TECHNICAL SPECIFICATION FOR HYDRAULIC DAMPERS
OF
HIGH HORSE POWER & WDM3D (WITH EQUALISER-LESS BOGIE)
LOCOMOTIVES

No. MP.0.40.99.03
(Revision - 04)
June 2018
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TECHNICAL REQUIREMENTS FOR HYDRAULIC DAMPERS OF HIGH HORSE POWER & WDM3D (WITH EQUALISER-LESS BOGIE) LOCOMOTIVES

1. SCOPE

This document covers the technical requirements for hydraulic dampers to RDSO Drawing No.SK.VL-484 (Revision Latest) on for High Horse Power locomotives, and RDSO Drawing No.SK.VL-387 (Revision Latest) for WDM3D (with equalizer less bogie) locomotives.

2. DEVIATION(s)

If deviations from original design, dimensions, etc. are desired by the 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 capacity shall be adjustable and the adjustment shall be easy to perform.

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 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 up to total thickness 200µm.

4.4 Strength test

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 between 12 to 15 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 (see above figure), shall be regular and symmetrical, and in particular shall be free from:
- flex as shown in above figure with letter A, B and C
- Local vibration 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. Damper forces during the extension and compression stroke shall be symmetrical.

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 Bushing Radial stiffness of Spheric 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% above the damping force at 0.10m/sec. Overhauling shall not be required before 4 years or 10,00,000km.
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 ring shall be ensured by appropriate method.

4.13 Sealing Arrangement
The damper shall be protected against ingress of dust along with piston rod by using low friction multiple 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 µm or better for cylinder and 0.1 to 0.3 µm 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.

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<tr>
<th>Locations</th>
<th>Primary vertical</th>
<th>Secondary Lateral/yaw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical</td>
<td>+/- 50 g</td>
<td>+/- 6 g</td>
</tr>
<tr>
<td>Lateral</td>
<td>+/- 5g</td>
<td>+/- 3g</td>
</tr>
<tr>
<td>Longitudinal</td>
<td>+/- 5g</td>
<td>+/- 5g</td>
</tr>
</tbody>
</table>

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. 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.

5. ENDURANCE TESTING OF HYDRAULIC DAMPERS
Endurance Testing of Hydraulic Damper shall 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 Annexeure II.

6. GUARANTEE / WARRANTY:

The manufacturer shall guarantee for service life of dampers i.e. 10,00,000km or 4 years, 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 nos. from every Batch of 100 no. or 3 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 shall be of ‘Aluminum’ and shall be fixed by ‘Aluminum’ rivets. The Hydraulic Dampers shall be marked in 10 mm height letters by punch mark and minimum depth of 0.25 mm on outer surface at bottom side of the dust cover on the damper with Manufacturer’s name or code, Serial No., Type of Damper, Rated Capacity, Month & Year of manufacture, “IR” & RDSO / EMD Drawing No.

10. PACKING

The manufacturer shall ensure that Hydraulic Dampers are suitably packed in polyethylene covers using suitable cartons to prevent ingress of foreign matter and damage during handling and storage.

11. OVERHAULING INTERVAL

The dampers shall be re-calibrated after 2 years and overhauling shall be done after 4 years.

12. FIELD TRIAL

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-7.1-11, dated 19.07.2016 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 ANGLE AND BUSHING RADIAL STIFFNESS OF HYDRAULIC DAMPERS FOR HIGH HORSE POWER & WDM3D (WITH EQUALISER-LESS BOGIE) LOCOMOTIVES

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 OF HIGH HORSE POWER & WDM3D (WITH EQUALISER-LESS BOGIE) LOCOMOTIVES

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

.1 Procedures

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 preferably 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. However, in the case of hydraulic dampers where such installation is not possible, flexible elements suitable for installing the hydraulic damper on testing machine (having characteristics identical to that of flexible element provided on the hydraulic damper), shall be allowed to be used provided prior approval of RDSO has been obtained for this purpose.

The damper shall undergo a life/wear test with at least 10,00,000 cycles at maximum velocity of 30 cm/sec and stroke between 12 to 15 mm. In addition, a side load shall be applied which shall be equivalent to 50% of torsion angle or conical angle, whichever is greater.

The damper oil temperature shall not exceed 70°C temperature during the endurance test.

After completion of 2 lakh, 4 lakh, 6 lakh and 8 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. Necessary data shall be recorded as per the Proforma enclosed at Annexure – II A. A continuous record of endurance testing shall be maintained in the log sheet as per the Proforma placed at Annexure – II B.

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.

.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 ±25% of rated damping capacity upto 6 lakh cycles and ±30% beyond that.

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## DAMPER PERFORMANCE DURING / AFTER ENDURANCE TEST

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Endurance Test Stage</th>
<th>At Constant Stroke of 12 mm/15mm</th>
<th>At Piston Velocities of</th>
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<tr>
<th></th>
<th></th>
<th>10 (cm/sec)</th>
<th>30 (cm/sec)</th>
<th>Comp</th>
<th>Expn</th>
<th>Comp</th>
<th>Expn</th>
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<td>4.</td>
<td>After 6 Lakh Cycles</td>
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<td>After 8 Lakh Cycles</td>
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### LOG SHEET FOR ENDURANCE TESTING DATA OF HYDRAULIC DAMPERS

**Product:** Vertical hydraulic damper / Lateral damper  
**Capacity (Kg):**

**Application:** Primary / Secondary  
**RDSO Drawing No:**

<table>
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<th>Sl. No.</th>
<th>Date</th>
<th>Started time</th>
<th>Stopped time</th>
<th>Total hours</th>
<th>No. of cycles</th>
<th>Cumulative no. of cycles completed</th>
<th>Temperature of damper (ºC)</th>
<th>Remarks</th>
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Annexure III

QUALITY ASSURANCE & GUARANTEE CERTIFICATE
(Reference – Clause 6 of Specification No. MP.0.40.99.03)

No. ........................................... ..........................................................

Dated:.................................

Railway : ........................................... ..........................................................

P.O. No. : ........................................... ..........................................................

Dated:.................................

Quantity : ........................................... ..........................................................

Consignee:...........................................

Hydraulic Damper Description:

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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

MANUFACTURER)
**PROFORMA FOR REPORTING DAMPER FAILURES OF LOCOMOTIVES**

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<th>S.No.</th>
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<td>Primary / Sec / Yaw</td>
<td>Location (L1-L6 or R1-R6)</td>
<td>Fitment Date</td>
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