GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

TECHNICAL SPECIFICATION FOR SPHERIBLOCS USED ON THREE PHASE ELECTRIC LOCOMOTIVES (WAP5, WAP7 & WAG9)

Specification No. RDSO/2007/EL/SPEC/0051 (Rev.'3')

Xxxxx'2020

Approved by	Signature
PEDSE	

ELECTRICAL DIRECTORATE
RESEARCH DESIGNS AND STANDARDS ORGANISATION
LUCKNOW-226011

Status of Revision

S.N.	Date of Revision	Page No.	Revision	Reasons for Revision
1.	May'2007	All	0	First Issue
2.	Feb'2012	All	1	1. Specified value of modulus at 100% Elongation is not achievable. 2. Only nominal value of density has been given and there was no range. 3. Use of standard Spheriblocs as comparator in place of standard surface pad. 4. In order to avoid duplicity, to delete STR as Sec B, which is a separate document STR 50 since Aug'2008.
3.	Oct'2012	All	2	1. Density of the rubber before ageing should be 1.2 g/cm3 (max.) in place of 1.2 g/cm3 (min.). 2. Typographical errors : a. Nitrite shall be nitrile b. Standard Pad shall be Spheribloc
4.	XXXXX'2020	All	3	1. To ensure consistency of quality as well as safety and reliability of equipment. 2. Language Corrections to have more clarity. 3. To refer ISO Standard for field trial quantity & period. 4. Deletion of guarantee/tender related clauses

CONTENTS

1.0 GENERAL:

This specification outlines the requirements of rubber bonded elastic Spheriblocs used on WAP5/WAG9/WAP7 three phase Electric Locomotives. Three types of Spheriblocs as per ABB drawings as indicated in para 2 below are used in following applications as described below:

1.1 **AXLE GUIDE ROD SPHERIBLOC FOR WAP5/WAG9/WAP7 LOCOMOTIVES:** The axle guide rod, which is bolted to the axle box housing and to the bogie frame, provides a longitudinal guide for the axle box housing. The guide rod is fitted with Spheriblocs at each end, which provide positive longitudinal guidance while allowing negligible resistance to lateral movement. Spheribloc fitted in the guide rods allow the axle lateral movement without undue restrictions.

1.2 **TORQUE ARM SPHERIBLOC FOR WAG9 AND WAP7 LOCOMOTIVES:** Mounting plate of traction motor is supported by torque arm. Spheriblocs are fitted at the both end of torque arm.

1.3 **TRACTION MOTOR SPHERIBLOC AND TRACTION MOTOR SUPPORT ARM SPHERIBLOC FOR WAP5 LOCOMOTIVES:** Traction motor support arm is fitted with bogie frame mounting lug through TM support arm Spheribloc and other side of traction motor is fitted on the center transom mounting lug of bogie through 2 nos. of Traction Motor Spheriblocs.

1.4 **GEAR CASE SPHERIBLOC FOR WAP5 LOCOMOTIVES:** Gear case, fitted to each axle of bogie is suspended in the bogie frame at the nose end by suspension arm. Both end of the suspension arm is fitted with Spheriblocs to allow for twist and movement of axle.

2.0 SCOPE OF SUPPLY:

Quantities of different Spheriblocs for different types of locomotives are as follows:-

2.1 **FOR WAG9 / WAP7 LOCOS:**

SN	Application (Quantity per loco)	ABB's Drawing No.	Spheribloc Quantity per loco
2.1.1	Axle Guide Rod (12)	IA016-00005 (Rev.3)	24
2.1.2	Torque Arm (06)		12

2.2 **FOR WAP5 LOCOS:**

SN	Application(Quantity per loco)	ABB's Drawing No.	Spheribloc Quantity per loco
2.2.1	Gear Case (04)	IA016-00005 (Rev.3)	08
2.2.2	Axle Guide Rod(08)	IA016-00003 (Rev.1)	16
2.2.3	Traction Motor (08)	IA016-00269 (Rev.3)	08
2.2.4	Traction Motor support arm (04)		04

3.0 CLIMATIC, ENVIRONMENTAL AND WORKING CONDITIONS:

The Spheriblocs are subjected to heavy dynamic cyclic load. This load can be considered as continuous within the limits specified as maximum axial and radial force in the ABB's above relevant drawings. The Spheriblocs shall be suitable for operation under tropical conditions of high temperature, high humidity, heavy rainfall and fungus conductive environment.

The climatic and environmental conditions prevailing in India in the area of operations are the following:

Atmospheric temperature	Maximum Temperature: 70°C Minimum temperature: -10°C (Also snow fall in certain areas during winter season)
Solar radiation	1 kW/m^2
Humidity	100% saturation during rainy season
Altitude	1776m above mean sea level
Rain Fall	Very heavy in certain areas
Atmospheric conditions	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/m3 in many iron ore and coal mine areas.
Coastal area	Spheriblocs shall be designed to work in coastal area in humidity and salt laden and corrosive atmosphere. The maximum values of the condition will be as follows: a) Maximum pH value – 8.5 b) Sulphate- 7 mg/litre c) Max. concentration of chlorine- 6mg/liter d) Maximum conductivity- 130 micro Siemens/CM

4.0 MATERIAL:

4.1 RUBBER: The supplier shall select the elastomeric material based on the requirements of this specification and their experience with similar applications / products. This may include natural rubber, chloroprene or nitrile butadiene synthetic rubbers. The material have been used in a similar rolling stock application should be chosen preferably. Supplier should demonstrate the same. Use of regenerated / re-constituted material is not permitted.

Properties of rubber used for spheriblocs are given below:-

A. Properties of rubber before ageing:

SN	Properties	Permissible Value
1	Hardness	65 ± 3 Shore A
2	Tensile strength	200 kg/cm^2 (min.)
3	Stretch (elongation) at break	250% (min.)
4	Modulus at 100% elongation	30 kg/cm^2 (min.)
5	Compression set (residual compressive deformation after 24 +0/-2 hours at 70 ± 1 °C)	< 22%
6	Density	1.2 g/cm^3 (max.)
7	Ash contents	5% (max.)
8	Resistance to ageing	7 days at 70 +1/-0 °C
9	Bond strength	500 PSI (min.)

B. Variation in physical properties of rubber after ageing at 70±1 °C for 7 days in an air oven.

SN	Properties	Permissible Variation
1	Hardness	≤ 5 Shore A
2	Tensile strength	± 25%
3	Stretch (elongation)at break	+10% / -30%
4	Modulus at 100% elongation	± 20%

4. 2 **STEEL:** The metal part shall be manufactured from mild steel with the minimum yield stress of 200MPa and shall conform to IS: 1875, Class-4. The surface shall be electroplated (Zn) according to IS: 1573 and IS: 9839 to achieve the finish specified on the drawing. Proposals for an alternative corrosion protection, if any, may be submitted for approval of the RDSO. The profile of the metal components shall be selected to ensure that the load is distributed evenly over the elastomer. The bond shall be at least as strong as the parent elastomer itself.

The metal parts shall be shot/grit blasted to IS: 9139 Grade S M 300 or G M 30 and chemically cleaned before bonding with the rubber. It has to be ensured before bonding that the metal surface is free from rust, moisture and other foreign matter. The process adopted for bonding of rubber to metal shall be a proven one using suitable bonding agents to achieve the required bond strength.

5.0 CONSTRUCTION AND FINISH:

The Spheriblocs shall be manufactured in accordance with ABB drawings as indicated in para 2 above. All spheriblocs shall fully comply with the dimensions and tolerances on the relevant drawing. The metal part shall be chemically bonded with rubber. The rubber shall be smooth and free from pinholes, blisters and other visual tears. The manufacturer shall prepare a "Standard Spheribloc" of all three types of Spheribloc and have it approved by RDSO/Lucknow during prototype test. These Spheribloc shall serve as a comparator for surface defects. Spheriblocs shall be resistant to organic fecals, waste products, oils, acids and ageing.

6.0 INSPECTION, TESTS AND ACCEPTANCE:

6.1 TYPE TESTS:

Type test will be conducted on all three types of Spheriblocs. The type tests will consist of the visual inspection, dimension check, load deflection characteristics tests, tests for rubber properties, endurance tests, and the field trials. At the time of offering material for prototype tests, the firm shall submit the internal test report.

6.1.1 DIMENSION CHECK:

The prototype spheriblocs shall be checked for dimensions as per ABB drawings as indicated in para 2 above.

6.1.2 LOAD DEFLECTION CHARACTERISTICS:

The load deflection characteristics of prototype sample shall be checked in Radial, Axial, Torsional (α) and Conical (β) deflections for conformance of the stiffness values as per ABB drawings as indicated in para 2 above. The loads to be applied for test for each types of spheriblocs are given below:-

SN	Mode	Spheribloc as per clause 2.1.1, 2.1.2 & 2.2.1			Spheribloc as per clause 2.2.2			Spheribloc as per clause 2.2.3 & 2.2.4		
		Max. load	Starting from	Step size	Max. load	Starting from	Step size	Max. load	Starting from	Step size
1	Radial	140kN	0	20kN	80kN	0	10kN	66kN	0	11kN
2	Axial	30kN	0	6kN	20kN	0	5kN	17kN	0	4kN
3	Torsional (α)	+700Nm	0	140Nm	+170Nm	0	85Nm	-	-	-
		-700Nm	0	140Nm	-170Nm	0	85Nm	-	-	-
4	Conical (β)	+580Nm	0	145Nm	-	-	-	-	-	-
		-580Nm	0	145Nm	-	-	-	-	-	-

The condition of rubber of spheribloc should be checked periodically for various defects like cracks, de-bonding, crushing, crumbling etc.

6.1.3 TESTS FOR RUBBER PROPERTIES:

The tests shall be carried out as per IS 3400 to verify that the rubber used in spheriblocs meets the properties as given in para 4.1 above. For this purpose the supplier shall prepare two samples of size 2 x 250 x 250 mm of the rubber compound prepared for batch production. Test specimens for compression set and bond strength test shall also be prepared as per IS 3400 part-10 & part-14 respectively by using same rubber compound as that of finished product with same degree of vulcanization. To assess the bond strength, method 'B' as given in IS 3400 part-14 shall be followed. All precautions taken for metal preparation and bonding for preparing test piece shall also be followed for batch production. The un-vulcanised rubber disc for preparing the test piece shall be taken from the rubber compound prepared for batch production (sample shall be selected at random from the lot). However, purchaser reserves the right to cut any finished Spheribloc, if needed.

For the purpose of conforming / co-relating the composition of the test specimens with that of the finished product, following tests shall be performed both on test slab /specimen and the finished product and shall comply the requirements as given under:-

(a) Specific gravity: The results shall be within ± 0.02

(b) Percent Ash content: The results shall be within ± 1.0

6.1.4 **ENDURANCE TEST:**

Endurance test of prototype sample of different types of Spheriblocs mentioned at para 2 above shall be carried out as per test parameters given below. These tests are divided into force-controlled test and angle rotation controlled test. After completion of endurance test there should not be any permanent set and damage to rubber or steel. Complete endurance test shall be carried out with load cases on each prototype sample as described below. The tests frequency will be 1 Hz for endurance tests under radial forces and 0.5 Hz for endurance tests under angular twists.

Load case	Load cycles	Spheribloc as per cl. 2.1 & 2.2.1		Spheribloc as per cl. 2.2.2		Spheribloc as per cl. 2.2.3	
		Mean	Amplitude	Mean	Amplitude	Mean	Amplitude
Radial force	8×10^5	37 kN	+/-23 kN	20 kN	+/-20 kN	22 kN	+/-15 kN
Radial force	8×10^5	-9 kN	+/-23 kN	-20 kN	+/-20 kN	-8 kN	+/-15 kN
Radial force	2×10^5	14 kN	+/-38 kN	0 kN	+/-32 kN	7 kN	+/-21 kN
Radial force	5×10^3	71.5 kN	+/-57.5 kN	40 kN	+/-40 kN	40 kN	+/-33 kN
Torsional angle α	1×10^5	0	+/-1 deg.	0	+/- 1.5 deg.	-	-
Cardanic angle β	1×10^5	0	+/-2 deg.	0	+/-1.0 deg.	-	-

6.1.5 **FIELD TRIAL:**

After passing type tests, the Spheriblocs will be subjected to field trials specified for period & quantity as per ISO document No.EL-WI-8.1-1 latest version which will form the basis of acceptance of the prototype. The performance of Spheriblocs shall be monitored jointly by users Railway, RDSO & supplier. After completion of successful field trial, the remaining quantity of Spheriblocs will be manufactured incorporating all the modifications found necessary during the prototype test / field trial, by the firm without any additional cost.

6.2 **ROUTINE TESTS:**

6.2.1 Visual inspection shall be done on 100% basis.

6.2.2 Dimensions shall be checked as per ABB drawings as indicated in para 2 above on at least two nos. spheriblocs for each lot or 10% of lot quantity, whichever is more.

6.2.3 The tests of the deflection characteristics over the entire force range up to the maximum force (according to para 7.1.2) shall be conducted on at least two samples from each batch of the rubber mix. This test shall include the confirmation of the radial stiffness Cr, the axial stiffness Ca and the angular stiffness Mdα and Mdβ.

6.2.4 The rubber properties shall be verified on one sample from each batch of the rubber mix as per clause 7.1.3.

6.3 **INSPECTION PLAN:**

The inspection plan for type test and routine test shall be got approved by RDSO / Lucknow before offering for prototype inspection. The supplier shall supply, free of charge, the material required for testing *(except of routine inspection)* and shall, at his own cost, furnish and prepare the necessary test pieces and supply labour and appliances for such testing as may be carried out at his premises.

7.0 MARKING:

Each Spheribloc shall bear the following clear readable marking on metal portion only at appropriate location:

a) Supplier's name/Trade mark

b) Specification No.

c) Serial No. / Batch No.

d) Year and month of manufacture.

8.0 PACKAGING AND DELIVERY:

The spheriblocs shall be prepared and packed in such a manner as will properly protect them from damage or deterioration during transit and storage prior to installation.

9.0 STORAGE:

Rubber, whether under storage or in use, continue to deteriorate and ultimately may become unserviceable. The deterioration may be the result of one particular factor or a combination of factors viz; the action of oxygen, ozone, light, heat, humidity etc. The deleterious effects of these factors may, however, be minimized by adopting appropriate conditions of storing and duration of storage. This guideline proves suitable conditions for the storage of rubbers in all forms.

(i) The rubber components should be stored in a cool place as far as practicable, preferably below 30ºC.

(ii) They should be kept away from direct sunlight preferably in a dark place. Direct sunlight causes much faster degradation of the rubber components.

(iii) The humidity of the storage condition should not be such that condensation of moisture takes place on the surface of the components.

(iv) In the vicinity of these components, any loose electrical connections should be avoided, as these cause production of ozone, which adversely affects rubber.

(v) They should be stored away from contact with materials containing copper and manganese, which act as poisoning agents and resulting in their faster degradation.

(vi) Under no circumstances, rubber components should be stressed during storage. The portion under stress undergoes deformation with permanent set and leading to degradation. They should be stacked in such a way so that any super imposed stresses are substantially avoided.

(vii) Any contact with grease or oil should be avoided as these cause swelling, softening and deterioration of rubbers.

(viii) French chalk or soapstone or mica should liberally be applied on the surface of rubber components.

(ix) Great care is to be exercised so that the material is used in the order of their receipt in the stores i.e. 'first-come-first issue basis'. The rubbers whether under storage or in use continue to deteriorate. The only difference is that under service condition, deterioration is much faster. Every moment of storing is at the cost of useful life and prolonged storage of the material may render it unserviceable due to progressive deterioration.

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