



भारत सरकार  
रेल मंत्रालय

**GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS**

डीजल विद्युत लोकोमोटिव में प्रयोग होने वाली कर्षण मशीनों में प्रयोग किये जाने वाले कार्बन ब्रश एवं प्रयुक्त होने वाले ब्लॉक, ग्लू फ्लेजीबल शंट, इन्सुलेटेड टॉप तथा टैपिंग चूर्ण की विशिष्टि

**SPECIFICATION FOR PROCUREMENT OF CARBON BRUSH  
CONSISTING OF CARBON BLOCK, GLUE, FLEXIBLE SHUNT,  
TERMINALS, INSULATED TOP AND TAMPING POWDER ETC. FOR  
TRACTION MACHINES OF DIESEL ELECTRIC LOCOMOTIVE**

विशिष्टि नं० एमपी०-०.२४००.६० (रिवीजन-०६)  
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अनुसंधान अभिकल्प एवं मानक संगठन  
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**LIST OF AMENDMENTS**

Sl. No.	Amendment date	Revision	Details
1.	Aug'2021	06	Addition of list of Amendments
			Addition of Index
			Addition of clause no. 1.1 (Scope)
			Addition of clause no. 2.1 (Vendor changes in approved status)
			Addition of clause no. 2.2 (Reference to Make In India)
			Addition of clause no. 3.0 to 3.7 (General Requirements)
			Addition of clause no. 4.0 & 4.1 (Quality Assurance Plan-QAP)
			Addition of clause no. 5.0 & 5.2 (Quality Control Organization)
			Addition of clause no. 7.0 - Testing: (Type Tests & Routine/Acceptance tests)
			Addition of clause no. 7.3 to 7.9 (Tests/Parameters of the components)
			Addition of clause no. 8.0 (Terminals)
			Addition of clause no. 9.0 (Insulated Top)
			Addition of clause no. 10.0 (Marking)
			Addition of clause no. 11.0 (Packing)
			Addition of clause no. 12.0 (Field Trial Scheme)
Addition of clause no. 13.0 (Applicable Standards)			

**INDEX**

<b>S No.</b>	<b>DESCRIPTION</b>	<b>PAGE No.</b>
-	Cover page	1
-	List of amendments	2
-	Index	3
1	Introduction	4
1.1	Scope	
2.0	Objective	4
2.1	Vendor changes in approved status	4
2.2	Preference to make in India	4
3.0	General requirements	4
4.0	Quality assurance plan (QAP)	5
5.0	Quality control organization	6
6.0	Scope of supply (Table-A & B)	6 & 7
7.0	Testing	8
7.1	Testing of Tamping Power	8
7.2	Testing of Glue	8
7.3	Testing of Carbon Block	8
7.4	Tests of Copper Wire	9
7.5	Tests on Flexible Shunt	9
7.6	Tests on Rubber Top	10
7.7	Testing of Carbon Brush	10
7.8	Endurance test	10
7.9	Test for Effect of Temperature	11
8.0	Terminals	11
9.0	Insulated top	11
10.0	Marking	11
11.0	Packing	11
12.0	Field trial scheme	12-13
13.0	Applicable Standards	13-14

**Specification for procurement of Carbon Brush consisting of Carbon Block, Glue, Flexible shunt, Terminals, Insulated top and Tamping powder etc.**

**1. INTRODUCTION:**

This specification governs various grades of Carbon brushes used in traction machines of diesel-electric locomotives.\_

**1.1 SCOPE:**

This specification covers manufacturing and testing of carbon blocks & brushes used in traction machines of diesel electric locomotives. It also covers properties and testing of various components used in manufacturing of carbon brushes viz. flexible shunt, tamping powder, insulated top, terminals etc.

**2.0 OBJECTIVE:**

The objective of the specification is to lay down guidelines for manufacturing and supply of carbon brushes consisting of carbon block, glue, flexible shunt, terminals, insulated top and tamping powder etc.

**3.0 VENDOR CHANGES IN APPROVED STATUS**

All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11 dated 01.07.2020 (Title "Vendor-Changes in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.

**4.0 PREFERENCE TO MAKE IN INDIA:**

The Government of India policy on make in India shall apply.

**5.0 GENERAL REQUIREMENTS:**

**5.1** The firm shall have valid ISO-9001 certification issued by an approved agency with the activity desired clearly mentioned in the scope of certification. The firm shall have a Quality Manual indicating the extent of control over production.

**5.2 QUALITY ASSURANCE PLAN (QAP):**

The firm shall prepare a Quality Assurance Plan (QAP) for all items for which approval is sought and submit the same as a part of compliance of this Specification. The QAP shall be a comprehensive document covering the following aspects including all the

parameters in accordance with ISO Document No. QM-RF-8.1-3, Version No. 1.0 or latest - Guidelines for preparing QAP during registration.

Followings are the salient points for preparing the QAP.

- (i) Details of Quality Control Organization of the firm along with key personnel engaged in the QC function.
- (ii) Quality Assurance Process of incoming materials used for the subject items.
- (iii) Process Flow Chart indicating process of manufacture of an individual product or for a family of products, if the process is same.
- (iv) List of plant, machinery, measuring and Testing Equipment.
- (v) Quality Assurance System – Inspection & Testing Plan including stage inspection.
- (vi) Calibration scheme and status of calibration of equipment's used in the quality process.
- (vii) The firm shall have a system of documentation with respect to rejection at customer end, warranty replacement and failure of item supplied by them during service.
- (viii) Details of In-house manufactured and items outsourced.

The QAP is required to be approved by RDSO.

## 6.0 SCOPE OF SUPPLY:~

6.1. The scope covers supply of carbon brushes consisting of carbon block, glue, flexible shunt, terminals, insulated top and tamping powder etc.

6.2 The references drawing of Carbon Brush along with applicable machines and locos is furnished as Table-A. The recommended grade of carbon block with size is furnished as Table-A.

**TABLE-A**

SN	Machine / Application	Applicable Locos	RDSO Ref. Drg. No.	DMW Ref. Drg. No.
1	TG 5GT740 PAI	YDM4A	-	CB 17RF
2	TG GT586	WDM2	-	CB 18RF
3	TG 10931 AZ / TG 10919 AZ	WDM2	SK.DP-3729	CB 20RF (A&B)
4	TM 165M / GE752 / TM 4906/ TM 4907	WDM2, WDM3A, WDM3C, WDM3D	SK.DP-3727	CB 21RF
5	TM 761 PA3	YDM4, YDM4A	-	CB 23RF
6	TM 761 PA3	YDM4, YDM4A	-	CB 36RF
7	TM 253 BX / AZ / TM 4601 AZ	YDM4	-	CB 24RF
8	AG 51	WDM2,WDP1	SK.DP-3814	CB 38
9	DY 3423	WDM2,YDM4	-	CB 44RF
10	AG 3101 AZ / AY	WDM3A,WDM3C,WDM3D, WDG3A & WDP3A	SK.DP-3815 & SK.DP-4098	CB 46
11	Aux Gen & DB 5GY27 & 5GY19	WDM2	SK.DP-3817	CB 47

12	TM5002	WDP1,WDP3A, WDP3DH	SK.DP-3816	CB 55
13	TA 10102CW / DW	WDM2,WDM3A, WDM3C, WDM3D, WDG3A,WDP1, WDP3A & YDM6	SK.DP-3818	CB 57
14	TM 5002AZ / BY	WDP1,WDP3A, WDP3DH	SK.DP-3816	CB 59RF
15	Main Alternator TA-17 of HHP locos	WDP4,WDP4B & WDG4	SK.DP-3921	CB 60
16	Companion Alternator CA-6 of HHP locos	WDP4,WDP4B & WDG4	SK.DP-3922	CB 61
17	DB Blower motor (HHP locos)	WDP4,WDP4B & WDG4	SK.DP-3923	CB 62
18	TM 7362A	WDP1,WDP3A, WDP3DH	SK.DP-3890	CB 63RF
19	TM 4303 AZ/CZ	1400HP DEMUs	-	CB 64RF (Item No.1)
20	TM 4303BY/DY	1400HP DEMUs	-	CB 64RF (Item No.2)
21	DB Grid Motor (Imported)	WDP4,WDP4B & WDG4	-	CB 68
22	TG 5301 BX	WDM2	SK.DP-3729	-
23	TG 581/586A	WDM2	-	-
24	TA 10105 AZ, TA 10106 AZ	WDM2,WDM3A, WDM3C, WDM3D, WDG3A,WDP1, WDP3A & YDM6	-	-
25	AG 2513, AG 2501	WDM2,WDP1	-	-
26	AG 2702 AZ	WDM2	-	-
27	Exciter Alternator 5G7A6A1 (GE)	WDM2	-	-
28	TM-2141 (CGL)	700HP DEMUs	-	-
29	DB Blower Motor- 5GY90	WDM2	-	-
30	Fuel Pump Motor	WDM2	-	-
31	Fuel Pump Motor-ES- 117 (ELGI)	WDM2,WDM3A, WDM3C, WDM3D, WDG3A,WDP1,	-	-
32	Fuel Pump Motor 5BC76AB286(GE)	WDM2	-	-
33	Crank Case Exhauster Motor ES- 92 (ELGI)	WDM2,WDM3A, WDM3C, WDM3D, WDG3A,WDP1,	-	-
34	Eddy Current Clutch EC-9005/2/M	WDM2,WDM3A, WDM3C, WDM3D, WDG3A,WDP1,	-	-
35	Clutch Gear- 5DGY32A1	WDM2	-	-
36	TG-GT-740 PAI	YDM4A	-	-
37	Exciter Auxiliary Generator (GM)	YDM4	-	-
38	Crank Case Exhauster Motor	YDM4	-	-
39	Hasler Speedometer	WDM2, YDM4	-	-

Sl. No.	DMW reference Drawing No.	Machine / Application	Block-size in mm	No. of brush/ block
1	GB17RF	TG-5GT740-PAI	120x68x23	4
2	GB18RF	TG-GT586	120x68x23	4
3	GB20RF (A&B)	TG-10931-AZ / TG-10919-AZ	A-127x68x26.5 B-120x68x26.5	4
4	GB-21RF	TM-165M / GE752 / TM-4907	98x59x23	2
5	GB-23RF	TM-761-PA3	122X53X23	3
6	GB36RF	TM-761-PA3	122X61X23	3
7	GB-24RF	TM-253-BX / AZ / TM-4601-AZ	163x47x30	3
8	GB-38	AG-51	146x68x30	12
9	GB-44RF	DY-3423	146x69x29	9
10	GB-46	AG-3101-AZ / AY	125x56x38	12
11	GB-47	Aux-Gen & DB-5GY27 & 5GY19	95x57x30	8
12	GB-55	TM5002	11x51x54 (GL)	0.5
13	GB-57	TA-10102GW / DW	124x52x27	3
14	GB-59RF	TM-5002AZ / BY	59x51x11	0.5
15	GB-60	Main Alternator TA-17 of HHP locos	114x69x31	8
16	GB-61	Companion Alternator CA-6 of HHP locos	118x43.5x23	8
17	GB-62	DB Blower motor (HHP locos)	87x55.5x25	4
18	GB-63RF	TM-7362A	124x46x23	2
19	GB-64RF (Item No.1)	TM-4303-AZ&CZ	98x56x25	2
20	GB-64RF (Item No.2)	TM-4303-BY/DY	98x59x25	2
21	GB-68	DB-Grid Motor (Imported)	110x21x25	2

**6.3** Firm shall have to furnish all data pertaining to the Machine/Application as given in the above Table A & indicated at Table B to Table H.

**6.4** Procurement of tamping power and glue is to be carried out adhering to parameters mentioned in Table- B.

If procurement of carbon block, tamping power and glue is to be done, in form of kit, then Table - A & Table - B to be complied. Sufficient working allowances should be added to the estimated quantity while tendering. The relevant part nos., for tamping powder & glue are given in **Table-B** for both the firms:

**TABLE-B**

Items → Parameters ↓	Tamping Powder	Glue
Type of Powder	Silver Coated Copper Tamping Powder/ Graphite Copper Tamping Powder	Bakelite Powder or any other type of glue given by OEM duly approved by RDSO
Packing Condition	Powder should be supplied in Sealed condition	It contains 01/02 different Components to be mixed in recommended proportions as declared by the firm.

Part No.	To be furnished by firm in QAP		To be furnished by firm in QAP		
	Sealed	Open	Sealed	Open & Un-mixed	Mixed
Minimum Shelf Life	06 months	1 Day	06 months	06 months	04 days

**6.5** The requirement of carbon brush, tamping powder, glue, flexible shunt & other ingredients should be evaluated by firm as per requirement considering the limited shelf life of tamping powder & glue. ~~The requirement of carbon block, tamping powder and glue should be tendered as a kit so that the offers are evaluated as a kit. Since the tamping powder /glue have a limited shelf life, the supply of these items should be staggered in such a way so as to limit the inventory.~~

**7.0** TESTING:

**Type Tests:** Type tests shall be carried out by Vendor Controlling Authority/RDSO at firm's premises on newly developed Carbon Brush Grade with existing approved design offered by manufacturer.

**Acceptance Tests:** Acceptance tests shall be carried by purchaser at firm's premises on the Carbon Block & Brush Grade as offered, which is already developed and type tested.

**Following Table indicates the Type Tests and Acceptance Tests to be carried out:**

**7.1** **Testing of Tamping Powder:**

The tamping powder shall be tested against the parameters given below in **Table-C**.



**Table-C**

SN	Type of test	Acceptance Criteria for Tamping Powder	Specification of Testing	Type Test	Acceptance Test
1	Bulk Density	1.80- 3.2 gm/cc	IS-4848, 1981	√	√
2	Flow Rate	24-40 sec for 50 gms powder	IS-4840, 2006	√	√
		15-35 sec for 50 gms powder or any other powder given by OEM duly approved by RDSO/Vendor Controlling Authority	IS-4848, 1981	√	√
			As per relevant IS	√	√
3	Sieve Analysis (If applicable)	<b>Method-A</b>		-	-
		Above 40#	Nil	√	√
		Passed through 40# and retained on 100#	Min. 75%	√	√
		Passed through 100# and retained on 200#	Max. 20%	√	√
		Passed through 200#	Max. 5%	√	√
		<b>Method-B</b>		-	-
		28# (650 microns)	Max. 0.2%	√	√
		+200# ( 75 microns)	Min. 85%	√	√
		-200# (75 microns)	Max. 15%	√	√
		or <b>Any other Method /Acceptance Criteria</b> furnished by OEM in QAP duly approved by RDSO/Vendor Controlling Authority		√	√
4	Copper Content (If applicable)	80-95%	IS-440,1964	√	√
5	Grain Size	50 microns (Max.)	BS-410	√	√

**7.2 Testing of Glue: \_**

The glue shall be accepted on the test certificate issued by the OEM conforming to their specification or the firm shall produce an under taking for its suitability.

**7.3 Testing of Carbon block:**

The Carbon block sample shall be tested against IS: 13584-1993. The tests shall be carried out on the carbon block of different grades as per **Table-D** given below:

Table-D

SN	Tests	Governing	Acceptance limits	Type	Acceptance
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		<b>Specification</b>		<b>Test</b>	<b>Test</b>
1	Bulk Density	Clause no. 6.0 of IS 13584:1993	As per relevant standards/drawings	√	√
2	Porosity (Only for Electro-Graphite Grades)	Clause no. 6.0 of IS 13584:1993	As per relevant standards/drawings	√	x
3	Hardness	Clause no. 7.0 of IS 13584:1993	As per relevant standards/drawings	√	√
4	Resistivity	Clause no. 8.0 of IS 13584:1993	As per relevant standards/drawings	√	√
5	Transverse Strength	Clause no. 9.0 of IS 13584:1993	As per relevant standards/drawings	√	√
6	Ash Content (Only for Electro-Graphite Grades)	Clause no. 10.0 of IS 13584:1993	As per relevant standards/drawings	√	x

**7.4 TESTS OF COPPER WIRE:****Table-E**

<b>SL. No</b>	<b>Tests/parameters</b>	<b>Governing Specification</b>	<b>Acceptance limit</b>	<b>Type test</b>	<b>Acceptance Test</b>
1	Visual test	Clause 5.4 & 3.1 of IS:13525-92	No abnormality	√	√
2	Measurement of weight	Clause 6.3.5 of IS:13525-1992	As per Table-1 of IS:13525-1992	√	√
3	Chemical composition for electrolytic tough pitch (ETP) copper	IS:191 (Part-5):2007	Copper purity = 99.85% (Min.)	x	x
4	Conductivity at 20°C (minimum)	Cl. 6.3.6 of IS13525-92	As per Table -1 of IS-13525: 1992	x	x
5	Electric resistance Test	Cl. 6.3.4 of IS 10810 (Part5)-1984		x	x
6	Annealing test (Before stranding)	Cl. 6.3.3 of IS 13525:1992	As per Table-1 of IS-13525: 1992	x	x

**7.5 TESTS ON FLEXIBLE SHUNT:****Table-F**

<b>SL. No</b>	<b>Tests/parameters</b>	<b>Governing Specification</b>	<b>Acceptance limit</b>	<b>Type test</b>	<b>Acceptance Test</b>
1	Visual test	Clause 6.4.1 of IS:13525-92	No abnormality	√	√
2	Construction	Product Drg.	As per product Drg.	√	√
3	Measurement of dia.	Clause 6.4.3 of IS:13525-92	As per product Drg.	√	√
4	Electrical resistance	Clause 6.4.4 of IS:13525-92, IS10810 Part-5	As per Table-2 of IS:13525-1992	√	x

5	Measurement of weight	Clause 6.4.5 of IS:13525-92	As per Table-2 of IS:13525-1992	√	√
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**7.6 TESTS ON RUBBER TOP:****Table-G**

SL. No	Tests/parameters	Governing Specification	Acceptance limit	Type test	Acceptance Test
1	Hardness (Shore 'A')	RDSO/M&C/ RP-130/84 2020	70±5	x	x
2	Tensile Strength (Kg/sq.cm)	-do-	50 (min)	x	x
3	Elongation at Break %	-do-	125 (min)	x	x
4	Compression set (%)	-do-	25 (max)	x	x
5	Accelerated Ageing Test Hardness (Shore A) max. Tensile strength Elongation at Break	-do-	+7/-0 ± 25% ± 30%	x	x
6	Test for Effect of Temperature	Clause 7.9 of this spec	As per clause 7.9 of this spec	√	x

**7.7 TESTING OF CARBON BRUSH:****Table-H**

SN	Tests	Governing Specification	Acceptance limits	Type Test	Routine/ Acceptance Test
1	Workmanship	Cl. 16.4 of IS 13466-1992	No abnormality	√	√
2	Dimensional	As per relevant drawing	As per drawing	√	√
3	Millivolt Drop test	Cl.16.6 of IS:13466-1992	As per Table-2 of IS:13466-1992	√	√
4	Pull Out Strength test	Cl.16.7 of IS:13466-1992	As per Table-3 of IS:13466-1992	√	√
5	Endurance test	As per cl. No. 7.8 of Spec no-MP.0.2400.60 Rev-06	As per cl. No. 7.8 of Spec no-MP.0.2400.60 Rev-06	√	x
6	Test of effect of temperature	As per clause no. 7.9 of this spec no. MP.0.2400.60 Rev-06	As per clause no. 7.9 of this spec no. MP.0.2400.60 Rev-06	√	x
7*	Brush wear	Clause no. 11.3 of IS 13584:1993	As per firm's declaration on grade property chart	√	x

8	Co-efficient friction	of	Clause no. 11.2 of IS 13584:1993	As per firm's declaration on grade property chart	√	x
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**Note:**

All tests mentioned in Table-C, D, E, F, G & H which are marked with “x” are to be verified from Supplier's TC or Internal Test report/Test report of NABL/Govt. approved Lab only.

\*Brush wear obtained on Test Setup is indicative. Actual brush wear is to be obtained from field performance on actual machines.

~~**Note:-**~~

~~In case of purchase inspection for complete Carbon Brush Assembly, acceptance test will be carried out as per Clause no. 7.7 applicable for Routine test and Internal routine test report of components given above (Para 7.1 to 7.6) may be verified.~~

### 7.8 Endurance test of Carbon Brush (To be conducted during Type Test and at periodic interval as per firm's QAP ):

- 1) Select 15 carbon brushes at random from the lot.
- 2) From the 15 selected brushes, subject 5 brushes to initial millivolt drop test followed by pigtail pullout strength. Average values of mV drop and pigtail pull out strength shall be used for evaluating performance of remaining 10 brushes subjected to endurance.
- 3) Subject the balance 10 carbon brushes to mV drop test. 100 heating and cooling cycles. The heating/cooling cycles shall consist of passing 1.7 times the normal machine current per flexible for 2 minutes followed by 4 minutes cooling under natural environment. A small hole will be drilled near pigtail into the brush, to determine the temperature rise during this test.
- 4) During the test, record following for each above 10 brushes:-
  - i. Millivolt drop test at each pigtail.
  - ii. Pull out strength of each pigtail.
- 5) Criteria for Acceptance:
  - a) The millivolt drop of each brush, subjected to endurance test, shall not exceed five times the average millivolt drop as observed in Test (7.8- 2).
  - b) The average value of pull out strength of the 10 brushes, after the test, shall not be less than 70% of the average value of five brushes subjected to Test (7.8- 2).

### 7.9 Test for Effect of Temperature on Rubber Top of Carbon Brush (To be conducted during Type Test and at periodic interval as per firm's QAP ):

Two samples out of every lot of finished carbon brushes shall be taken and hardness of insulating rubber measured. The samples shall then be put inside oven at 180°C for 2 hours. The hardness of insulating rubber shall not vary by more than  $\pm 5\%$  from the value measured before putting the samples in oven. The insulated top joint shall not be removable with normal effort.

## 8.0 TERMINALS:

Terminals shall be made of electrolytic grade copper. The type and size of the terminals shall be as per drawing. The joints between terminals and flexible shunt of carbon brushes shall be crimped and soldered unless specified otherwise in product drawing.

**9.0 INSULATED TOP:**

Carbon brushes shall be provided with insulated top wherever specified in the product drawing. Dimension & tolerances of the insulated top shall be as per specified product.

The insulating material of the insulated top shall be suitable grade of silicon rubber compound and conform to the requirements of RDSO specification no- RDSO/M&C/RP-130/84 2020 (Copy enclosed).

A suitable hard top made of hard material bonded with the silicon rubber insulation shall be provided wherever specified in the product drawing. The hard top should not break, crack and the bonding between the hard top and insulating rubber should not fail due to the mechanical forces encountered in service.

Insulated top shall be properly fixed on carbon brush top surface by good quality of adhesive. The adhesive shall not adversely affect the properties of rubber of carbon. The joint formed shall not be removable with normal effort. —

**10.0 MARKING:**

The following particulars shall be legibly and indelibly engraved/pad printed on each carbon brushes on two wider faces **or as specified** in the product drawing above the condemning mark”:

- Grade of carbon brush.
- Identification of source of manufacturer.
- Batch no, month and year of manufacture.

**11.0 PACKING:**

Carbon brushes shall be suitably packed so as to avoid any damage during transit.

**12. FIELD TRIAL SCHEME:**

The specified Quantities shall be subjected to field trials for specified period before clearance is given for bulk supply. The Quantity and period of Field trials shall be governed by RDSO Document no. MP-M-8.1-1(Latest).

Field trial of Carbon Brushes shall be carried out and performance to be monitored as per following format:

SN	Rly/ Shed	Make Carbon brush grade & M/c	Duration	Type of loco & M/c	Population of carbon brush	Condition of commutation	Wear rate /10000 km	Life obtained in Months	Uprooting of pigtails	melted Pigtails overheated/	Chipping	Breakage	Other defects, if any	Total

**13. APPLICABLE STANDARDS:** The specification refers to the following standards:

S. No	Reference Standard	Description
1	IS: 4848-1981	Method for Determination of Apparent Density of Free Flowing Powders for Powder Metallurgical Purpose.

2	IS:4840-2006	Metallic Powders- Determination of Flow Time by Means of a Calibrated Funnel (Hall Flowmeter)
3	BS-410-1, 2000 and BS-410-2, 2000	Test Sieves.
4	IS:440-1964	Methods for Chemical Analysis of Copper.
5	IS:13584-1993	Brush Materials for Electrical Machinery.
6	IS:13525-1992	Flexible Conductors for Carbon Brushes.
7	IS:191:2007	Copper (4 <sup>th</sup> revision)
8	IS:10810(Part5) -1984	Methods of Test for Cable (Conductor Resistance Test).
9	RDSO/M&C/RP-130/2020 (Revision 1.0)	Specification for Rubber Top of Carbon Brush and Rubber Sleeve of Pigtail of Carbon Brush.
10	IS:13466-1992	Brushes for Electrical Machines.

2nd Final DRAFT SPEC