भारत सरकार
रेल मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

डीजल विद्युत लोकोमोटिव (अल्को) और डेमू में कर्षण मशीनों में प्रयोग किये जाने वाले ब्रश होल्डरों के तकनीकी जरूरतों की विशिष्टि

SPECIFICATION FOR BRUSH HOLDERS USED ON TRACTION MACHINES OF DIESEL ELECTRIC LOCOMOTIVE (ALCo) & DEMU

स्पेसीफिकेशन नं॰ एम॰पी॰–0-2400-09
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अनुसंधान अभिकल्प एवं मानक संगठन
मानक नगर, लखनऊ – 226011
RESEARCH DESIGNS & STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW-226 011

TECHNICAL SPECIFICATION FOR BRUSH HOLDERS USED ON TRACTION MACHINES OF DIESEL ELECTRIC LOCOMOTIVES (ALCO) and DEMU.

1.0 SCOPE

This specification covers the technical requirements for the manufacture, supply and inspection of the brush holders used on traction machines of Diesel Electric Locomotives (ALCO) & DEMU. It specifies technical requirements and relevant inspection procedures applicable to inspection acceptance.

In the revised specification, brush holder support pin (insulating arm) has been deleted subsequently to change over to mycalex pin. This shall be procured as per RDSO drawing details enclosed at Annexure-B.

2.0 DRAWINGS AND MOUNTINGS

2.1 The brush holders shall be suitable for mounting on brush holder support Pin/ Arm of the TM/TG/TA/AG as per respective drawing no./catalogue no. given in Annexure-A.

2.2 The brush holders shall be manufactured as per dimensions conforming to relevant drawings as per table given in Annexure-A.

2.3 The manufacturer is free to offer a brush holder of a design different from that given in the clause 2.2 subject to prior approval of RDSO. In such a case the design dimension should be such as to suit mounting of the brush holder on relevant machines as provided in clause 2.1.

3.0 TOLERANCES AND FINISH

Finish and tolerance shall be maintained as specified in relevant drawing.

4. MATERIAL

4.1 Body: Brush Holder shall be manufactured either by sand casting or die-casting and shall conform to respective material grade as per the type of Brush Holder covered under the specification. The physical and chemical properties of the material shall conform to material of the brush holder referred in the drawing. The pockets into the brush holder should be made by broaching process with tolerances as mentioned in the relevant drawing.

4.2 Standards for Material of Brush Holder Body:

Sl.	Machine type	Drawing no.	Process required for brush holder body (Die Casting/ Sand Casting)	Material specification of the Brush Holder body
1	• TM4906AZ/BZ, TM4907BZ • TM165M/165 • TM4603BZ/252 • TM4501AZ/M • TM752/761(GE) • TM7362/A(CGL) • TMC1001 (CGL) • TM5002 AZ/BY/BW • TM4303 BY/DY • TMC1005(CGL) • TM2141A(CGL) or any other traction motor type equivalent to OEMs duly approved by RDSO	Please refer to Annex – A/OEM drg.	Material: Leaded gun metal/Brass Manufactured by: Sand casting/Die Casting	IS-1458-1965 Class-V/ IS-1264-1997, Grade: DCB1/DCB2
2.	• TG10931AZ/M • TG10919 AY • TG4302 AZ • TG586 • TG740 • TA10102 AZ/AY/CW/DW/EV • TA10105 AZ • TA10106AZ/BZ • AG2702 AZ/BX • AG3101AZ/AY • AG51/M • AG2513AZ/M • AG2501AZ/M • DY3423/M or any other traction machines type equivalent to OEMs duly approved by RDSO		Material: Brass Manufactured by: Gravity Die casting/Sand Casting.	IS-1264-1997, Grade: DCB1/ DCB2

4.2.1 Properties of brush holders manufactured with Leaded Gun Metal:

A) Chemical Composition:

The Brush holder body shall be manufactured by sand casting/ Gravity die-casting as per IS: 1458-1965, class -V. The material shall be analysed in accordance with IS: 4027.

Sl.	Element	Percent	
		Min.	Max
1	Tin	4.0	6.0
2	Lead	4.0	6.0
3	Zinc	4.0	6.0
4	Phosphorus	-	0.05
5	Iron	-	0.35**
6	Antimony	-	0.3**
7	Aluminium	-	0.01
8	Other elements including iron+ antimony+	-	0.6
9	copper+ incidental nickel	Remainder	

** Iron and antimony together shall not exceed 0.5 percent.

B) Physical Properties:

Physical Properties of the Brush Holder body manufactured by Leaded Gunmetal shall be tested in accordance with IS: 1608:2005 and shall conform to IS: 1458-1965 Class-V Table-2 Sr.No-2 with following physical properties.

Tensile Strength (Min)	Elongation % (Min)
21 kgf/mm²	12

4.2.2 Properties of brush holders manufactured with Brass:

A) Chemical Composition: The Brush holder body shall be manufactured by Gravity Die Castings & shall conform to IS 1264:1997 and the chemical composition of the material shall be analyzed in accordance with IS: 3685-1966.

Sl.	Constituent Elements	GRADE DCB 1		GRADE DCB 2	
		Min (%)	Max (%)	Min (%)	Max (%)
1	Copper	59.0	63.0	58.0	63.0
2	Tin	-	-	-	1.0
3	Lead	-	0.25	0.5	2.5
4	Nickel	-	-	-	1.0
5	Iron	-	-	-	0.5
6	Aluminium	-	0.5	0.2	0.8
7	Manganese	-	-	-	0.5
8	Silicon	-	-	-	0.05
9	Impurities (excluding Ni+Pb+Al)	-	0.75	-	2.0
10	Zinc	Remainder		Remainder	

B) Physical properties:

Tensile Test: The Brush Holder body manufactured by Brass Gravity Die Castings (IS 1264:1997 Grade DCB1/ DCB2) shall be tested in accordance with IS: 1608:2005 and shall conform the following physical properties.

Tensile Strength (min.), MPa		Elongation (%)	
Grade DCB1	Grade DCB2	Grade DCB1	Grade DCB2
275	315	23	20
Note: 1MPa=0.102 kgf/mm²			

4.3 PRESSURE ARM ASSEMBLY:

4.3.1 SPRING:

4.3.1.1 Material of spring: The spring manufactured as per the table given below shall be Steel wire for mechanical springs: Cold drawn unalloyed steel wire conforming to IS: 4454 (Part-I) 2001 and Steel wire for mechanical springs: stainless steel wire with material grade X04Cr19Ni9 conforming to IS: 4454 (Part-IV) and the material of the stainless steel strip type spring conforming to IS: 6911-1992 with material grade X04Cr19Ni9.

Sl. no.	Machine Type	Material Specification of Spring (wire type/strip type)
1.	• TG10931 AZ • TG10931 AZ/M • TG10919 AY • TG4302 AZ • TG586 • TG740	IS: 4454 (Part-I) for Steel wire for mechanical springs: Cold drawn unalloyed steel wire. IS: 4454 (Part-IV) for Steel wire for mechanical springs: stainless steel wire with material grade X04Cr19Ni9. IS: 6911-1992 for Stainless Steel strip type spring with material grade X04Cr19Ni9.
2.	• TM752, TM761 • TM165,TM165/M • TM4906AZ/BZ, • TM4603 BZ,TM-4501 • TM4907BZ,TM-4906 • TM5002.AZ/BY/BW • TM4303BY/DY • TM4601AZ/TM4603BZ • TM5002.AZ/BY/BW • TM4603 BZ,TM4501AZ/M • AG2702AZ/AX/BX/BY AG3101AZ/AY • AG51/AG51M, DY3423M • AG2513AZ/M • AG2501AZ/M	
3.	• TMC1001,TM7362/A • TMC1005,TM2141A	
4.	• TA10102AZ/AY/CW/DW/ EV • TA10105 AZ, • TA10106 AZ/BZ	

4.3.1.2 Chemical Composition:

A) The material of the Steel wire for mechanical springs: stainless steel wire with material Grade mentioned in Table-2 of IS: 4454(Part-I), when analyzed in accordance with IS: 228 shall conform to chemical composition with permissible variation as given in Table-3.

B) The material of Steel wire for mechanical springs: Cold drawn unalloyed steel wire with material Grade: 2 designations X04Cr19Ni9 to IS: 4454(Part-IV) when analyzed in accordance with IS: 228 shall conform to chemical composition with permissible variation as given in table below.

C% (Max)	Si% (Max)	Mn% (Max)	S% (Max)	P% (Max)	Cr% (Max)	Ni% (Max)	Mo% (Max)
0.08	1.00	2.00	0.030	0.045	17.0 to 20.0	8.0 to10.0	-

C) The material of the Stainless Steel strip type spring to IS: 6911-1992 having material X04Cr19Ni9 when analyzed in accordance with IS: 228 shall conform to chemical composition with permissible variation as given in table below.

C%	Si%	Mn%	Ni%	Cr%	Mo%	S%	P%
0.08 (max)	1.0 *(max)*	2.0 (max)	8.0-10.0	17.5- 20.0	-	0.03 *(max.)*	0.045 *(max.)*

4.3.1.3 (A) Mechanical properties (for Steel Wire type spring):

(a) The tensile test of Cold drawn unalloyed steel wire to IS: 4454(Part-I) shall be carried out in accordance with IS: 1608-2005 and results shall conform to Table-5 of IS: 4454(Part-I).

(b) The tensile strength and test for reduction of area after fracture for stainless steel spring wire conforming to IS: 4454(Part-IV) shall be tested in accordance with IS: 1608-2005 and results shall conform to Table-4 of IS: 4454(Part-IV).

4.3.1.3 (B) Mechanical properties (for Stainless Steel strip type spring):

The mechanical property for Stainless Steel Strip type spring shall be done in accordance with IS: 6911-1992 and results shall conform to Table-4 of IS: 6911-1992.

4.3.2 Sleeve/Spring Hub for adjusting Pressure Arm (TM 4906/7):

Sleeve used in brush holder assembly is mounted on a pivot pin. Sleeve has 10 nos. of equally spaced through holes. It also has a cut in through which one end of the pressure spring is inserted. The pressure of the spring on carbon brush can be adjusted by changing the position of the sleeve on the pin. The sleeve plated with cadmium/zinc shall conform to IS: 2062-1992 Grade-B. The chemical composition of sleeve shall be tested in accordance with IS: 228, and the composition shall conform to Table-1 of IS: 2062-1992.

4.3.2 (A) Physical Properties for Sleeve/Spring Hub:

The Physical properties of the sleeve/spring shall be tested in accordance with IS: 1608(2005). The test results shall conform to Table -2 of IS: 2062-1992.

4.3.3 Pivot Pin for Pressure Arm:

This pin is used as a pivot for pressure arm spring. The pin shall be cadmium /zinc plated and shall be manufactured from Grade-B steel to IS: 2062-1992 or carbon steel conforming to Class 2A indicated in Table 1 of IS: 2004-1991. The chemical

composition of pivot pin shall be tested in accordance with IS: 228 and the test results shall conform to values as given in Table-1 of IS: 2004-1991/Table-1 of IS: 2062-1992 as applicable.

4.3.3 (A) Mechanical Test:

The mechanical tests of pivot pin shall be carried out in accordance with IS: 1608(2005) and the test piece shall conform to properties against Class 2A as given in Table-2 of IS: 2004-1991/Table -2 of IS: 2062-1992.

4.3.3 (B) Bend Test:

The test piece shall be subjected to bend test and shall be carried out in accordance with IS: 1599 -2012. After bend test the test piece shall not show any sign of crack/fracture on the outer convex surface.

4.3.4 Split Pin:

The split pin is provided in the brush holders of TM/AG/TA. The material properties of split pin shall adhere to IS: 549-2005 / IS: 6603-2001.

4.3.5 Rivet, Barrel:

Tests for Rivet and Barrel provided in AG3101 shall adhere to IS 319:2007.

4.3.5 (A) Chemical composition:

The material of the **Barrel** to conform IS: 319-2007 and **Rivet** to conform IS: 8364-1989, *Grade-1* when analyzed in accordance with IS: 3685 it shall conform to the composition of both as mentioned in the table below.

S. No	Element	Percent (%)	
		Min.	Max.
1.	Copper + incidental Nickel	56.0	59.0
2.	Lead	2.0	3.5
3.	Iron	-	0.35
4.	Total Impurities (excluding Iron)	-	0.7
5.	Zinc	Remainder	

4.3.5 (B) Mechanical properties:

(i) Tensile Strength: Tensile strength of **Barrel** when tested in accordance with IS 1608:2005 shall conform to parameters as per Table 2 of IS: 319-2007, *Grade1*.

SL No.	Cross sectional dimension, mm	Ultimate tensile strength in N/mm² Min.	Percent Elongation Min.
1	Up to & incl. 10	405	4.0

Note: Up to 10 mm size, gauge length shall be 100 mm.

(ii) Tensile Strength: Tensile strength of **Rivet** when tested in accordance with IS 1608:2005 shall conform to parameters as per Table 2 of IS: 8364-1989, *Grade1*.

SL No.	Cross sectional dimension, mm	Ultimate tensile strength in N/mm² Min.	Percent Elongation Min.
1	Up to & incl. 6	410	4.0

4.3.6 Pressure Flinger, Ratchet, Adjusting Lever:

Material of Pressure Flinger, Ratchet and Adjusting Lever provided in AG3101 shall adhere to IS: 513-*2008*.

4.3.6 (A) Chemical Composition:

The material composition of Pressure Flinger, Ratchet and Adjusting Lever shall be tested from melt analysis. The composition of material from melt analysis shall be as follows.

C % *(Max)*	Mn % *(Max)*	S % *(Max)*	P % *(Max)*
0.12	0.50	*0.035*	0.040

4.3.6 (B) Mechanical Properties:

Bend Test: Bend test of test piece shall be carried out in accordance with IS: 1599(2012).The test piece shall be capable of being bent cold through 180° close without showing sign of cracks or fracture on the outer convex surface.

5.0 Saddle (BHEL TG):

Saddle used in BHEL type brush holders shall be manufactured from brass and conform to IS: 410-1977. Chemical composition of the material shall be tested in accordance with IS: 3635 and shall conform to table-1 of IS: 410-1997. The tensile strength should be as per table-2 of IS: 410-1977 when tested in accordance with IS 1608:2005.

5.1 Pressure Arm Assembly for TG Brush Holder:

5.1.1 Clamp/Catch:

Sl. No	Size	Hardness
1.	Up to & Incl. 1.25mm,thick	115HV,max
2.	Above 1.25mm,thick	125HV,max

Clamp shall be manufactured from hot rolled carbon steel sheet conforming to Grade mentioned in table-1. The chemical composition of the material when analyzed in accordance with IS: 228 shall conform Table-3 of IS: 1079:2017 and the mechanical properties when tested in accordance with IS: 1608(2005) shall conform to Table-5 of IS: 1079:2017.

5.2 Hinge Pin/Pivot Pin:

Hinge Pin used in brush holder for pressure assembly shall be manufactured from steel to IS: 2062-1992 or carbon steel conforming to Class 2A indicated in Table 1 of IS: 2004-1991 but pin shall be cadmium/zinc plated. Chemical composition and the Physical properties of hinge pin shall conform Table1 and Table-2 of IS: 2062-1992/ Table -1 and Table-2 of IS: 2004-1991 as applicable. The finished material shall be free from cracks, surface flaws, laminations and all other harmful defects.

5.3 Damping Bush:

Damping bush used in pressure arm assembly under leaf spring shall be manufactured from neoprene/chloroprene rubber.

6.0 Machining – Dimensions and Tolerance:

The dimensions, tolerances and surface finish of Brush Holders specified in the relevant drawings of different electrical machines is given at annexure-A shall be strictly adhered to.

7.0 Spring Pressure: Spring pressure requirement for traction motor, traction alternator, traction generator and auxiliary machines shall be as under.

TABLE (A):

Type of machine	Traction Motors (ALCo Loco)							
	GE		BHEL				CGL	
	TM 752	TM 761	TM165/ 165M & TM4906/7	TM253 TM4603	TM4501	TM 5002	TM 7362/A	TM C1001
Spring pr. (kgs)	4.5 to 5.5	3.6 4 to 4.1	4.5 to 5.4	2.7 to 3.65	3.2 to 3.7	4.5 to 5.5	3.0 to 3.6	4.5-5.4

TABLE (B):

Type of machine	Traction Motors (DEMU)			
	BHEL		CGL	
	TM4601	TM4303	TM 2141A	TM C1005
Spring pr. (kgs)	2.7 - 3.65	3.65 ± 0.4	2.9 - 3.2	4.8 – 6.2

TABLE (C):

Type of machine	Traction Generator (ALCo)				Traction Alternator (ALCo)
	GE, TG586	GE, TG581	BHEL, TG10931	BHEL, TG10919	BHEL TA10102/TA10105
Spring pressure (kgs)	1.42 to 1.7	1.42 to 1.7	1.6 to 1.9	1.6 to 1.9	1.56 to 2.21

TABLE (D):

Type of machine	Auxiliary Machine (ALCo)		
	AG 3101	AG 2702	AG51/M
Spring pressure (kgs)	840gms. (In 1st notch) ±10%	1200gms. (In 2nd notch) ±10%	1200gms. (In 2nd notch) ±10%

The Spring Pressure shall be measured outside the machine.

8.0 Sampling and Test: The tests of complete Brush Holder assembly shall constitute type test, routine test/ acceptance test.

8.1 Type test:

Type testing constitutes material composition, physical properties, and dimensional check as relevant to Brush Holder drawing which is mandatory for product approval or approval of firm. However, approving authority reserves the right to repeat the tests or waive off the tests at their discretion.

Type testing constitutes submission of manufacturing QAP & shall offer four nos. of brush holders for one traction motor type TM 4907 or its equivalent for type testing as per this specification. Type Test shall be carried out by RDSO representative at

the cost of firm seeking approval. After prototype test, the firm shall manufacture 72 brush holders for eighteen nos. of machines type TM 4907 (i.e. 3 loco set) as per the relevant drawing and material mentioned in this specification for service field trial of at least 06 months. On successful completion of field trials, the product shall be cleared for inclusion in the "List of RDSO vendors for Developmental order". The purchaser reserves the right to repeat the type test of an approved product. If the firm does not have test facility for conducting any one of the tests mentioned in this specification, the same may be carried from Govt. approved laboratory /outside agency accredited by NABL/NABCB.

Sl.	Type Test	Test Criteria
1.	Visual Examination & Dimensional check	Visual Examination & Dimensions check on 04 nos.
2.	Test for Mechanical Properties and Chemical composition	Test for chemical and mechanical properties as per this specification.
3.	Spring pressure	Spring pressure on at least 04 nos.
4.	Radiographic testing	02 nos. (Acceptance criteria for any defect shall be upto Level3 of ASTM E272-15)

8.2 Acceptance Test:

This test shall be carried out by purchasing authority or authority nominated by them as per the table given below:

Sl.	Acceptance test	Test criteria
1.	Visual Examination & Dimensional check	Visual Examination, Envelope and Pocket dimensions. (On sample lot)
2.	Test for Mechanical Properties and Chemical composition	It shall conform to the material properties as per this specification. (Upto 200 nos. - 1 sample) (Above 200 nos.- 2 samples)
3.	Spring pressure	Spring pressure (Upto 200 nos. – 5%) (Above 200 nos .- 3%)
4.	Radiographic testing	Acceptance criteria for any defect shall be upto Level3 of ASTM E272-15. (Upto 200 nos. – 1 sample) (Above 200 nos. - 2 samples)

9.0 Marking:

Brush Holder shall be marked with month/year, manufacturer's name and identification number on the outer surface of the product.

10.0 Warranty:

The Brush Holder and its related components covered under specification shall be warranted for satisfactory performance and trouble free operation for a period of two years from the date of its commission in service.

11.0 Packing:

The brush holder and its related components shall be packed as to permit convenient handling and to protect against losses or damages during transit and storage.

ANNEXURE-A

List of Brush Holder Drawings/Catalogue No

Sl.no.	Make	Machine Type	RDSO Drawing No./BHEL Catalogue No./ CGL Drg.No.
1.	GE	TG586,TG740	RDSO drg. No.- SKDP-3012
		TM752	RDSO drg. No.- SKDP-3013
		TM761	RDSO drg. No. -SKDP-3014
2.	BHEL	AG3101 AZ/AY/AY-1/AX	RDSO drg. No.- SKDP-3540 BHEL Catalogue No- 422200002
		AG2702 AZ/AX/BX/BY	RDSO drg. No.- SKDP-3541 BHEL Catalogue no- 426200003
		AG51/AG51M AG2513AZ/M AG2501AZ/M	BHEL Catalogue no- 417200002
		TG10931 AZ/M TG10919 AZ/AY TG4302 AZ	BHEL Catalogue no- 416200012
		TM165,TM165/M TM4906AZ/BZ TM4907 BZ	RDSO drg. No. SKDP-3834 RDSO drg. No. SKDP-3835 BHEL Catalogue no- 401200001
		TM4603BZ/ TM4601AZ/ BZ/BY/BX	BHEL Catalogue no- 441200002 for LH BHEL Catalogue no- 441200004 for RH
		TM4501AZ/M	BHEL Catalogue no- 453200002
		TM4303 BY/DY	BHEL Catalogue no- 480200001
		TM5002 AZ/BY/BW	BHEL Catalogue no- 427200001 for RH & BHEL Catalogue no- 427200002 for LH
		TA10102AZ/AY/CW/DW/EV TA10105 AZ TA10106 AZ/BZ	BHEL Catalogue no- 425200005
3.	CGL	TM7362/A	CGL drg. No.CGM/102402 CGL drg. No. CGM/12403
		TM C1001	CGL drg. No.CGM/309402
		TM 2141A	CGL drg. No.CGM/11402
		TM C1005	CGL drg. No.CGM/206402

Note:

1. Drawings mentioned above are complete drawings of the brush holder assembly including insulating brush holder arm (insulating stud/pin). However insulating stud has been deleted from the scope of this specification. Separate drawings of insulating arm/stud have been issued to Railways vide RDSO letter no.SD.DFM.A.2.2 dated: 07-05-03. Railways shall procure brush holder as per brush holder specification no. MP.0.2400.09 *(Rev-04)*. Railways shall procure insulating arm for brush holders as per drawing no./catalogue no. given in Annexure-B.
2. For technical requirements of constant pressure brush holder for auxiliary machine type AG3101AZ/AY refer to specification no.MP.0.2400.71 Rev-00 and RDSO drg. No- SKDP-4097.

ANNEXURE-B

List of Drawings/Catalogue no. for Insulating Arm of Brush Holder

Insulating arm for brush holder which are applicable for different electrical machines are as follows (for reference purpose only).

Sl. No.	Machine Type	RDSO Drawing No./BHEL Catalogue No./ CGL Drawing No.
1	TM165 TM165/M TM 4906AZ/BZ TM 4907BZ	RDSO drg.no- SKDP 3501 BHEL Catalogue no- 401320017
2	AG 2702 AZ/AX	RDSO drg. no- SKDP 3542 BHEL Catalogue no- 426200017
3	AG 3101 AZ/AY/AY-1/AX	RDSO drg. no- SKDP 3543 BHEL Catalogue no- 422200010
4	TG 10931 AZ/M TG 10919 AZ/AY	RDSO drg. no-SKDP 3544 BHEL Catalogue no- 425200001
5	TM 5002 AZ/BY/BW	RDSO drg. no- SKDP 3590 BHEL Catalogue no- 427200008
6	AG 51/AG51M AG 2513 AZ/M AG 2501 AZ/M	RDSO drg. no- SKDP 3591 BHEL Catalogue no- 417200003
7	C1001TM	CGL drg. no- CGM/309407
8	C1005TM	CGL drg. no.- CGM/306402
9	TM 7362A	CGL drg. no- CGM/42404
10	TM 2141A	CGL drg. no- CGM/31401

Note: The latest version of drawing indicated above or as mentioned in the P.O. shall be followed by the manufacturer.