REVISION OF SPECIFICATION / STR

Ref: Current spec no. C-8703(Rev-2) Amend-1, Specification for Double Acting Hydraulic Shock Absorbers for ICF Design Coaching Stock for secondary suspension.

RDSO is reviewing the specification/STR to cater to the latest technological developments in the field, modify clauses not relevant in the present context and making them more enabling with focus on functional requirements.

1. It is requested that your comments / suggestions with regard to improvements / modifications in specification / STR of this item may be submitted in the following format along with the justification for the changes required.

Part A: Basic Information

SN	Particulars	Information
1	Name	
2	Designation	
3	Professional Qualification	
4	Organization / Firm's Name	
5	Address for Correspondence	
6	Contact No.	
7	Email ID	
8	**In case of Firm / Individual:** Manufacturing experience of item (or similar Item) on which comments are offered	
9	**Where relevant:** Whether any technical document to support suggested changes is available / enclosed for better appreciation	

Part B: Comments / suggestions on the specification

SN	Clause No. of RDSO STR / Spec	Clause, as exists in RDSO STR / Spec	Clause , as it should read after incorporation of comments / suggestions in the RDSO Spec / STR	Justification for changes

Comments may be sent to:

Director/SS/Carriage
Research Designs and Standards Organization
Manak Nagar, Lucknow – 226011

Email: edcar.rdso@gmail.com or dirssrdso@gmail.com

INDIAN RAILWAYS

SPECIFICATION FOR DOUBLE ACTING HYDRAULIC SHOCK ABSORBERS FOR ICF DESIGN COACHING STOCK FOR SECONDARY SUSPENSION

S. No.	Month/Year of issue	Revision / Amendment	Page No.	Reason for Amendment
1	December, 1987	Nil	-	First issue
2	December, 1997	Rev. 1	-	-
3	February, 2007	Rev. 2	All pages	Shock absorbers of different capacities included
4	August, 2016	Amendment-1	3	To include ISO Document No: QO-D-7.1-11 as clause 1.3 under Clause 1 **Scope**

Issued By:
Carriage Directorate
Research Designs and Standards Organisation
(Ministry of Railways)
Manak Nagar, Lucknow - 226 011

Signature			
Name & Designation	Prepared By:- Shyam Shankar JE/SS/Carriage	Checked By:- Praveen Kumar Dy. Director/SS/Carriage	Approved By- Vineet Singhal Director/SS/Carriage

Amendments slip No. 1 of August, 2016 to Spec No. C-8703 (Rev.-2) specification for double acting hydraulic shock absorbers for ICF design coaching stock for secondary suspension, **Clause 1.3** added under clause 1. **SCOPE** and shall be read as under:

1.3 'All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-7.1-11 dated 19.07.2016 (titled "**Vendor – Changes in approved status**") and subsequent versions/amendments 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.'

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SPECIFICATION FOR DOUBLE ACTING HYDRAULIC SHOCK ABSORBERS FOR ICF DESIGN COACHING STOCK FOR SECONDRY SUSPENSION

1. SCOPE

1.1 This specification covers the requirements of double acting hydraulic shock absorbers of both lateral & vertical type for use in secondary suspension on ICF design coaching stock including air suspension.

1.2 The Specification covers the supply of damping unit with end fitting/mounting as an assembly termed as hydraulic shock absorber.

2. DEFINITION

2.1 **Double acting shock absorbers**-which damp the oscillations of a vehicle suspension in both the directions, damping action being different or equal in either direction depending on the individual application requirements.

2.2 **Overall damping characteristic** – shall, for all type of shock absorbers refer to the damping forces and corresponding relative velocities between the attachment points of the shock absorber to the vehicle and shall include the effect of the end mounting flexible elements.

2.3 **End Mounting characteristics** – shall refer to the forces and corresponding deflections of the shock absorber mounting flexible elements under stipulated static/dynamic loading conditions.

2.4 **Maximum piston velocity** – subsequently referred to as velocity shall be defined by the expression :

$V = 2\pi Rf$ or πDN

Where V = Maximum Piston velocity (mm/sec.)

R = Amplitude of oscillation (mm)

D = Stroke in mm = 2R

f= Frequency of oscillation (Hz)

N = Revolution per second of testing machine.

2.5 **Specified characteristics** – shall refer to the theoretically required over all damping characteristics of the shock absorber.

2.6 **Submitted characteristics** – shall refer to the mean overall damping characteristics of a specified number of prototype shock absorbers submitted by a manufacturer to RDSO for acceptance.

2.7 **Approved characteristics** – shall refer to a submitted overall damping characteristics of shock absorber that has been accepted by RDSO.

2.8 **Symmetrical characteristics** – shall refer to an overall shock absorber force/velocity characteristics which is identical on the compression and extension strokes. Other characteristics shall be referred to as Asymmetrical characteristics.

2.9 **Prototype shock absorber** – shall refer to a shock absorber, the design, construction, characteristics or application of which differs in any respect (other than changes of stroke specified by RDSO) from that of shock absorbers previously supplied and approved by RDSO.

2.10 **Production shock absorber** – shall refer to a shock absorber being manufactured/supplied by a RDSO approved firm for which prototype has been approved by RDSO

Note: Shock absorbers of a non-RDSO approved source which may be similar to production shock absorbers of an RDSO approved source, shall be considered prototype shock absorbers.

2.11 **Shock Absorber temperature** – shall refer to the temperature of the oil in the shock absorber .For measurement purpose, the temperature of the outside surface of bottom side of the main body of the shock absorber shall be taken.

2.12 **Compressed length** – length between the mounting eyes i.e. center-to-center distance (in case of loop type) or mounting faces (in case of stem-type) of a shock absorber when it is compressed to the maximum of stroke.

2.13 **Extended length** – length between the mounting eyes i.e., center to center distance (in case of loop type) or mounting faces (in case of stem type) of a shock absorber when it is pulled out to the maximum of stroke.

2.14 **Stroke** – the difference between the extended length and the compressed length (effective maximum travel of the shock absorber).

3. DRAWINGS

3.1 The shock absorber shall generally conform to either ICF/RCF/RDSO/purchaser's drawing(s) or the manufacturer's drawing(s) duly approved by the RDSO.

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

4. CAPABALITIES OF PRODUCTION AND PROTOTYPE SHOCK ABSORBERS

4.1 Characteristics of shock absorbers

4.1.1 Basic tolerance for overall damping characteristics

The actual overall shock absorber damping forces on the compression and extension strokes, taken separately, shall be within the following tolerances of the approved characteristics, at shock absorber temperature range of 30ºC ± 3ºC inclusive:

Damper Capacity(Kg)	Allowance
100, 200	±20%
300, 400	±15%
Others (of higher rating)	±10%

4.1.2 Effect of temperature on overall damping characteristics

No temperature corrections shall be applied at shock absorber temperature within the range of 27 ºC to 33 ºC inclusive. At temperature range between 0 to 60 ºC inclusive, the overall damping characteristics shall be permitted to exceed the tolerance stipulated in clause 4.1.1 by not more than 0.50% for each 1 ºC change in temperature above or below the basic temperature range of 27 ºC To 33 ºC inclusive.

4.1.3 Effect of oscillation frequency on overall damping characteristic

The tolerances stipulated in clause 4.1.1 and 4.1.2 shall apply at all frequencies between 0.17 to 6.67 Hz.

General form of overall damping characteristics

The characteristics shall not have any sudden deviation or changes of slope (other than that which occurs at cut-off) and shall have a general form similar to that of the approved characteristic.

Consistency of overall

damping characteristic throughout stroke

The stipulated tolerances and requirements of clauses 4.1.1 to 4.1.4 shall apply at all points within the required working stroke of the shock absorber.

4.2. Strength

4.2.1 The construction of shock absorber and mountings shall be such as to withstand the static compressive axial load of 30 KN when fully closed and a tensile load of 30 KN when fully extended respectively. However in case of 100kg capacity shock absorbers, the load should be 20 KN.

4.3 End mountings and methods of shock absorbers attachment

4.3.1 End mountings shall be of a type and construction specified or approved by RDSO. The design shall allow the maximum angular misalignments specified by RDSO without imposing such forces on the shock absorbers which would prevent it meeting the requirements of clauses 4.1 of the specification.

4.3.2 The characteristics of the mounting shall be within ± 10% of the shore-hardness of the approved values.

4.3.3 Drawings of shock absorber submitted by manufacturer shall also indicate the maximum misalignment of end mountings as attached to the shock absorber and get the same approved from RDSO/Purchaser.

4.3.4 The fixing arrangement at top and bottom side for 600/900 Kg shock absorber shall be of steel flanges. Fixing arrangement of shock absorber other than 600/900 Kg shall be as per ICF/RCF/RDSO drawings or manufacturer's drawings approved by RDSO.

4.3.5 The extended and compressed length of shock absorbers shall be as per ICF/RCF/RDSO drawing or manufacturer's drawing approved by RDSO. The telescopic shock absorbers with loop/flange ends, the end mountings shall be attached to the dampers within the tolerance stipulated in the respective drawings.

4.4 Performance in service

4.4.1 Shock absorbers and end mountings shall function satisfactorily without attention and in accordance with the requirements of this specification for 400000 kms. of service running on a vehicle or for 2 years from the date of fitment on a vehicle whichever is earlier. Satisfactory performance in this context means complying with the clauses 4.1.1 to 4.3.2.

4.4.2 Shock absorbers and end mountings shall be suitable for use in service in the ambient temperature range of 0 ºC to 60 ºC. However, during endurance testing as per Appendix V, shock absorber temperature may rise upto 70 ºC, which should not cause any damage to shock absorbers.

5. PROCEDURE FOR TESTING OF PROTOTYPE SHOCK ABSORBERS.

5.1 Complete shock absorbers

5.1.1 Physical tests:

Ten complete prototype shock absorbers of each type shall be subjected to dimensional checks as per drawings, material test records, interchangeability of the components, general workmanship and surface finish.

5.1.2 Overall damping characteristics approval tests:

If the requirements of para 5.1.1 are met, all the ten prototype shock absorbers shall be tested in accordance with Appendix-II for establishment of approved characteristics. In case shock absorbers fail to meet the requirements of Appendix II, no further tests shall be done. However, if shock absorbers comply with the requirements of Appendix II, further tests as per following paragraphs shall be done on the ten prototype shock absorbers, which have already been tested as per this paragraph.

5.1.3 Strength tests:

Out of ten numbers tested shock absorbers any five shock absorbers shall be subjected to tests as per Appendix-IV to ascertain their strength. If shock absorbers successfully clear these test, they shall be subjected to endurance testing as given in para 5.1.4.

5.1.4 Endurance tests:

Out of ten numbers shock absorbers any three shock absorbers shall be subjected to endurance tests as per Appendix V. Failure of any shock absorber to comply with the

requirements of this test will make all ten shock absorbers liable for rejection and the application of the firm will be treated as closed.

5.2 Inspection & tests on end mountings:

5.2.1 Ten sets of end mountings of the type used in prototype shock absorber, specified in RDSO/RCF/ICF drawings or for which manufacturer's drawing have been approved by RDSO shall be subjected to characteristic tests as per Appendix-III. End mounting shall not be tested in isolation.

5.3 Approval of prototype shock absorber:

5.3.1 Based on the results of tests as per clause 5.1 & 5.2 (inclusive), if found satisfactory, the adequate number of shock absorber will be subjected to service trial on limited scale upto 400000 Km running on a vehicle or for two years from the date of fitment whichever is earlier. After the successful completion of the trial prototype shock absorbers may be approved by RDSO to become a production shock absorber and consider the manufacturer of the prototype as an approved supplier provided he possesses other necessary facilities needed for this purpose.

6. Procedure for Inspection and Testing of Production Shock Absorbers

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

6.1.1 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 shock absorber 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 shock absorber is as per specification laid down.

6.1.2 The inspecting authority shall conduct the following checks from the offered lot of shock absorbers.

6.1.2.1 2% shock absorbers picked up at random shall be checked for dimensions with respect to assembly installation drawing. In case, the lot size is less than 100 Nos., minimum 2 Nos. of shock absorbers shall be taken for dimensional check.

6.1.2.2 5% shock absorbers selected at random by Inspector, with a minimum of one shock absorber per order, shall be tested in accordance with the requirements stipulated in Appendix I, clause 1 to 6.1 inclusive.

6.2 In case any of the samples picked up fail in any of the tests indicated in Para 6.1.2.1 and 6.1.2.2 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 shock absorbers 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 6.1.2.1 and 6.1.2.2. In case any of the samples again fails in any of the tests/checks, the entire lot shall be rejected.

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

6.4 On successful completion of check tests as per Para 6.1.2.1 and 6.1.2.2 remaining 10% shock absorbers of the batch shall be check tested in accordance with the requirements stipulated in clause 6.2 of Appendix-I, Clauses-1 to 5 of Appendix-I shall also apply to these tests. Should any shock absorber fail during check testing, it shall be rejected.

6.5 In normal course, testing of production shock absorber offered by the manufacturer for strength, endurance and end-mountings shall form part of the 'Internal Quality Assurance System' for which proper record shall be maintained and represented to the inspecting authority on demand. For this, following test procedure shall be followed.

6.5.1 One shock absorber out of every 2500 Nos. produced shall be subjected to strength and endurance tests as per Appendix-IV to V by the manufacturers as part of the quality assurance programme and documents maintained. The result of these tests shall be monitored by the inspector to ensure the quality.

6.5.2 Shock absorbers shall be tested for strength and endurance in the presence of Inspector, as per Appendix IV and V at the rate of one per 5000 shock absorbers produced or once in six months whichever is earlier. For this purpose, samples shall be drawn at random from a batch of not less than 50 shock absorbers. The tests can be conducted and witnessed by the Inspector at the firm's premises or at RDSO at his discretion.

6.5.3 End mounting at the rate of one per 5000 shock absorbers produced or once in six months whichever is earlier shall be tested for characteristics as per Appendix III in the presence of inspecting authority. For this purpose, sample shall be drawn at random, from a batch of not less than 50 shock absorbers.

6.5.4 At the discretion of inspecting authority, these tests may be carried out at any time in addition to the frequency specified in clauses 6.5.1 to 6.5.3 inclusive.

6.6 Notwithstanding what has been written in clause 6.5, for the purpose of purchase inspection, inspecting authority, at his discretion may ask for testing of one shock absorber out of 5% selected as per clause 6.1.2.2 for strength, endurance and end mounting tests as per Appendix - III, IV and V of the specification. Should any of the samples fail during such tests entire lot of shock absorbers offered shall be rejected.

7. PARTICULAR REQUIREMENTS

7.1 Manufacturer willing to supply shock absorber for the use of Indian Railways shall register themselves with RDSO.

7.2 The manufacturer shall have adequate facilities for the manufacture and testing of shock absorber conforming to this specification.

7.3 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: -

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

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

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

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

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

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

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

7.4 Rubber items shall be procured from RDSO approved sources only. However, the manufacturer shall be fully responsible for the satisfactory performance of the rubber items

7.5 Manufacturers should have the ISO 9001-2000 Certificate for manufacture of Double acting hydraulic Shock Absorber.

8. GUARANTEE / WARRANTY

8.1 The manufacturer shall furnish a guarantee that each new shock absorber supplied, shall function satisfactorily without attention and in accordance with the requirements of this specification for 4,00,000 kms of service running on a vehicle or for 2 years from the date of fitting to a vehicle, whichever is earlier. A format of the certificate is given at Appendix. VI.

8.2 The warranty shall survive inspection, payment for and acceptance of the goods, but shall expire 24 months after placement in service or 4,00,000 kms of service running of a vehicle, whichever is earlier, except in respect of complaints, defects and/or claims, notified to the contractor within 2/3 months of such date. Any approval or acceptance by the purchaser of the stores of or the material incorporated herein shall not in any way limit the contractor's liability.

9. GENERAL

9.1 All welded joints of the shock absorber shall be free from welding defects and shall be sufficiently strong to withstand the loads as stipulated under clause – 4.2.

9.2 The shock absorber shall be assembled in such a manner that the damping shall be uniform throughout the stroke. For this test, the shock absorbers shall be primed three or

four times in a vertical position. This test is only indicative of the uniformity of damping and is not indicative of the actual damping value.

9.3 The external dimensions, design, construction, characteristics or materials used in the manufacture of the shock absorber 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 telescopic dampers shall be within ±3mm of the specified dimension.

9.4 The hydraulic fluid used in dampers shall be a type and grade which has previously been approved in writing by RDSO.

9.5 After suitable pretreatment, shock absorber shall be painted with primer under coat and finishing coat The shock absorbers of 900 Kg capacity shall be painted sky blue finish coat. Shock absorber of other capacities shall be in black colour. Paint must not be permitted to adhere to the working portion of the piston rods.

9.6 The shock absorber shall be manufactured and assembled at the manufacturer's own works.

9.7 Shock absorber 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.

9.8 Shock absorber 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 shock absorbers have been duly inspected.

10. GENERAL INSPECTION

10.1 All the materials or fittings used in shock absorbers shall be subjected to inspection by the Inspecting Authority and shall be to his entire satisfaction.

10.2 The manufacturer shall supply the necessary labour and appliances for testing and inspection of the shock absorbers and mountings and shall supply to inspector a copy of the test results signed by manufacturer or his representative.

10.3 The Inspecting Authority shall have right to: -

10.3.1 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.

10.3.2 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.

10.3.3 Visit at any reasonable time and without previous notice, the manufacturer's works to inspect progress and the quality of the work and the manufacturer shall provide free of the charge all equipments, gauges and other facilities required by him for the purpose.

10.3.4 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.

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

11. TRAINING AND INFRASTRUCTURAL FACILITIES.

The manufacturer shall provide the requisite training to the staff of purchaser to use, repair and overhaul the shock absorbers. He shall also supply 10 sets of maintenance/instruction manuals for each order indicating dimension of critical items and its permissible wear, specification and quantity of oil etc. to the user Railways along with one set of tools for maintenance. The manual shall be vetted by RDSO before issue to Railways.

12. MARKING

Marking identification plate should be of aluminium and should be fixed by aluminium rivets. The shock absorbers shall be marked with:-

a) Manufacturer's name or Code

b) Serial No.

c) Type of shock absorber

d) Rated capacity

e) Month & year of manufacture

f) "IR"

In addition to marking plate, the manufacturers name or code, rated capacity, serial number and month & year of manufacture shall also be marked in 10 mm height letters by punch mark with minimum depth of 0.25mm on outer surface at bottom side of the shock absorber.

13 PACKING

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

APPENDIX – I

TESTS FOR ASCERTAINING OVERALL DAMPING CHARACTERISTICS

Tests for ascertaining the overall force-velocity characteristic of shock absorber shall be carried out in accordance with the following clauses: -

1. Prior to testing each shock absorber shall be compressed to its fully closed position and then extended to its maximum stroke position.

2. Each shock absorber shall be primed prior to testing to ensure that all the air is brought into the correct chamber of the shock absorber and then handled in such a way that the primed condition is maintained during testing.

3. Normally the shock absorbers shall be tested in their normal plane of operation unless otherwise specifically asked by RDSO.

4. The shock absorber shall be connected to the testing machine with its flexible end mountings in the same manner as is done on the coach. No additional flexible elements shall be used for this purpose. However, in the case of shock absorbers where such installation is not possible, flexible elements suitable for installing the shock absorber on testing machine (having characteristics identical to that of flexible element provided on the shock absorber), shall be allowed to be used provided prior approval of RDSO has been obtained for this purpose.

5. The inspector shall be at liberty and required to witness the calibration of the load measuring devices of the testing machine and to check the maximum velocities being obtained across shock absorber under test.

6. There shall be two categories of characteristic tests for shock absorbers as follows: -

COMPREHENSIVE TEST:

The tests shall be carried out at different test velocities varying from 20 mm per second onwards to maximum velocity of the shock absorber (to be specified by the manufacturer) in steps of 40 mm/sec and damping forces for both compression and tension strokes recorded. Variation in velocity shall be achieved in following two manners and recording done separately for both the cases: -

By varying frequencies at a constant stroke of 19 mm.

By varying strokes at a constant frequency of 1.67 Hz.

Ideally the shock absorbers temperature during the test shall be between 27^{o}C to 33^{o}C (both inclusive). However, if it is not possible to do so, temperature during test shall be recorded and temperature correction as per Para 4.1.2 of the specification shall be applicable.

The characteristic shall be deemed satisfactory if in the case of prototype shock absorber, the characteristic is approved and in the case of production shock absorbers the requirements of clauses 4.1.1 to 4.1.5 of this specification are met.

CHECK TESTS:

The test shall be carried out at test velocity of 100 mm/sec. with frequency and strokes being 1.67 Hz and 19 mm respectively. Ideally, the shock absorber shall be tested at temperature between 27deg C to 33 ^{o}C(both inclusive). However, if it is not possible to do so, temperature during the tests shall be recorded and temperature correction as per Para 4.1.2 shall be applicable. The characteristic shall be deemed satisfactory if the values of damping forces conform to the clauses 4.1.1 and 4.1.2 of the specification.

Note

If desired by RDSO, tests as per clauses 1 to 6.1 (inclusive) shall be conducted in fatigue testing lab of the organization where shock-absorber characteristic testing machine is available.

APPENDIX – II

PROCEDURE FOR ESTABLISHING APPROVED CHARACTERISTICS

1. For each different specified characteristics for which an approved characteristic has not previously been established, the manufacturer shall prepare at least 10 numbers nominally identical shock absorber using normal production techniques and materials.

2. These shock absorbers shall be tested in accordance with Appendix-I, clauses 1 to 6.1 (inclusive). Graphs shall be prepared for each shock absorber showing to suitable scales, the shock absorber forces separately for both compression and rebound strokes (Newtons) and corresponding velocities (mm per second). Separate graph as above shall be prepared for tests pertaining to clauses 6.1.1.1 and 6.1.1.2 of Appendix-I respectively to enable studying of effect of stroke/frequency variation on damping characteristics.

3. In the case of shock absorbers having a symmetrical specified characteristic, a graph showing a single mean line, referred to as the submitted characteristic shall be drawn by clubbing together all the test points as per clauses 6.1.1.1 & 6.1.1.2 of Appendix-I for all the tested shock absorbers. The graph shall also include to the same scales, the specified characteristic and shall be in the form indicated in Fig.1.

   For shock absorbers having an asymmetrical specified characteristic, a graph showing two separate lines shall be drawn by clubbing together all the test points as per clauses 6.1.1.1 & 6.1.1.2 of Appendix-I for all the tested shock absorbers; one relating to the shock absorber forces for the compression stroke and the other relating to the shock absorber forces for the extension stroke. The graph shall also include to the same scales, the specified characteristics and shall be in the form of hysterisis loop and the locus of damping values shall confirm to the damping force verses velocity characteristics shown in Fig.1.

4. Basic data obtained as a result of these tests for individual shock-absorbers, graphs as per clauses 2 and 3 of this appendix, all bearing signatures of the manufacturer's authorized representative and inspecting authority shall be submitted to RDSO for consideration and approval. In case any of the shock absorbers fails to comply with the requirements of clauses 4.1.1 to 4.1.5 of this specification, RDSO may not accord approval for the approved characteristics of the prototype shock absorber. However, decision of RDSO in this regard shall be final and binding.

5. A submitted characteristic which on acceptance by RDSO becomes an approved characteristic, shall be re-drawn in the form indicated in Fig.2 giving tolerance values for shock absorbers in accordance with clause 4.1 of this specification and shall include statement of specified characteristics in the form indicated in Fig.3.

APPENDIX – III

PROCEDURE FOR TESTING THE CHARACTERISTICS OF SHOCK ABSORBER END MOUNTINGS

1. The mountings shall be assembled to simulate the manner in which they will be used in service and checked for dimensional and other parameters as laid down in approved drawings.

2. The static load-deflection characteristics in the direction of the longitudinal axis of the assemble shall be measured and graph plotted for loads upto 150% of the mean load that the damper will provide at its maximum test velocity which shall be specified by the manufacturer.

3 The assembled mountings shall then be subjected to a further test, during which dynamic forces are applied in the direction of the longitudinal axis of the assembly at the frequency of 2 Hz.

The amplitudes of the deflection produced in the flexible elements of the mountings and the resulting forces imposed, shall be measured simultaneously. The amplitudes shall be increased from zero until the compression and rebound forces are equal to the maximum forces that the shock absorber will provide at its maximum test velocity.

A force deflection graph shall be plotted to show the dynamic characteristics of the mounting at the specified conditions in the form of hystersis loop.

4. For new or modified types of mountings, the results of the above tests shall be submitted to RDSO for approval where RDSO has already given approval of the characteristics of the type of mounting in question, the tolerances stipulated in clause 4.3.2 of this specification shall apply.

5 The maximum cardenic angular displacements for end fasteners/rubber fittings with respective permissible stiffness about orthogonal axis shall be as under:

a) Maximum conical stiffness as 6 N-m/Degree - 8 to 10 degree angle.
b) Maximum torsional stiffness as 8 N-m/Degree - 7 to 8 degree angle.
c) Maximum longitudinal stiffness as 20 to 23 KN/mm.

Static tests shall also be made and graphs plotted, to show the torque Vs angular rotation rates at nominal fitment distance of the mounting in the two orthogonal directions and to the appropriate angular limits, which is required to be stated by manufacturer as per clause 4.3.1 of this specification.

The above characteristics of end fasteners/rubber fittings should be for vertical and lateral dampers of 100Kg, 200Kg 300 Kg and 400Kg at 10 cm/sec velocity.

APPENDIX – IV

PROCEDURE FOR TESTING STRENGTH OF SHOCK ABSORBERS

Tests for ascertaining the strength of shock absorbers shall be carried out in accordance with the following clauses :

1. The overall damping characteristics of each shock absorber shall first be ascertained in accordance with Appendix-I clauses 1 to 6.1 inclusive.

2. The shock absorber shall then be attached to a tensile and comprehension testing machine of a type approved and loaded in accordance with the requirements of clause 4.2 of this specification.

3. The overall damping characteristic shall subsequently be determined in accordance with Appendix-I clauses 1 to 6.1 inclusive.

4. The overall damping characteristic shall not have changed as a result of this test, nor shall the shock absorber or any of its components have suffered damage or permanent distortion.

APPENDIX – V

PROCEDURE FOR TESTING ENDURANCE OF SHOCK ABSORBERS

1. Shock absorbers submitted for testing shall have overall damping characteristics which confirm to the requirements of this specification as confirmed by tests following the procedure given in Appendix-I, clauses 1 to 6.1 (inclusive) before undertaking endurance tests.

2. An external means of cooling shall be applied during endurance test to maintain a shock absorber temperature not exceeding 70 ºC.

3. Shock absorbers shall be fitted in vertical mode on endurance testing machine with flexible mounting components as per clause 4 of Appendix-I for this test. This machine shall enable keeping one end of the shock absorber fixed and the other end oscillating at 1.66 Hz with amplitude of ± 9.5 mm corresponding to a maximum velocity of 100 mm per second. Shock absorber shall then be subjected to a total cyclic working of 1.6 million cycles and recording as per following paragraphs shall be done.

4. After completion of 2 lakhs, 5 lakhs, 10 lakhs and 16 lakhs cycles respectively, shock absorber shall be removed from endurance testing machine and retested for overall damping characteristics as per Appendix-I, clauses 1 to 6.1 (inclusive) after it has been cooled as per para given below.

5. The cyclic working on endurance testing machine shall be continuous except for short intervals when shock absorber is removed for checking their capacity or when circumstances are beyond the control of testing agency e.g. power failures etc. The manufacturer shall keep records for any such happenings.

6. A shock absorber shall be considered to have passed this endurance test, at the completion of test, it, its overall force/velocity characteristics have not deteriorated beyond ± 20% of the nominal rated values and also it, continues to meet the requirements of clauses 4.1.2 to 4.1.3 inclusive of this specification.

7. Prior to ascertaining force-velocity characteristics on the completion of an endurance test, the shock absorber shall have been previously allowed to cool, so that the characteristics test is carried out with the shock absorber at a temperature ideally between 27 to 33 ºC inclusive. However, it this is not possible, overall characteristic testing shall be done at temperature nearest to this temp. range and temperature correction as per clause 4.1.2 of the specification shall be applied.

APPENDIX – VI

QUALITY ASSURANCE & GUARANTEE CERTIFICATE

(Reference – Clause 8 of specification)

No. …… Dated ……

Railway ……..

P.O. No. …… Dated ……

Quantity …… Consignee ……

Shock Absorber Description

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i. THIS IS TO CERTIFY THAT THE SHOCK ABSORBERS 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 SHOCK ABSORBER SUPPLIED AGAINST THIS PURCHASE ORDER SHALL FUNCTION SATISFACTORILY AS PER CLAUSE 8 OF SPECIFICATION C-8703 (LATEST ISSUE).

Q.C. INCHARGE

DATED: (SIGNATURE & SEAL OF THE MANUFACTURER)

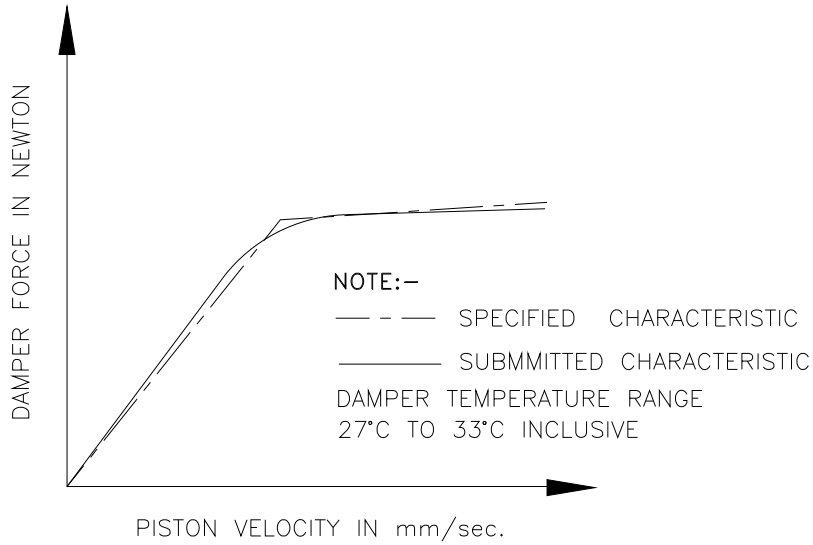
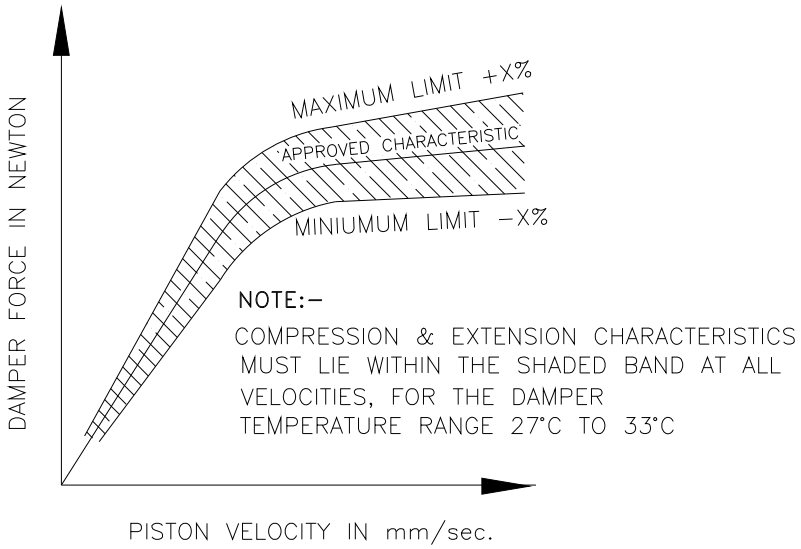


FIG.1 MANNER OF PRESENTING THE SUBMITTED CHARACTERISTIC



THE VALUE OF 'X' SHALL BE AS PER CLAUSE−4.1.1

FIG.2 MANNER OF DRAWING APPROVED CHARACTERISTIC

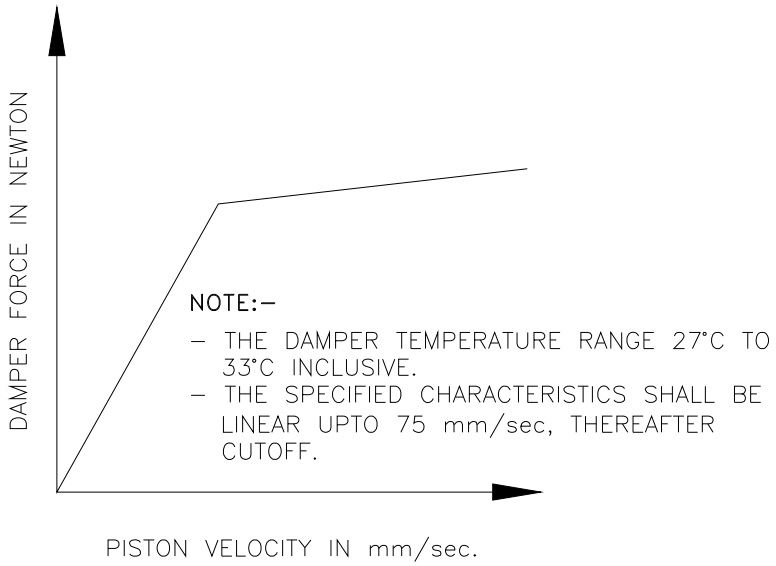


FIG.3 MANNER OF SHOWING THE SPECIFIED CHARACTERISTIC