (when fully closed) and a tensile load of 3 tonnes (when fully extended) without any failure, damage or permanent change in damping characteristic at nominal velocity and Stroke shall be  $\pm 9.5$  mm or reduction in service interval. All welded joints of the Hydraulic Damper shall be free from welding defects and shall be sufficiently strong to withstand the loads intended.

#### 4.5 Reliability

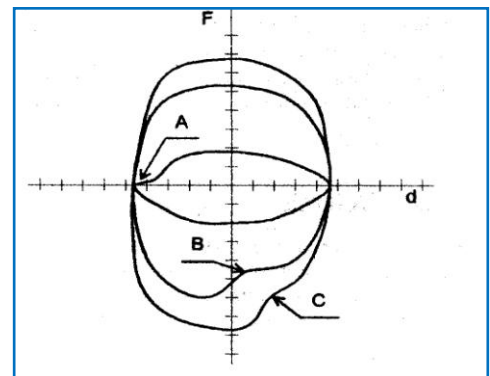
Reliability of the component shall meet the following locomotive reliability goals. Failure per locomotive year needing warranty replacement shall also not exceed 0.010. Failure per locomotive year causing line failure and unscheduled replacement shall not exceed 0.007. Failure means leakage of oil, deterioration in damper performance by 30% or more, breakage of any part of damper.

#### 4.6 Force - Displacement Characteristic

The shape of the Force - Displacement curve or Hysteresis Cycle should be regular and symmetrical as shown here.

The hysteresis cycle should be free from:

- flex as shown in this figure with letter A, B & C
- Local vibrational phenomena
- Jumps and sudden change in the shape of the curve



#### 4.7 Overall Damping Characteristics

The overall damping forces on the compression and extension strokes of the damper, taken separately, shall be as specified in the drawing(s).

The Hydraulic Damper shall be assembled in such a manner that the damping shall be uniform throughout the stroke i.e. the damping characteristics shall not have any sudden deviation or changes throughout the stroke.

The stipulated tolerances and requirements shall apply at all points within the required working stroke of the Hydraulic Damper.

#### 4.8 Twisting and Cardanic angles and Radial stiffness of Spheri bloc:

The twisting and cardanic angles of damper shall be as per specified in the drawings. Bushing radial stiffness shall be more than 20 KN/mm.

The test is to be carried out as per procedure given in Annexure -I.

#### 4.9 Damper Oil

The details of damper oil including type, viscosity and amount of the damper oil shall be provided by the supplier.

#### 4.10 Performance characteristics & Maintainability

The dampers shall be of robust construction and shall be rebuildable type. It shall be possible to recondition and recalibrate it to "as new" conditions. It shall have degressive or blow off feature to limit the maximum forces created by severe track conditions, where piston speed may reach 0.30 m/sec. The force rate shall be linear only up to a certain limit. Maximum force even at higher speeds shall not be more than 25% of the force specified as given in relevant drawing at 0.10m/sec.

#### 4.11 Dust Cover and Casing Tube

The joint shall be proven strong enough between piston eye and dust cover shall be done to prevent breakage at the joint. Casing tubes shall be made of steel by accurate and precision

Welding process or of seamless tube and similarly protection cover also be sufficiently strong and similarly protection cover shall also be strong to increase the life of dampers.

#### 4.12 Positive Locking of Piston and Piston Rod

Due to higher forces encountered at higher operating speeds, there is a possibility that piston can rotate and free itself from piston rod. Therefore, proper locking of piston with piston rod shall be ensured by appropriate method

#### 4.13 Sealing Arrangement

The damper should protected against ingress of dust along with piston rod by using suitable sealing arrangement with better wiping properties, provision of additional dust lip etc.

#### 4.14 Internal Design

It shall have all the constructional features to reduce friction, provide protection against dust and ensure long life. The internal mechanism shall have provision so that in any odd situation, the force of oil goes beyond a prescribed limit; the system shall take action automatically to prevent the failure of the damping system. The valve system shall be noise free and there shall also be arrangement to ensure absence of metal to metal contact in the piston & guide.

#### 4.15 Surface finish of cylinder & piston rod:

A high degree of surface finish of the order of 0.1 to 0.3  $\mu\text{m Ra}$  for piston rod shall be maintained during manufacture.

#### 4.16 Vibrational characteristic

The dampers shall be able to withstand the vibration levels of the intended application in primary / secondary suspension stages of locomotive bogie. Particularly yaw damper shall be specially designed to control small amplitude sinusoidal bogie rotational movements.

Damper shall function under exceptional accelerations for 5 hours as per IEC: 61373):

Locations	Primary vertical	Secondary Lateral/yaw
Vertical	+/- 50 g	+/- 6 g
Lateral	+/- 5g	+/- 3g
Longitudinal	+/- 5g	+/- 5g

Vibrational Test of Hydraulic Damper shall be done during the prototype inspection or when a new design is introduced or when there are any significant design alteration/quality issues.

#### 4.17 Leakage

The damper shall operate without excessive loss of oil throughout its operating life. Oil loss shall be considered excessive when there is visible evidence of accumulation of oil in the form of drip on the body of the damper.

#### 4.18 Salt spray test

Surface treatment must have durability against minimum 240 hours salt spray test as per ISO 9227/ASTM B-117. The result of test for degree of rusting shall be conforming to Ri 1 as per ISO 4628-3 and adhesion of paint shall be conforming to 0 until 1 (any squares may not come off) as per ISO 2409

Salt spray test shall be carried out during the prototype inspection or when a new design is introduced or when there are any significant design alteration/quality issues.

### 5. ENDURANCE TESTING OF HYDRAULIC DAMPERS

Endurance Testing of Hydraulic Damper should be done during the initial approval of a supplier as RDSO approved source for supply of Hydraulic Dampers to Railways/ PUs, or when a new design is introduced or when there is any significant design alteration.

Endurance Testing of Hydraulic Dampers shall be undertaken as per the “Endurance Testing Procedure” enclosed in the **Annexure II**.

**6. GUARANTEE / WARRANTY**

The manufacturer shall guarantee for service life of dampers i.e. 10, 00,000km or 4 years from the date of commissioning, whichever is earlier, even in the severest track and running condition as prevalent on Indian Railway system. Guarantee/Warranty shall be given as per Annexure-Annexure III.

**7. SAMPLING**

Dimensional check as per drawing – 10 Nos. from every Batch of 100 no., or 5 no. per batch if less than 100 nos.

Physical testing – 5 per Batch of 100 no. or 3 no. per batch 5 no. per batch if less than 100 nos.

**8. Deliverables**

Manufacturer shall supply maintenance/instruction manuals, indicating dimension of critical items and its permissible wear, specification, quantity of oil, sectional features etc. to the user Railways.

**9. MARKING**

Marking identification plate should be of ‘Aluminium’ and should be fixed by ‘Aluminium’ rivets. The Hydraulic Dampers shall be marked in 10 mm height letters by punch mark and minimum depth of 0.25mm on outer surface at bottom side of the damper with Manufacturer’s name or code, Serial No., Type of Damper, Rated Capacity, Month & Year of manufacture, “IR” & RDSO drawing No.

**10. PACKING**

The manufacturer shall ensure that Hydraulic Dampers are suitably packed in wooden box/ Cartons with separators for each damper to prevent ingress of foreign matter and damage during handling and storage.

**11. OVERHAULING INTERVAL**

The dampers shall be overhauled after 4 years.

**12. FIELD TRIALS**

After fitment of the component on locomotives, approval may be considered after satisfactory field performance as per ISO procedure. Field performance shall be monitored as per format at Annexure- IV.

**13. STORAGE**

The hydraulic damper shall be stored in a cool and dry place.

**14. VENDOR CHANGES IN APPROVED STATUS**

All the provisions contained in RDSO’s ISO procedures laid down in document no. QO-D-8.1-11, dated 12.09.2018 or latest (Titled “Vendor changes in approved status) and subsequent version/amendment thereof, shall be binding and applicable on the successful vendor/vendors in the contract floated by Railways to maintain quality of products supplied to Railways.

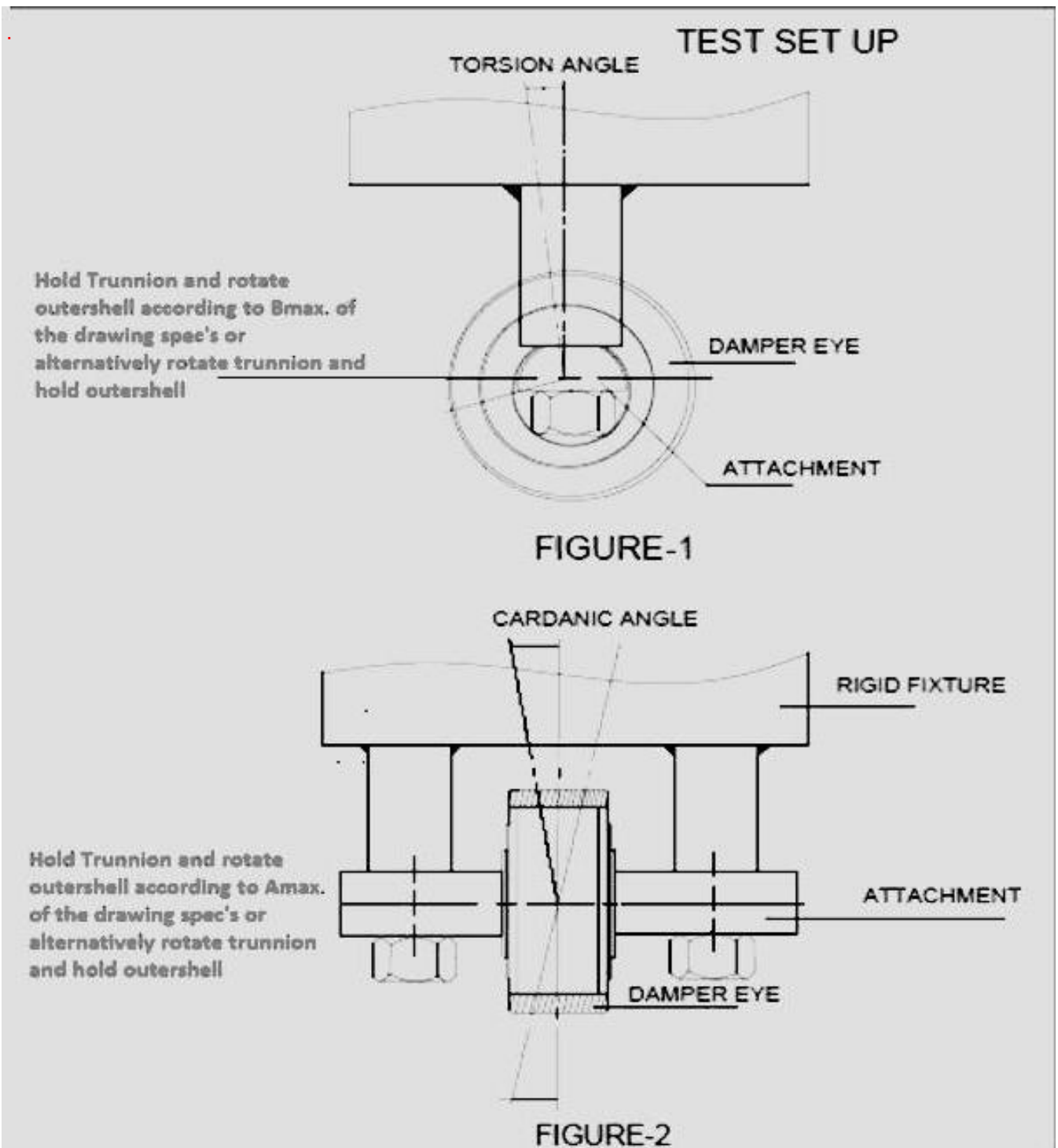
**15. INSPECTION**

Prototype inspection of Dampers under this specification shall be carried out by Motive Power Directorate/RDSO/Lucknow and regular inspection shall be carried out by the Inspecting Agency specified in the purchase order.

**Annexure I**

**TESTING PROCEDURE OF CARDANIC, TWISTING AND RADIAL STIFFNESS OF HYDRAULIC DAMPERS FOR ALCO LOCOMOTIVES EXCEPT WDM3D (WITH EQUALIZER LESS LOCO BOGIES):**

This test shall be conducted as per test set up is to be arranged as per figure 1 & 2. Clamp the attachment trunnion or bolt through holes in trunnion. In total apply 3 load cycles in one rotation direction. Rotate the inner part with reference to the outer shell starting at no preload up to required angle. The force shall be applied to rotate the silent block up to required angle as per drawing. The process shall be done in three times, during fourth cycle, force can be applied to rotate the silent block up to required angle as per drawing and force is being released freely to obtain its original position and subsequently cardanic angle and twisting angle is recorded. The same process shall be followed for Radial stiffness.



## ENDURANCE TESTING PROCEDURE FOR HYDRAULIC DAMPERS FOR HYDRAULIC DAMPERS FOR ALCO LOCOMOTIVES EXCEPT WDM3D (WITH EQUALIZER LESS LOCO BOGIES)

After ascertaining the damping characteristics and strength test, the hydraulic damper samples to be tested shall be subjected to endurance testing as follows:

### .1 Procedure

Two of the samples that have passed the tests under Para 4.1 to 4.18 shall be randomly selected for endurance testing.

The hydraulic dampers shall be tested in their normal plane of operation.

The hydraulic damper shall be connected to the testing machine with its flexible end mountings in the same manner as it is done on the locomotives. No additional flexible elements shall be used for this purpose.

The endurance testing machine shall enable keeping one end of the hydraulic damper fixed and the other end oscillating at 1.67 Hz with amplitude of  $\pm 9.5$ mm from mean position corresponding to a maximum velocity of 10 cm/sec. In addition, a side load shall be applied which shall be equivalent to 50% of torsion angle or conical angle, whichever is greater

Hydraulic damper shall thus be subjected to a total 3 million cycles. The damper oil temperature should not exceed 70°C temperature during the endurance test.

After completion of 8 lakh, 16 lakh, 24 lakh and 30 lakh cycles each, the hydraulic damper shall be removed from endurance testing machine and re-tested for overall damping characteristics as mentioned above after it cools to room temperature so that the damping characteristics test is carried out with the hydraulic damper at a temperature between 27° C to 33° C inclusive. The necessary data should be recorded as per the Proforma enclosed at **Annexure – I C**. A continuous record of endurance testing shall be maintained in the log sheet as per the Proforma placed at **Annexure – I D**.

The cyclic working on endurance testing machine shall preferably be continuous except for short intervals when hydraulic damper is removed for checking their capacity or when circumstances are beyond the control of testing agency e.g. power failures etc.

However, Manufacturers may carry out the endurance testing at more severe conditions than specified above.

### .2 Criteria for Acceptance

After completion of recommended endurance cycles as above, the sample hydraulic dampers shall be considered to have passed this endurance test if:

- a. No damage or distortion to damper components or oil leakage occurs.
- b. The damping characteristics do not deteriorate beyond  $\pm 20\%$  of rated damping capacity upto 16 lakh cycles and  $\pm 25\%$  beyond that.

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**DAMPER PERFORMANCE DURING / AFTER ENDURANCE TEST**

<b>Product:</b> Vertical hydraulic damper / Lateral damper		<b>Capacity (Kg):</b>
<b>Application:</b> Primary / Secondary		<b>RDSO Drawing No:</b>
<b>Sample No:</b>		
<b>Test Dates:</b>	<b>Start:</b>	
	<b>Completion:</b>	

S.No.	Endurance Test Stage	At Constant Stroke of $\pm 9.5$ mm						At Constant Frequency of 1.67 Hz					
		At Piston Velocities of						At Piston Velocities of					
		20 (mm/sec)		60 (mm/sec)		100 (mm/sec)		20 (mm/sec)		60 (mm/sec)		100 (mm/sec)	
		Comp	Expn	Comp	Expn	Comp	Expn	Comp	Expn	Comp	Expn	Comp	Expn
1.	Initial												
2.	After 8 Lakh Cycles												
3.	After 16 Lakh Cycles												
4.	After 24 Lakh Cycles												
5.	After 30 Lakh Cycles												

**LOG SHEET FOR ENDURANCE TESTING DATA OF HYDRAULIC DAMPERS**

<b>Product:</b> Vertical hydraulic damper / Lateral damper		<b>Capacity (Kg):</b>	
<b>Application:</b> Primary / Secondary		<b>RDSO Drawing No:</b>	
<b>Sample No:</b>			
<b>Test Dates:</b>	<b>Start:</b>		
	<b>Completion:</b>		
<b>Stroke (mm):</b>		<b>Frequency (Hz):</b>	<b>Velocity (cm/sec):</b>

Sl. No.	Date	Started time	Stopped time	Total hours	No. of cycles	Cumulative no. of cycles completed	Temperature of damper (°C)	Remarks

**Annexure III**

**QUALITY ASSURANCE & GUARANTEE CERTIFICATE**  
 (Reference – Clause 6 of Specification No. MP.0.49.00.16)

No. ....	Dated:.....
Railway : .....	
P.O. No. : .....	Dated:.....
Quantity : .....	Consignee:.....
Hydraulic Damper Description: .....	
.....	

- i. THIS IS TO CERTIFY THAT THE HYDRAULIC 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 AND AS PER APPROVED QUALITY ASSURANCE PLAN.
- iii. THIS IS TO CERTIFY THAT EACH HYDRAULIC DAMPER SUPPLIED AGAINST THIS PURCHASE ORDER SHALL FUNCTION SATISFACTORILY FOR THE INTENDED APPLICATION & PERIOD SPECIFIED IN THE RELEVANT SPECIFICATION.

**Dated:**

**Q.C. INCHARGE**  
 (SIGNATURE & SEAL OF THE MANUFACTURER)

**Annexure- IV**

**PROFORMA FOR REPORTING DAMPER FAILURES OF LOCOMOTIVES**

Shed ..... Railway ..... Date .....

S.No.	Loco No. / Type	Damper Details							Life Obtained	Remarks (like Reused after Repairs)
		Fitment Details			Damper Make	Whether Still in Service (Y/N)	Removal Details			
		Primary / Sec	Location (L1-L6 or R1-R6)	Fitment Date			Removal Date	Cause		
1.										
2.										
3.										
4.										
5.										
6.										
7.										