Carbon Brushes for Industrial and Railway Application

Application Recommendations

The following application recommendations for our standard grades are based on practical experience and measurements carried out in our laboratories. A variety of machines is listed in the following pages together with a list of brush grades that have performed well on such applications. Generally we have listed our basic grades but we can also use additional treatments such as X, Z and F to meet special requirements.

It is not possible, however, to take account of all the operating conditions which may occur, or different machine characteristics, in our application recommendations. A different grade of carbon brush may therefore be required in some cases.

Special requirements are imposed on the sliding contact of the carbon brushes, for example, by short-term overloads, rapid rates of rise or fall of current, prolonged no-load running, low-load operation, chemically corrosive gases and vapours, high or low ambient temperatures, oil fumes and high dust and ash contents in the surroundings. Attention should also be paid to the humidity level of the air.

The values shown in the recommendations for current density (calculated from the current running along the length of the brush), peripheral speed and brush pressure have been based on experience with machines in practical use.

The data are guideline values, in which the particular application has been taken into account and do not have to be strictly adhered to. Carbon brushes can be loaded with higher current densities, provided there is an adequate temperature reserve or good cooling and appropriately dimensioned fittings.

The limit is determined by the practical application. On commutators, the limit of overload ca- pacity or the maximum permissible continuous current density depends, not only on the materialcharacteristics of the carbon brushes and on the cooling, but also on the commutation.

Depending on the brush grade a prolonged low electrical loading can result in the formation of grooves or in chattering. In most cases low brush current density gives more problems than overloading.

With very good concentricity of commutators and slip-rings plus satisfactory commutation the stated peripheral speed may be exceeded, provided the current distribution between the individual brushes permits this (aerodynamic effects).

The brush pressure depends on the machine requirements and its operating conditions. The stated guideline values may therefore have to be corrected in use. With metallised graphite brushes it may be necessary to increase the brush pressure because of their greater mass.

Application Recommendations – Industrial Application

Application	Problems	Carbon brush grade	Guide-line values for continuous current density A/cm²	brush pressure cN/cm²	permis-sible speed m/s	Remarks
Auxiliary drives in hot and cold mills	mechanical shocks, short periods with high load, long low load periods	-E46X-	5 – 12	250	40	standard grade, excellent current sharing behaviour
		-E46XM-	5 – 12	250	40	specially shear drives
		-E55-	3 – 12	250	40	for cold mills, good with HCl atmospheres for low load conditions
		-E49X-	5 – 12	250	40	for difficult commutation
		-E101-	4 – 16	250	40	for difficult commutation
Battery driven vehicles	mechanical shocks, high starting and braking currents	-A12S-	10 –20	300	30	U ≤ 24 V
		-A20-	10 – 18	300	30	U ≤ 24 V
		-F17-	4 – 14	300	30	U ≤ 24 V
		-A24-	8 – 16	300	30	U 24 – 36 V
		-A30-	8 – 16	300	30	U 24 – 48 V
		-A41-	8 – 16	300	30	U ≤ 72 V
		-C201-	8 – 18	300	30	U 24 – 48 V
		-C16-	10 – 18	300	30	U ≤ 48 V
		-L300-	5 – 14	300	40	U ≤ 72 V
		-L310-	5 – 14	300	40	U ≤ 72 V
		-E43-	5 – 14	300	40	U ≥ 48 V
		-E160-	5 –20	300	40	U ≥ 72 V
		-E105-	5 –20	300	40	U ≥ 72 V
Blowers, ventilators	unbalance by V-belt or blower motor, contaminated atmos-pheres, low load	-F51, F61-	2 – 10	250	30	for low loads, max. 4 brushes in parallel per pole
		-E101-	4 – 16	250	30	for difficult commutation
Cable railways	low load conditions, low humidity, low temperatures	-E101X-	4 – 16	250	30	excellent behaviour for changing loads, for difficult commutation sandwich design
		-E466-	5 – 12	250	40	excellent film formation, for extremly low humidity

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Cement industry	cement dust high starting currents (rotary kilns)	-E101- -E46X-	4 – 16 5 – 12	250 250	30 30	for high dust concentrations, for rotary kilns, for extreme starting loads
Contact brushes	low currents	-S13- -B25- -E43-	– – –	400 400 600	20 20 30	on metal slip rings high mechanical strength on carbon slip rings
Cranes	long no-load operation periods, braking, vibrations, difficult commu-tation, influence of salt	-E101- -E105- -E108- -E46X-	4 – 16 5 – 20 4 – 16 5 – 12	250 250 250 200	30 30 30 40	for extreme vibrations if necessary pressure up to 350 cN/cm² for extreme commutation with salt water influence exellent film formation, given resistance against e. g. salt water influence
Earthing contacts	mechanical shocks	-S13/F19- -B24-	– –	250 250	30 30	for earthing of shafts with oil influence
Electric car	extreme high currents vibrations	-E105-	5 – 20	350	30	excellent commutation behaviour
Electroplating	high loads, influence of acids	-B14Z1- -B24- -B25- -C4073- -C50-	15 – 25 15 – 25 15 – 30 10 – 25 15 – 35	250 250 250 250 250	30 30 30 30 30	standard grade improved cleaning action for extreme loads for low loads for extreme loads, lead free
Extruders	low load conditions chemical vapours	-F49- -E101- -E108- -E50-	2 – 10 4 – 16 4 – 16 5 – 12	250 250 250 250	30 30 30 30	max. 4 brushes in parallel per pole, cleaning action for higher loads good film control capability
High speed motors	commutation problems contact problems	-E46-	5 – 12	250	30	current resistant, good contact capability, sandwich design will improve commutation capability
Lifts see Cable Railways						
Machine tools	high speeds, twofold rated current, metal dust, auxiliary oils	-E105- -E49-	5 – 20 5 – 12	250 250	30 30	excellent commutation properties, standard grade

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Mill motors	reversing, mech. shocks,	-E46X-	5 – 12	250	40	standard grade, excellent current sharing behaviour
	vibrations auxillary liquids	-E55-	3 – 12	250	40	specially for cold mills with influence of acids
	(hydrochloric acid)	-E101-	4 – 16	250	40	excellent commutation
Mining motors	peak load during acceleration and braking as well	-E46-	5 – 12	250	50	excellent current sharing behaviour, excellent at peak loads
	as low load	-E46X-	5 – 12	250	50	higher mechanical strength
		-E55-	3 – 12	250	50	excellent behaviour for low load
Off-shore drives	salty air	-E88X-	5 – 12	up to 350	40	for traction motors
		-E46X-	5 – 16	250	40	excellent film formation capability
Paper industry	low load conditions, aggressive gases (H_2S),	-E101-	4 – 16	250	30	main drives, wet zone
		-E101M-	4 – 16	250	30	improved commutation behaviour, cleaning action
	high humidity	-E108-	4 – 16	250	30	excellent film control
		-E107-	4 – 16	250	30	similar to -E108-, less sensi-tive to polluted atmospheres
		-E46X-	5 – 12	250	30	for dry zones, good film formation capability
		-F40, F63-	1 – 10	250	30	low load conditions, for pumps, max. 4 brushes in parallel per pole
Power plants	high circumfer. speeds	-E46F3-	5 – 12	160	max. 60	ungrooved rings
	long low load periods	-F19-	4 – 10	160	60	ungrooved rings
		-F23, F24-	4 – 10	130	80	grooved rings
		-E104-	4 – 16	130	80	grooved rings
Press drives	shocks, vibrations, and low load conditions,	-E49X-	5 – 12	350	30	standard grade
		-E101-	4 – 16	350	30	good commutation behaviour
	oil influence	-E55-	3 – 12	350	30	good behaviour at low loads, possibly critical at vibrations
		-E108-	4 – 16	350	30	for heavy oil influence

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Application	Problems	Carbon brush grade	Guide-line values for continuous current density A/cm²	brush pressure cN/cm²	permis-sible speed m/s	Remarks
Printing machines	low load, high humidity, influence of silicone	-F61-	1 – 10	250	30	excellent current sharing at low load, max. 4 brushes in parallel per pole
		-E49-	5 – 12	250	30	standard grade
		-E101-	4 – 16	250	30	good commutation capability
		-E108-	4 – 16	250	30	cleaning action, less sensitive against silicone
Pump drives	long low load periods, vibrations, peak currents	-E55-	3 – 12	250	30	good behaviour at high humidities
		-E101-	4 – 16	250	30	good commut. behaviour
		-F63-	1 – 10	250	30	for extreme low load
Ship motors	air containing oil, salty air, possible demand for long life time	-E46X-	5 – 12	250	40	specially for extreme low temp.
		-E49X-	5 – 12	250	40	universal grade
		-F45, F49-	2 – 10	250	30	excellent if silicone is present, max. 4 brushes in parallel per pole
Slip rings	dust (cement industry), possibly low humidity	-A12S-	10 – 20	250	30	for open machines (steel or bronze rings)
		-K14Z3-	10 – 20	250	30	for closed machines (steel or bronze rings)
		-C40, C40Z3-	10 – 25	250	30	for high temperature (steel or bronze rings)
		-B14Z1-	15 – 25	250	30	for high loads
		-B24-	15 – 25	250	30	similar as -B14Z1-, improved cleaning action
		-E43Z3-	5 – 12	250	40	low load resist. (bronze rings)
		-E46F3-	5 – 12	250	60	low load resist. (steel rings)
		-E468-	5 – 12	250	60	filmregulating properties
		-E200-	5 – 12	250	50	low load resist. (steel rings)
		-U7044-	3 – 14	250	50	special grade
		-A20-	10 – 20	250	30	for the slip rings of three-phase commutator motors
Steelworks	dusty environment, peak loads as well as long low periods	-E55-	3 – 12	250	40	low load resistant, for little commutation requirements, specially for cold mills
		-E46-	5 – 12	200	40	good film formation, excellent current sharing behaviour
		-E468-	5 – 12	200	40	filmregulating properties
		-E46X-	5 – 12	250	40	same as -E46-, improved mechanical strength
		-E49X-	5 – 12	250	30	for high commutation requirements
		-E101-	4 – 16	250	30	for high commutation requirements
		-F51, F61-	2 – 10	250	30	low load resistance, max. 4 brushes in parallel

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Storehouses	peak load during acceleration and braking as well as low load	-F61-	1 – 10	250	30	for driving motor, excellent current sharing behaviour at low loads
		-E101-	4 – 6	250	30	for lift motor, excellent behaviour at peak loads
Three phase AC-motors	high transversal currents	-F46-	2 – 10	250	30	standard grade
		-F52-	2 – 10	250	30	standard grade
		-F63-	1 – 10	250	30	standard grade
Tacho-generators		-S13-	1 – 15	250	30	standard grade
		-E43-	1 – 12	250	30	for silver tracks
Wind turbines	low load conditions vibrations	-A24-	8 – 20	200	30	for bronze and steel rings standard material
		-A24X-	8 – 20	250	30	improved wear behaviour
		-C72-	6 – 15	250	30	for low loads
		-K1473-	8 – 20	200	30	for higher loads
		-E43-	5 – 12	200	20	for carbon/carbon system counter material -FE85-
Wire annealing systems	high loads, polluted environment	-C40Z3-	10 – 25	250	30	standard grade, for variable loads
		-B20-	15 – 30	250	30	for high loads
		-B14Z1-	15 – 30	250	30	for high loads, standard grade
		-B25-	15 – 35	250	30	for extreme loads
		-C50-	15 – 35	250	30	for extreme loads, lead free

Application Recommendations – Railway Application

Application	Carbon brush grade	Guide-line values for continuous current density A/cm²	brush pressure cN/cm²	permis-sible speed m/s	Remarks
AC-Commutator motors	-E64Z4-	5 – 12	300	50	standard grade, excellent film formation
single-phase series wound motors 16 2/3 Hz, 50 Hz	-E79Z1-	5 – 12	250	50	good commutation capability, low commutator wear
	-E84S-	5 – 12	250	50	for extreme mechanical stress
	-E841-	5 – 12	250	50	similar to -E84S-,
	-E151-	5 – 12	250	50	improved wear resistance, improved commutator life
Auxiliary machines	-E29Z4-	5 – 12	350	30	starters in diesel electric locos
	-E49X-	5 – 12	350	30	standard material,
converter, ventilator, compressor, generator	-E55-	3 – 12	350	30	motor alternator sets suitable for light loads, improved commutator life
	-F40-	2 – 10	350	30	motor alternator sets
	-F51-	2 – 10	350	30	suitable for light loads
DC traction motors	-E64Z4-	5 – 12	300	50	for extreme climatic conditions
	-E79Z1-	5 – 12	250	50	for extreme climatic conditions, low commutator wear
overhead powered	-E79Z4-	5 – 12	300	50	mechanically stronger variant of -E79Z1-
	-E841-	5 – 12	350	50	for extreme mechanical stress
	-E94-	5 – 12	350	50	mechanically strong, good commutation
	-E160-	5 – 12	350	50	good film formation, wear resistance
	-E210-	5 – 12	350	50	commutator saving
DC traction motors	-E55-	3 – 12	350	50	for low load conditions, good film formation
diesel electric locos, motors	-E88X-	5 – 12	350	50	for the most difficult application
	-E141-	5 – 12	350	50	standard material
DC traction motors	-E46X-	5 – 12	300	40	good overload capacity
	-E49X-	5 – 12	300	40	for difficult commutation
diesel electric locos, generators	-E55-	3 – 12	300	40	suitable for light load conditions
	-E88X-	5 – 12	350	40	high mechanical strength

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DC traction motors	-E46X-	5 – 12	300	50	for critical ambient conditions (e. g. salty atmosphere)
local traffic, contactor controlled or	-E50X-	5 – 12	350	50	trams and underground with chopper control, improved commutator life
chopper controlled	-E151-	5 – 12	350	50	similar to -E50X-, improved wear resistance
	-E141-	5 – 12	350	50	trams, wear resistant
	-E160-	5 – 12	350	50	excelent film formation, wear resistant
DC traction motors	-E29, E29X-	5 – 12	350	50	trams
	-E49X-	5 – 12	350	50	good commutation capability
local traffic, switch controlled	-E141-	5 – 12	350	50	wear resistant
Earthing contacts	-A16-	10 – 25	400	–	good film formation on steel and bronze disks
	-A20X-	8 – 20	400	–	low friction coefficient, low noise
	-B20-	15 – 25	400	–	good film formation on steel and bronze disks, good wear resistance
	-B14Z1-	15 – 25	400	–	standard material
	-E43-	5 – 12	400	–	carbon grade -FE85- as counter material, extremly wear resistant
	-B25-	15 – 30	400	–	high mechanical strength
Mining locos	-E29-	5 – 12	400	40	standard material for battery and overhead-wire supply
	-E101-	4 – 16	400	40	for difficult commutation
Trolley-bus	-E50X-	5 – 12	350	40	for chopper control, improved commutator
	-E151-	5 – 12	350	40	similar to -E50X-, improved wear behaviour
	-E841-	5 – 12	350	40	for contactor control, high mechanical strength
	-E88X-	5 – 12	350	40	for difficult commutation, high mechanical strength
	-E140-	5 – 12	350	40	improved wear behaviour

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