Carbon Brushes for Industrial and Railway Application

Physical data of the principal grades

To characterize carbon and graphite materials used for carbon brushes, it is sufficient to state the following material characteristics:

- Specific electrical resistance
- Hardness
- Bending strength and Bulk density

For metal-graphite grades, we additionally state the metal content. All data are average values.

Information on the test methods and equipment is given in IEC Publication 413, the recommendations of which have been generally adopted.

As an indicator of the running performance of carbon brushes, voltage drop and coefficient of friction can be looked at. These two parameters are, however, affected by numerous environment influences and the operating conditions, so that they are subject to relatively high fluctuations.

A statement which is generally valid is therefore only possible by stating ranges, in which experience shows these values to lie.

The following summary shows the ranges selected in each case and the corresponding symbols:

Classification	Symbol	Voltage drop between two carbon brushes connected in series Uü (V)	Coefficient of friction μ
Very low	vl	< 1.5	< 0.08
Low	l	1.5 – 2.2	0.08 – 0.15
Medium	m	2.2 – 3.0	0.15 – 0.22
High	h	> 3.0	> 0.22

The grades are classified into the selected ranges on the basis of measurements under test conditions 1 – 7, which are explained in the following table.

On request we are able to supply detailed technical data sheets of our grades, which also contain information regarding other operating conditions.

No.	Current density A/cm²	Peripheral speed m/s	Brush pressure cN/cm²	Collector temperature °C	Related to the following fields of application of the carbon brushes
1	12	30	250	90	Stationary D.C. machines with and without commutation aids
2	12	50	250	90	Traction motors
3	10	30	200	90	Three-phase commutator motors
4	6	60	160	90	Turbogenerators and turbomotors
5	20	30	200	90	Slip-ring machines and low-voltage machines
6	16	30	200	90	Slip-ring machines and low-voltage machines
7	12	30	200	90	Slip-ring machines and low-voltage machines

Physical data of the principal grades

Grade	Material type	Voltage drop	Coeffi-cient of friction	Test condi-tions	Resis-tivity µΩm	Rock-well HR 10/40	HR 5/40	Bending strength N/mm²	Bulk density g/cm³	Metal content %
A12S	Copper-graphite	vl	l	6	0.25	90	–	–	4.00	70
A16	Copper-graphite	vl	m	5	0.15	70	–	–	5.00	85
A20	Copper-graphite	vl	m	7	2.0	85	–	–	2.90	50
A24	Copper-graphite	l	l	7	3.5	85	–	–	2.60	40
A30	Copper-graphite	l	l	7	8.0	85	–	–	2.25	25
A41	Copper-graphite	m	m	6	5.0	100	–	–	2.80	37
B14Z1	Bronze-graphite	vl	l	5	0.1	100	–	–	5.30	90
B20	Bronze-graphite	vl	l	5	0.08	75	–	–	5.45	90
B24	Bronze-graphite	vl	l	5	0.1	105	–	–	5.70	90
B25	Bronze-graphite	vl	l	5	0.3	95	–	–	5.50	90
B26	Bronze-graphite	vl	l	5	0.15	90	–	–	5.90	95
C16	Metal-graphite	l	l	6	1.0	100	–	–	3.00	45
C40	Bronze-graphite	vl	l	6	0.3	80	–	–	4.05	75
C40Z3	Bronze-graphite	vl	l	6	0.3	100	–	–	4.10	75
C50	Bronze-graphite	vl	l	6	0.4	100	–	–	5.65	92
K14Z3	Copper-graphite	vl	l	6	1.0	110	–	–	3.35	62
S11	Silver-graphite	vl	m	–	0.05	–	70	–	7.00	95
S13	Silver-graphite	vl	l	–	8.0	75	–	–	3.35	60
F17	Copper-graphite	l	l	6	30	90	–	18	2.20	20
F19	Graphite	m	l	4	9	–	–	7	1.40	–
F23	Graphite	m	l	4	15	–	–	10	1.30	–
F24	Graphite	m	l	4	18	–	–	10	1.25	–
F40	Resin-bonded graphite	h	l	3	110	100	–	35	1.75	–
F46	Resin-bonded graphite	h	l	3	300	105	–	35	1.75	–
F49	Resin-bonded graphite	h	l	3	350	105	–	30	1.70	–
F51	Resin-bonded graphite	h	l	3	300	100	–	25	1.70	–
F61	Resin-bonded graphite	h	l	3	250	100	–	30	1.70	–
F63	Resin-bonded graphite	h	l	3	210	70	–	12	1.60	–
E29	Electrographite	m	l	2	35	–	90	25	1.60	–
E43	Electrographite	m	l	7	20	100	–	30	1.70	–
E43Z3	Electrographite	m	l	7	20	–	105	38	1.80	–
E46	Electrographite	m	m	1	22	65	–	10	1.50	–
E46F3	Electrographite	m	m	4	22	65	–	10	1.50	–
E46X	Electrographite	m	m	1	22	90	–	20	1.60	–
E468	Electrographite	m	m	1	20	65	–	10	1.50	–
E49	Electrographite	h	l	1	55	–	90	16	1.60	–
E49X	Electrographite	h	l	1	55	–	105	30	1.70	–
E498	Electrographite	h	l	1	55	–	90	16	1.60	–

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E50	Electrographite	h	l	1	100	–	105	25	1.60	–
E50X	Electrographite	h	l	2	100	–	115	35	1.70	–
E55	Electrographite	m	l	1	20	–	90	28	1.75	–
E558	Electrographite	m	l	1	20	–	90	28	1.75	–
E64Z4	Electrographite	m	m	2	35	–	90	28	1.70	–
E79X	Electrographite	m	m	1	35	90	–	16	1.65	–
E79Z1	Electrographite	m	m	2	35	100	–	23	1.65	–
E84	Electrographite	m	l	2	40	–	105	25	1.70	–
E84S	Electrographite	m	l	2	32	–	110	35	1.70	–
E84X	Electrographite	m	l	2	35	–	110	35	1.75	–
E841	Electrographite	m	l	2	32	–	110	38	1.72	–
E88	Electrographite	m	l	2	40	–	105	30	1.70	–
E88X	Electrographite	m	l	2	40	–	115	40	1.75	–
E888	Electrographite	m	l	2	38	–	105	30	1.70	–
E94	Electrographite	m	l	2	40	–	100	30	1.65	–
E101	Electrographite	m	l	1	40	–	95	30	1.60	–
E101X	Electrographite	m	l	1	40	–	105	35	1.65	–
E104	Electrographite	m	m	4	28	–	–	5	1.30	–
E105	Electrographite	m	l	1	43	–	75	18	1.54	–
E106	Electrographite	m	l	1	55	–	80	23	1.60	–
E108	Electrographite	m	l	1	40	–	95	30	1.60	–
E140	Electrographite	m	l	2	40	–	90	20	1.65	–
E141	Electrographite	m	l	2	40	–	115	35	1.78	–
E151	Electrographite	h	l	2	90	–	115	35	1.70	–
E160	Electrographite	l	m	2	18	105	–	28	1.70	–
E190	Electrographite	m	l	2	40	–	90	20	1.56	–
E200	Electrographite	m	m	4	13	50	–	12	1.45	–
E220	Electrographite	m	l	2	65	100	–	22	1.70	–
L300	Carbon-graphite	h	m	7	28	95	–	18	1.62	–

10.14e/2006

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