BRUSHES FOR ELECTRICAL MACHINES

Technical guide

ISO 9001: 2000 | ISO 14001

CARBONE LORRAINE

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THE GRADE GROUPS

There are five principal groups each corresponding to a particular mode of manufacture.

To certain principal groups it is convenient to adjoin one subgroup concerning impregnated grades. The Note STA BE 16-22 treats this subject and indicates the particular properties of these special materials.

We give below a summary on the method of manufacture of each group, the main characteristics of each group (given under the conventional headings on pages 6 and 7), the principal applications and the limits of application for the majority of grades in the group.

A CARBOGRAPHITIC BRUSHES

These are made from mixtures composed of amorphous carbon powders, natural and artificial graphites ground, selected and agglomerated with a binder.

The powders thus moistened and dryed are compressed and the plates thus obtained are cooked in order to coke the binder.

Main character

Brushes having a good commutating ability, with a good polishing action and a medium value contact drop. They resist high temperatures and variable loads.

Principal applications

Old slow machines with or without interpoles and generally at low voltage. Modern machines working with permanent magnets, servomotors, universal motors.

Limit of application

Current density 8 to 16 A/cm^2 (maximum), depending on cases.
Admissible peripheral speed: up to 25 m/s.

Note
There is a range of carbographitic grades for universal motors of fractional power and up to several kW. These products are not stated in this technical guide. Please, ask for the specific literature.

EG ELECTROGRAPHITIC BRUSHES

Prepared from carbon powders and coke they are then subjected to other thermal treatments particularly at high temperature (above 2,500°C) in order to transform the basic amorphous carbon into artificial graphite.

Main character

These brushes have medium contact drop and low or medium friction, they have reduced losses and are particularly adapted to high speed applications.

Principal applications

For all industrial modern machines whether stationary or for traction, high speeds, low, medium and high voltage and constant or variable loads.

Brush current densities:
8 to 12 A/cm^2 (maximum) under steady conditions,
20 to 25 A/cm^2 (maximum) for short duration peaks.
Admissible peripheral speed: up to 50 m/sec.

LFC SOFT GRAPHITE BRUSHES

The base constituent is purified natural graphite or previously ground artificial graphite, then mixed with other constituents in well defined quantities, agglomerated with appropriate binders and fired in order to coke the binder.

Main character

Soft, plastic brushes having very good resistance to shock and mechanical vibration. Generally they have good cleaning properties.

Principal applications

Steel and stainless steel rings for high speed synchronous machines.

Limit of application

Brush current density:10 to 13 A/cm^2 (maximum).
Admissible peripheral speed: 65 to 90 m/s (even to 100 m/s).

CG-MC METAL GRAPHITE BRUSHES (CG - MC - CA)

These brushes are made by mixing in suitable proportions purified natural graphite and copper in powder form with the addition of powders of other metals. The mixed powders are then compressed and baked in an atmosphere and at a temperature chosen to give the degree of solidity and cohesion desired.

Equally a part of the metal graphite group are those brushes (EG and A) which are impregnated under pressure with pure molten copper or a mixture of molten copper, silver or salts (of metal impregnated page 7).

Main character

Dense or very dense brushes with low friction and very low contact drop therefore leading to very low losses and high currents.

Principal applications

DC machines of slow speed and low or very low voltage. Bronze rings of slow speed asynchronous motors, heavily loaded, with or without brush lifting gear. Rings of synchronous motors of low or medium speed. High current collection on rotating collectors, special machines, slip-ring assemblies.

Limit of application

Brush current density;
12 to 30 A/cm^2 (maximum) continuously,
about 100 A/cm^2 instantaneous transient peaks according to metal content.
Admissible peripheral speed: up to 35 m/s, according to metal content.

Note

There is a range of copper graphite and metal graphite grades which permit the unitary moulding of mass produced brushes for small low voltage machines. These products are not stated in this technical guide. Please, contact us.

BG BAKELITE-GRAPHITE BRUSHES

Natural or artificial graphite is ground and agglomerated with a thermo-hardening resin of the bakelite type. The mixture is compressed and polymerized at a suitable temperature.

Main character

Brushes are of high mechanical and electrical resistance, good commutating properties, cleaning properties with high contact drop and therefore high losses. Can work at very low current densities.

Principal applications

AC commutator motors of the Schrage or Schorch type. Many DC machines, either traction or stationary, of medium speed and load.

Limit of application

Brush current density: vary with grades (better on low load motors).
Admissible peripheral speed: up to 40 m/s.

Note

There is a range of resin agglomerated grades which permits the unitary moulding of mass produced brushes for modern motors of fractional power and several kW. Please, contact us.

PRINCIPAL CHARACTERISTICS OF BRUSH

GRADE GROUP	GRADE	Apparent density	Resistivity µΩ.cm µΩ.inch	Shore Hardness	Flexural strength MPa PSI	Contact drop ΔU en V	Friction	Maximum current density A/cm² A/inch²	Upper speed limit m/sec. ft/sec.	Metal content %
Carbo-graphitic	A 121	1,75	2 250 (886)	30	26	M	L	12 to 20 (75 to 125)	⩽ 15 (⩽ 49)	
	A 122	1,67	45 000 (17 716)	27	21	H	L	10 to 12 (65 to 75)	⩽ 15 (⩽ 49)	
	A 176	1,60	52 500 (20 670)	40	20	H	L	8 to 10 (50 to 65)	30 (98)	
	A 210	1,57	25 000 (9 840)	30	16	M	L	8 to 10 (50 to 65)	⩽ 25 (⩽ 82)	
	A 252	1,57	45 000 (17 716)	27	16	H	L	10 to 12 (65 to 75)	⩽ 25 (⩽ 82)	
Soft graphitic	LFC 501	1,46	1 900 (748)	10	10	M	L	6 to 10 (40 to 65)	75 (246)	
	LFC 554	1,26	2 000 (748)	12	12	M	L	11 to 13 (71 to 84)	100 (328)	
Electro-graphitic	EG 34D	1,60	1 100 (433)	40	25	M	M	12 (75)	50 (164)	
	EG 389P	1,49	1 600 (630)	29	19	M	M	12 (75)	50 (164)	
	EG 396	1,52	1 600 (630)	27	19	M	M	12 (75)	50 (164)	
	EG 362	1,60	2 500 (984)	35	21	M	M	12 (75)	50 (164)	
	EG 40P	1,62	3 200 (1 260)	57	27	M	M	12 (75)	50 (164)	
	EG 313	1,66	5 000 (1 968)	50	21	M	L	12 (75)	50 (164)	
	EG 367	1,53	4 100 (1 614)	52	21	M	M	12 (75)	50 (164)	
	EG 332	1,52	4 200 (1 653)	52	21	M	M	12 (75)	50 (164)	
	EG 387	1,60	3 500 (1 378)	60	31	M	M	12 (75)	50 (164)	
	EG 300	1,57	4 200 (1 653)	58	24	M	L/M	12 (75)	50 (164)	
	EG 98	1,60	3 400 (1 338)	64	33	M	M	12 (75)	50 (164)	
	EG 369	1,55	5 500 (2 165)	60	22	M	M	12 (75)	50 (164)	
	EG 319P	1,46	7 200 (2 834)	52	26	H	M	12 (75)	50 (164)	
	EG 321	1,46	7 200 (2 834)	52	26	H	M	12 (75)	50 (164)	
	EG 365	1,62	5 300 (2 080)	40	15	M	M	12 (75)	50 (164)	
Impregnated electro-graphitic	EG 7099	1,72	1 100 (433)	40	34	M	M	12 (75)	45 (148)	
	EG 9599	1,61	1 600 (630)	33	28	M	M	12 (75)	45 (148)	
	EG 9117	1,69	3 300 (1 300)	77	36	M	M	12 (75)	50 (164)	
	EG 8019	1,77	4 700 (1 850)	77	31	M	M	12 (75)	45 (148)	
	EG 8067	1,67	3 900 (1 535)	77	36	M	M	12 (75)	45 (148)	
	EG 8220	1,82	5 000 (1 968)	90	48	M	M	12 (75)	50 (164)	
	EG 7097	1,68	4 000 (1 575)	80	35	M	M	12 (75)	50 (164)	
	EG 341	1,57	7 200 (2 834)	74	34	H	M	12 (75)	50 (164)	
	EG 6489	1,57	7 200 (2 834)	75	35	H	M	12 (75)	50 (164)	
	EG 8285	1,70	5 400 (2 126)	71	27	M	M	12 (75)	50 (164)	
	EG 7655	1,70	5 600 (2 200)	68	33	M	M	12 (75)	50 (164)	

CONTACT DROP

The value of contact drop and friction is given by the use of symbols having the following significance

Symbol	Indication	Contact drop in volts Sum of both polarities	Friction
H	High	H > 3	H > 0.20
M	Medium	2.3 < M < 3	0.12 < M < 0.20
L	Low	1.4 < L < 2.3	L < 0.12
VL	Very low	0.5 < VL < 1.4	
VVL	Very very low	VVL < 0.5	

GRADES (ACCORDING TO STANDARD CEI 60413)

GRADE GROUP	GRADE	Apparent density	Resistivity µΩ.cm µΩ.inch	Shore Hardness	Flexural strength MPa PSI	Contact drop ΔU en V	Friction	Maximum current density A/cm² A/inch²	Upper speed limit m/sec ft/sec	Metal content %
Bakelite graphite	BG 412	1,82	14 000 (5 512)		36	H	M	8 to 10 (51 to 77)	35 (115)	
	BG 469	1,80	10 000 (3 938)		34	H	M	6 to 8 (77)	35 (115)	
	BG 400	1,50	25 000 (9 842)		25	H	M	8 to 10 (51 to 77)	40 (131)	
Metal graphite	C 6958	2,50	350 (138)		30	VL	M	10 to 25 (130 to 220)	⩽ 32 (98)	25
	CG 33	2,30	550 (216)		25	VL/L	L	10 to 12 (65 to 75)	40 (131)	30
	C 8386	2,80	100 (39)		29	VL	L/M	20 to 30 (130 to 220)	⩽ 30 (98)	46
	CG 651	2,95	130 (51)		30	VL	L	12 to 14 (75 to 90)	35 (115)	49
	CG 626	2,88	180 (71)		45	VL	L	12 to 15 (75 to 90)	30 (115)	49
	CG 665	4,05	28 (11)		50	VL	L	15 to 20 (100 to 130)	30 (98)	65
1- Agglomerated	CG 75	4,65	12 (4)		55	VVL	L	16 (105)	25 (82)	77
	OMC	6,00	7 (3)		77	VVL	L	25 to 30 (160 to 200)	20 (66)	90
	MC 79P	5,20	8 (3)		98	VVL	L/M	25 to 30 (160 to 200)	20 (66)	83
	MC 12	6,00	32 (12)		173	VVL	L/M	25 to 30 (160 to 200)	20 (66)	91
	MC 689	5,95	23 (9)		138	VVL	L/M	25 to 30 (160 to 200)	20 (66)	89
2- Metal impregnated	M 609 (4)	2,65	310 (122)	35	33	VL/VVL	VVL	12 to 15 (75 to 100)	35 (115)	45
	M 673 (4)	1,72	1 180 (464)	35	26	VVL	H	10 to 12 (65 to 75)	40 (131)	5,5
	M 9426	1,62	1 775 (700)	24	20	VVL	M	12 to 15 (75 to 100)	30/45 (131)	9
	M 621	3,00	400 (157)	34	35	VVL	M	40 (267)	40 (131)	44
	M 9020	1,75	2 700 (1 060)	68	37	L		12 to 15 (75 to 100)	45 (131)	5
	M 8295	1,80	1 775 (700)	54	34	VVL	M	12 to 15 (75 to 100)	30/45 (131)	9

Note :
Our main standard grades framed in white (indicative values only).
1) 1 MPa (Megapascal) = 10 daN/cm² (decanewton/cm²) and 1 kPa (kilopascal) = 10 cN/cm² (centinewton/cm²).
2) Another designation for LFC 3 = KK1.
3) For silver graphite grades see our publication Silver graphite brushes: Ref. BE 205.
4) Please contact us.
5) LFC : Shore C2 (indicative value).

AND FRICTION

Contact drop and friction values are measured in the laboratory on slotted copper commutators under the following conditions.

Elements	Contact drop	Friction
Current	continu	
Current density	10 A/cm²	10 A/cm²
Speed	12.5 m/s	25 m/s
Pressure	18 kPa	
Temperature	65-70°C	
Brush type	radial	

The limits for current density and peripheral speed result from observations on actual machines in good state of repair and working under normal conditions.

RATIONALIZATION OF BRUSH GRADES

An increasing number of industries show a desire to reduce the number of types and grades of brushes which they now use.

This operation does not impose great difficulties for easy applications, which represent the majority of cases.

In the following table we have grouped the common codings of our brush qualities.

For difficult machines, such rationalization requires a careful study according to the case.

Our technical services are at the disposal of our customers to examine the details of each case. In France, please contact Bureau Technique Application phone n° +33 (0)3 22 54 45 60 - Fax n° +33 (0)3 22 54 46 08.

Our subsidiaries established in more than 40 countries around the world, are at your disposal for any local technical assistance.

GRADE GROUPS	OLD DESIGNATIONS	NEW DESIGNATIONS OR GRADES
ELECTROGRAPHITIC GRADES	EGAD - EGA - EG 344 EG - X - 274 - Z - EG 389 EG 97 - EG 97B - EG 72 EG 306 EG 98B - EG 43 - EG 99 - EG 99B EG 5309N - EG 5309D - EG 20N - EG 25 EG 48P EG 70 - EG 70D - EG 48 - EG 316 - EG 300 P EG 319	EG 34D EG 389P - EG 396 EG 367 - EG 313 EG 300 EG 98 EG 309 EG 98P EG 300 ou A 176* EG 319P ou EG 321*
GRAPHITIC GRADES	LFC 2 - LFC - LFC 60 - LFC 3BS LFC 76 - LFC 4 - LFC 557 A 107 - A 141	LFC 501 LFC 554* A 176 - A 121* - A 252
METALLIC GRADES	CG 50 - CG 2 - M 609 - M 685 - MK 45 CG 65 - CG 3371 - CG 653 - CG 6535 CG 3 - CG 4 - MC 94 MC - MC 3702 MC 1 - MC 22 - MC 2 MK 75 - MK 75E	CG 651 CG 665 MC 79P OMC - MC 79P MC 12 CG 75
BAKELITE-GRAPHITE GRADES	BG 62 - BG 417 - BG 404 - LFC 62 BG 530 - BG 540 - BC 550	BG 412 - BG 469* BG 400 - A 104*

* Please contact us.

APPLICATIONS OF GRADES

In this table of application, machines are classed in coherent groups taking into account the usual operating conditions of the brushes (current density, peripheral speed and applied brush pressure).

The brush grades shown for each group of machines are those, currently, most used.

The order of the grades given is not necessarily the order of preference for a given application.

Never mix brushes of different grades on any one ring or commutator. (See Technical note STA BE 16-6 for information on exceptions to this rule).

STATIONARY COMMUTATOR MACHINES

Current type	Current density A/cm²	Speed m/sec.	Pressure kPa	Grades
DIRECT CURRENT				
Old machines without interpoles	6	15	18	EG 40P - A 176 - EG 389P - EG 396
Low voltage machines (all sizes)				
Marine T.A. exciters 30 to 50 V	4-8	25	18	LFC 3 - EG 98 - EG 7099 - CG 651
Welding generators 30 to 50 V	0-20	< 20	18	EG 389P - EG 98B - EG 367 - EG 309 EG 396 - EG 313
Industrial machines (110-750 V)				
Motors for general applic. (high speed)	8-12	20-45	18	EG 34D - EG 313 - EG 367 - EG 389P
Exciters hydro T.A.	8-12	< 20	18	EG 34D - EG 7099 - EG 389P - EG 9599
Exciters steam T.A.	8-10	35-50	18	EG 98 - BG 412 - EG 367 - EG 369 EG 9599
Pilot exciters	2-5	< 35	18	EG 34D - EG 389P - BG 412
Amplidynes	4-12	25	18	S-EG 34D - EG 389P
Illgner and Ward Leonard generators (all speeds)	4-12	20-35	18	EG 98 - EG 389P - EG 98P S-EG 34D - EG 396 - EG 9599 - EG 7099
Generators and motors for paper mills	4-12	35	18	EG 34D - EG 389P/J - BG 469 - EG 6489 EG 313
Marine generators	4-12	20-35	18	EG 34D - EG 389P - EG 7099 - EG 6732* - EG 313
Reversing motors	8-20	0-15	18	EG 332 - EG 319P - EG 369 - EG 321 EG 313
Rolling mill motors	8-15	20-35	18	EG 389P - EG 40P - EG 319P - EG 6489 EG 313 EG 321
Mine winder motors	12	25	18	EG 309 - EG 332 - EG 369 - EG 313
Totally enclosed motors	10-12		18	EG 9117 - EG 8067 - EG 7593
ALTERNATING CURRENT				
Single phase and repulsion motors	8	5-15	18	EG 98 - EG 332 - A 252
Three-phase Schrage motors	8-12	5-35	18	BG 412 - BG 469* - BG 400 - EG 367*
Three-phase Schorch motors	10-14	5-35	18	BG 28* - BG 469 - EG 98 - EG 367 BG 400
Sherbius machines	7-9	30	18	EG 98B - EG 389P - EG 396 - EG 313 LFC 554

* These brushes can be supplied on demand either in sandwich brush (2 parts in same grade) or in dual grade brush (BG/EG) providing the thickness in the tangential direction "t" exceeds 6 mm.

TRACTION COMMUTATOR MACHINES

Current type	Current density A/cm²	Speed m/sec.	Pressure kPa	Grades
DIRECT CURRENT				
Light traction	8-12	40-50	30-40	EG 34D - EG 98 - EG 8285 - EG 7099 EG 365 - EG 9599 - EG 8067 - EG 364 EG 7823
Heavy traction				
Old motors	10-12	< 45	< 35	EG 34D - EG 98B - EG 98P
Modern motors	> 12	> 45	35	EG 337** - EG 300 - EG 9117 - EG 365 EG 8067 - EG 9049 - EG 7097 - EG 7045 EG 9041 - EG 6754 - EG 364 - EG 5563
Diesel electric traction				
DC generators	10-14	40	25	EG 389 - EG 98/T - EG 300 - EG 7099 EG 8067 - AC 137
Alternators (slip rings)	8-12	< 50	22	EG 34D - EG 389P
Motors	15	45	35	EG 7099 - EG 8067 - EG 7097 EG 6754 - EG 6948
Battery electric vehicule motors (low voltage)				
Stock handling	15-20	10-25	35	A 121 - M 621 - C 7788
RECTIFIED CURRENT				
Heavy traction				
Modern motors	12-15	50	35	EG 367** - EG 300 - EG 8067 EG 9049 - EG 7097 EG 9041 - EG 6754 - EG 5563 - EG 7823
ALTERNATING CURRENT				
Heavy traction 16 $^{2/3}$ and 50 Hz				
Motors	12-16	45	25	EG 367** - EG 8067 - EG 7097 - EG 364 EG 5563 - EG 7823

** This grade is not recommended when thickness of brushes (or layers) is less than 8 mm.

SLIP RING MACHINES

Current type	Ring metal	Current density A/cm²	Speed m/sec.	Pressure kPa	Grades
AXLE GROUNDING	Steel-Bronze	$\epsilon - 30$	3-8	35-40	MC 689 - MC 12 - MC 79P - MC 664
DIRECT CURRENT					
Tinning rolls	Bronze	20-30	3	18-40	MC 12 - MC 79P - MC 664
Synchronous machines	Stainless Steel	11-13	100	13-18	LFC 554
Grooved or plain — 3,000 r.p.m.	Steel	6-10	70-80	15-18	LFC 501
Grooved or plain — 1,500 r.p.m.	Steel-Bronze	8-12	⩽ 40	18	CG 665 - CG 651 (Bronze) EG 34D - EG 389P (Steel)
Grooved or plain — ⩽ 500 r.p.m.	Cast iron	6-10	⩽ 20	18	EG 34D - EG 389P
For operation in hydrogen	Steel-Bronze	5-8	25	18	EG 34D/J - M 5155
ALTERNATING CURRENT					
Asynchronous machines (STA 16-42)					
Open type	Steel-Bronze	12-16	15-25	18	CG 665 - CG 651 - EG 34D - EG 389P
Totally enclosed type	Steel Cupro-Nickel	6-8	15-25	18	EG 34D - CG 33
Motors with brush lifting device	Steel-Bronze	25-30	20-25	18	MC 12 - OMC - MC 79P
High speed asynchronous (pumps, fans)	Bronze	8-10	50	18	EG 389P - EG 34D - M 9426
Synchronous induction machines	Bronze	8-12	15-40	18	CG 33 - M 609 - M 673 - M 9426
Wind power generators	Steel-Carbon	12-15	45	18	M 8285 - M 9426

IMPORTANT REMARKS

STOCK

We hold many brush designs in stock in grades and designs developed in conjunction with machine constructors. Furthermore these types generally comply with the recommendations of the International Electrotechnical Commission (I.E.C.).

SETS OF DRAWINGS

We are quite willing to draw up for you indices or sets of plans for the types of brushes which are fitted to your machines. These indices or sets of drawings will facilitate the task of your Service Department in identifying and ordering spare brushes.

QUESTIONNAIRES

At the end of the present guide (pages 25 and 26) you will find a questionnaire (Ref. BE 5) which meets the recommendations of the I.E.C. In order to supply you with the brush adapted to each particular application case, please, send back such a questionnaire duly filled in.
On request we can send separate questionnaires.

MOUNTING

The mounting of brushes has been studied in conjunction with the constructors of machines and brush-holders. Moreover, they are rational because they follow the technological problems posed by the grades, treatments and machining - and also because they have been subject to long tests. For this reason we recommend that designs should not be modified without very good reason. When a modification is made we recommend that the brush drawings should not be modified without the agreement of our technical services.

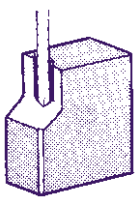
FLEXIBLES

Flexibles used for our brushes have the following characteristics:

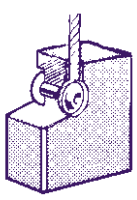
Diameter (mm)	1.6	1.8	2	2.2	2.5	2.8	3.2	3.6	4	4.5	5	5.6	6.3
Nominal value of current (A)	15	17	20	24	28	32	38	44	50	60	75	85	100

All these flexibles can be made of tinned wires.

PRINCIPAL PROCESSES for FIXING FLEXIBLES on to BRUSH



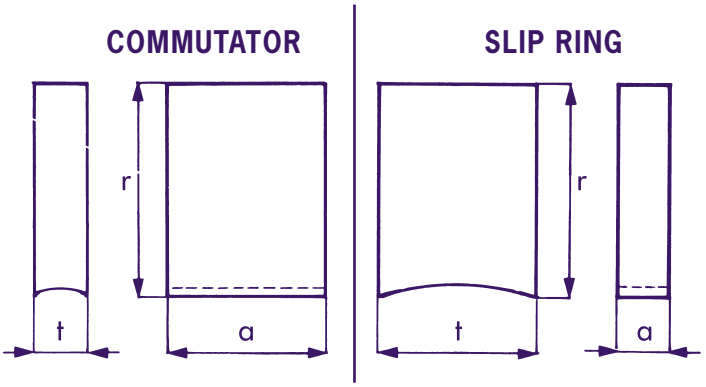
Fixing by tamping
Conductive powder pressed down mechanically into the hole around the flexible.



Fixing by rivet
Process which is applied for specific applications (aviation) or dimensions.
The loop of the cable is preformed with a tool before riveting.

SHAPES AND MAIN DIMENSIONS OF BRUSHES

t - a - r DIMENSIONS



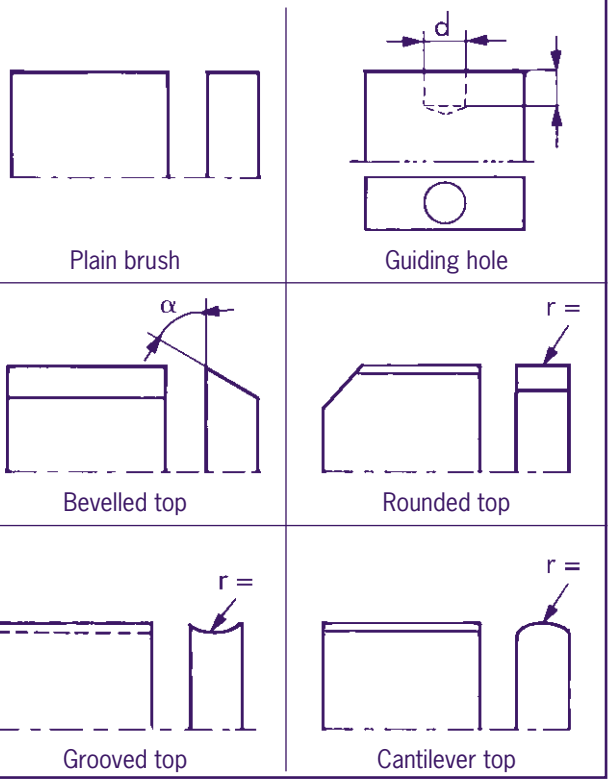
Dimensions should be stated in nominal value and in the following sequence “t” - “a” - “r” recommended by I.E.C.

The “r” dimension may be approximate.

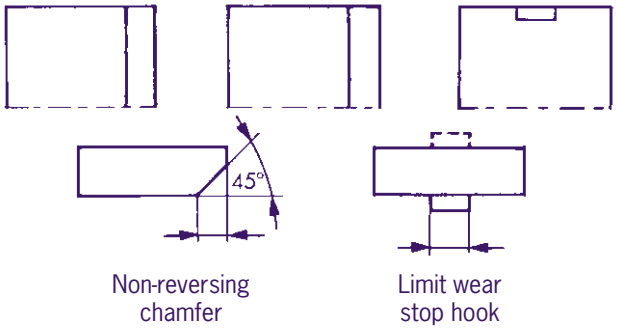
As metric dimensions and non-decimal system are both used, it is necessary to verify particularly for the dimensions “t” and “a”, that the brush and brush-holder belong either to the first or to the second as there is a possibility of confusion between certain dimensions in inches and mm's.

Example: 12.5 mm and 1/2 “ (12,7) - 16 mm and 5/8 “ (15.87).

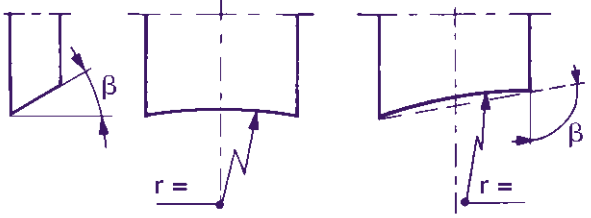
BRUSH TOP (USUAL SHAPES)



OUTER SIDE



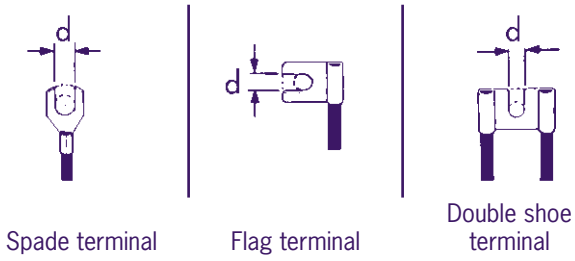
CONTACT SURFACE



Recommended values
Bevel = STA 16-36

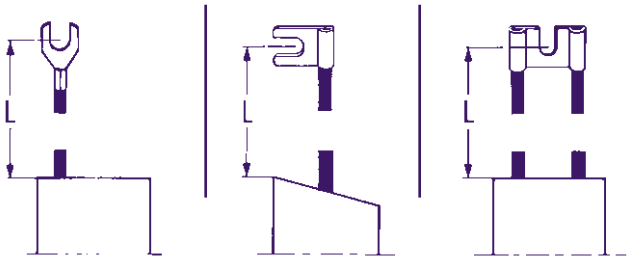
Radius = from 6 to 40 : from 0,5 by 0,5
from 40 to 100 : from 1,0 by 1,0
from 100 to 200 : from 5,0 by 5,0
> 200 : from 10,0 by 10,0
not carried out if arrow > 0,1 mm

TERMINAL TYPES - DIMENSIONS



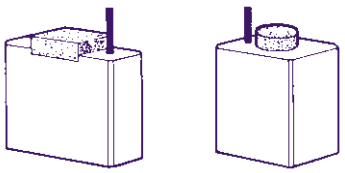
Slots and holes dimensions						
screw ø (mm)	3	4	5	6	8	10
d (mm)	3.4	4.3	5.2	6.5	8.5	10.5

FLEXIBLE LENGTH

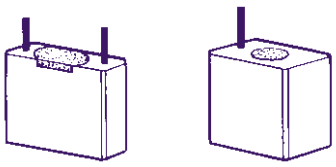


Standardized values L (mm)
16 - 20 - 25 - 32 - 40 - 50 - 56 - 63 - 71
80 - 90 - 100 - 112 - 125 - 140 - 160

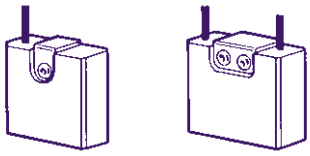
FITTING AND MOUNTING METHODS



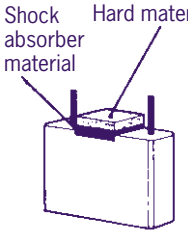
Glued shock absorber



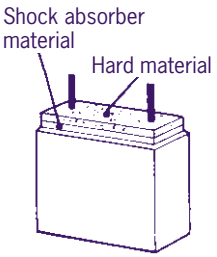
Hard insulating top (recessed and glued)



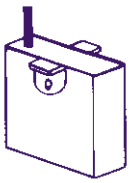
Riveted metal top plates



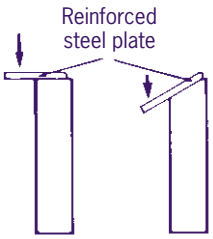
Shock absorber and hard material fixed plate SILESS



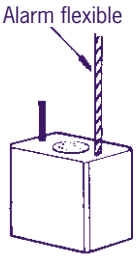
Shock absorber and hard plate (the two plates are threaded on two flexibles and not glued)



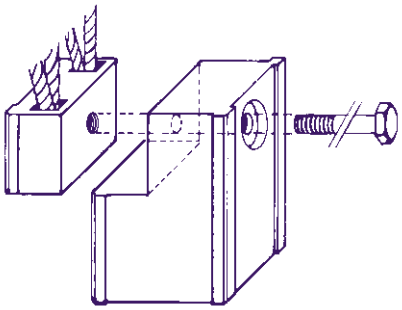
Wear limiting plastic clips



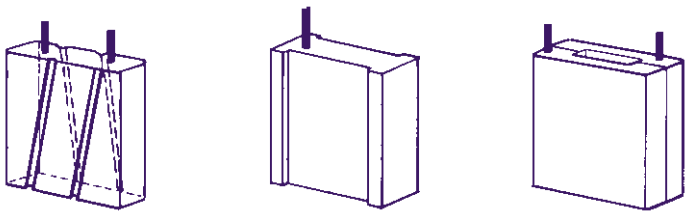
Top plate for cantilever pressure device



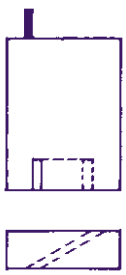
Brush with alarm flexible



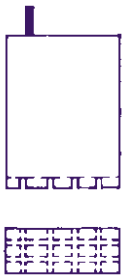
Brush with removable top for tinning rolls



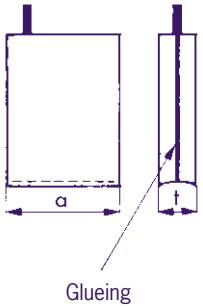
Dust grooves and recesses (See Technical Note STA BE 16-13)



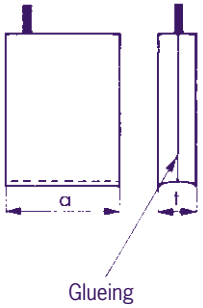
Contact face with saw cut



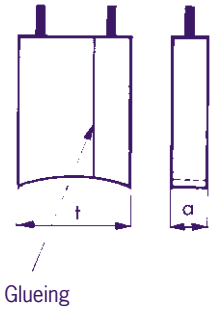
Cross grooved contact face



Sandwich brush* (2 layers EG)



Glued brush* 1 EG layer 1 BG layer



Ring glued brush* 1/3 EG layer 2/3 CG layer

* See Technical Note STA BE 16-19.

FITTINGS FOR DIVIDED BRUSHES

METAL TOPS

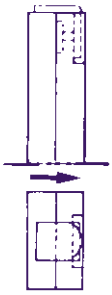


Fig. 1

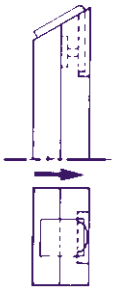


Fig. 2

Metal top fittings are the oldest and the most popular. These fittings are always used on uni-directional machines, but are not so satisfactory on reversing machines because the mechanical stability of the brush is better for one direction of rotation than the other.
On uni-directional machine the brush should be placed in its box in order that the half-brush with metal top should be in trailing position.
Hard top plate fittings are frequently replaced by SILESS fittings.

Rubber pad

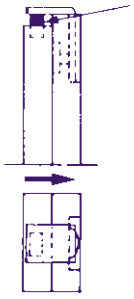


Fig. 3

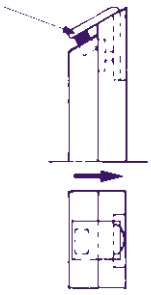


Fig. 4

The rubber pad inserted or glued on the half-brush without metal top appreciably improves the mechanical stability of these fittings (fig. 3 and 4).

GLUED RUBBER BRIDGE

Fig. 5

Fig. 6

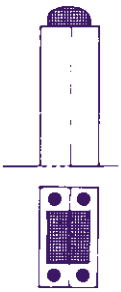


Fig. 7

This fitting is symmetric and convenient for both directions of rotation but the pressure is located at the contact of finger. Furthermore the high friction coefficient of the rubber does not improve the sliding of the finger on the top following the brush wear.

SHOCK ABSORBER PLATE AND HARD TOP PLATE

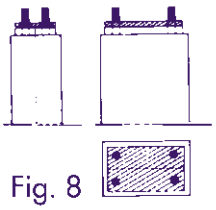


Fig. 8

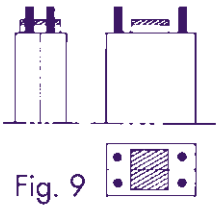


Fig. 9

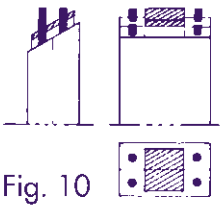


Fig. 10

Directly located on the brush the shock absorber plate is under a non-metallic and hard material top. Threaded on flexibles these 2 pieces are thus kept in position and can be glued each other and on the brush (fig. 9 and 10) or unglued (fig. 8).

SILESS

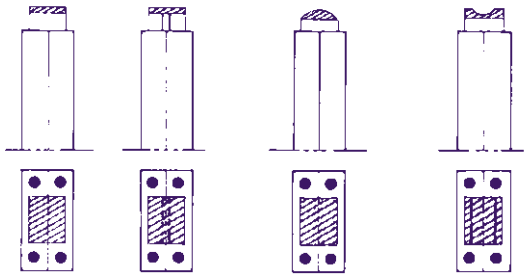


Fig. 11 Fig. 12 Fig. 13

When the 2 tops are glued together and on the brush with elastomer rubber, the fitting is named SILESS (fig. 11).

WEDGE DEVICE WITH SHOCK ABSORBER AND SILESS HARD PLATE

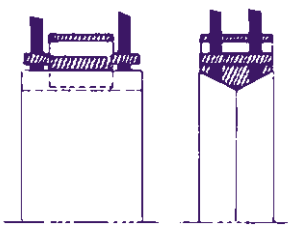


Fig. 14

This design combines the advantages of an elastomer rubber top with the spreading action of a 120° bridge piece. It allows the flexible to be tamped directly into each wafer and is generally used on machines subject to frequent reversal.

THE BRUSH ON THE MACHINE

The brush has an essential function in the operation of an electrical machine, and in order to accurately fulfil its purpose it must have a certain mechanical "comfort", adequate current load and ambient conditions.

In the short study which follows, we examine the main "sensitive points" of a brush, which may be grouped under three headings: Mechanical, electrical and chemical aspects.

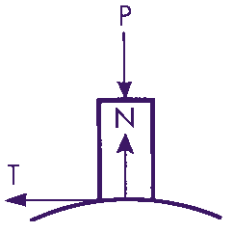
In passing, we shall quote the Technical Note Numbers (STA) which treat the subject more fully. These Technical Notes will be supplied on request, but are also available on out website www.elec.carbonelorraine.com

MECHANICAL ASPECTS

Friction coefficient

The friction coefficient *f* is the relationship between the tangential force T due to the friction and the reaction N.

$$f = \frac{T}{N}$$



The force N is equal to the force P exercised by the spring in the case of the radial brush, but is less when the brushes are inclined (Technical Note STA BE 16-7).

The friction does not have a fixed value. It is an outcome of many factors dependent on the grade of the brush, the speed, the load, the state of the commutator and the ambient conditions.

It is not, therefore, possible to give a precise value for *f* for a certain grade of brush, but solely an estimate of magnitude, which, however, is enough for most machine calculations (Technical Note STA BE 16-8).

Conditions of the ring and commutator surfaces (roughness)

Commutators and rings should have a surface which is neither too smooth (glossy) nor too rough (Technical Note STA BE 16-1), and when necessary, should be trued up so that the out of round is confined within accepted limits (Technical Note STA BE 16-16).

For commutators, faulty mica recessing is often responsible for serious disturbances, and this should be carefully verified to ensure sufficient depth of milling, and no slivers along the bar edges. The edges of the bars should be chamfered (Technical Notes STA BE 16-3 and BE 16-31 and figures L6 and T16).

On rings, especially those with a high peripheral speed, there is generally a helical groove to improve the stability of the brush and to prevent the phenomenon of "glazing". In order to prevent rapid wear of the brush, it is important to chamfer the edges of this groove (Technical Note STA BE 16-3).

Vibrations

All vibration impairs the contact between brush and commutator.

It may have at its origin:
- bad balance, defective bearings, bad alignment (Technical Note STA BE 16-34) and external equipment to the machine itself (gearing, coupling and driven or driving equipment);
- a commutator in a bad condition or deformed (Technical Note STA BE 16-26);
- very high or very variable friction dependent upon unadapted brush grade, polluted atmosphere, condition of the skin and under-loading of the machine, low surface finish (iced).

The vibratory system constituted by the brush, the spring and the brush holder with its support, can enter into resonance; this is generally followed by serious deterioration of the brush and even also of the brush holder.

These incidents may be minimised if not eliminated by the choice of brush with a different shore hardness (Technical Note STA BE 16-14), a bevelled contact brush, trailing or reaction (Technical Note STA BE 16-7), a brush with a rubber or elastomer shock absorber (see page 12 "Mounting" and Technical Note STA BE 16-2), a split brush (Technical Note STA BE 16-49) a grade better adapted to the operating requirements or to the ambient atmosphere (Technical Note STA BE 16-22).

Pressure

The recommended pressures (Technical Note STA BE 16-27) for each grade of brush are situated between;
– low pressures, advisable in order to diminish the friction losses, but which can cause a higher electrical wear as a result of sparking;
– and high pressures (Technical Note STA BE 16-46), which tend to diminish the contact drop of the brush, thus electrical losses, but provoke wear by higher mechanical erosion (Technical Notes STA BE 16-8 and 16-35).

However, for particular applications (traction, small machines...) a high pressure is preferred because of strong vibrations for which specially treated brushes are used (Technical Note STA BE 16-22).

On a ring or a commutator, the pressure on all brushes should be equal to ensure good distribution of the current. A periodical careful checking, by the use of a balance or a dynamometer, is therefore recommended (see our commercial leaflet BE 22-07).

With brush-holders for which the pressure varies with the wear of the brush, it is advisable to regroup by polarity those brushes of the same length, at any rate, for the more important machines.

Brush support

The brushes should be supported throughout a sufficient length, with a definite clearance to prevent wedging, but not so great a clearance that might allow hammering by the brush between the brush box walls. The allowed clearances for various brush sizes are defined by the International Electrotechnical Committee (I.E.C.) and their standards are gradually substituting the older national standards (Technical Notes STA BE 16-4 and 16-36).

In certain cases, dust grooves are arranged on the faces of the brushes (Technical Note STA BE 16-13).

In order to diminish frequent brush replacement, brushes with considerable length have been created, that is to say, with their wear length augmented. These adapt themselves particularly well to constant pressure brush holders. This type of brush-holder assures good brush support and exercises a constant force throughout the whole brush wearable length (Technical Note STA BE 16-17).

As a general rule, the brush-holders should be well aligned and adjusted to a distance of 2 to 3 mm from the ring or commutator. Such holders should be inspected and cleaned at regular intervals (Technical Note STA BE 16-20).

Disposition of the brushes

The lateral setting of the brush arms one relative to the other is called “staggering” and must be carried out in accordance with precise rules (Technical Note STA BE 16-9).

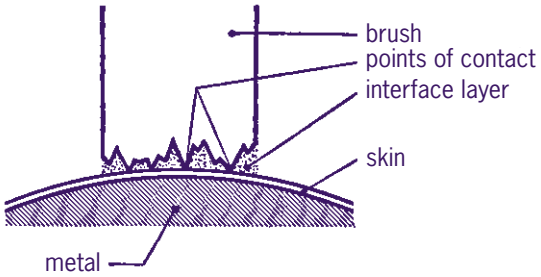
With better stability and commutation in mind, it is interesting to note that the brushes should have a correct orientation relative to the direction of running, at least, in so far as the soft grades are concerned.

We observe this rule when machining brushes for commutators or rings.

In the case of brushes for slip rings, in particular, split brushes, it is possible that difficulties in rational mounting may arise (Technical note STA BE 16-10).

ELECTRICAL ASPECTS

CONTACT DROP



This is an important characteristic of sliding contacts, and is less an electrical property of the brush or of the machine than a property of the complex film deposited on the ring and the commutator (skin) and of the interface layer.

The skin is a mixture of metallic oxides, carbon and water.

The interface layer is composed of a gaseous film, ionised with particles of carbon in suspension and sometimes of fine dust.

It is, therefore, to be expected that the contact drop should be influenced by all the factors which may modify the skin or the interface layer. For example, the temperature, the pressure and the ambient humidity, the atmospheric impurities, the speed of the commutator, the pressure applied on the brushes, the transverse currents and the nature of the brush itself.

The recording of the contact drop curve, when it is made, shows the importance of these variations, for it would be seen that there are superimposed on the main curve, oscillations of short duration due to the continuously changing nature of the sliding contact.

The contact drop given for each of the grades can only be the average value obtained during a well defined operating period. Because of the difficulty of giving precise values the range is grouped into four classes, each one being represented by a symbol (see page 4).

Contact drop gives rise to electrical losses and heating of the commutator or ring occasioned there by (Technical Note STA BE 16-8) and influences commutation and the distribution of current between brushes.

COMMUTATION

In reality, the phenomena of commutation which are often responsible for sparking at the brushes are the consequences of current reversal in those sections of the armature which momentarily undergo short-circuit by the brushes.

One should not mistake commutation sparking for sparking which is a result of mechanical causes (vibrations) or of bad adjustment of the neutral (Technical Notes STA BE 16-18 and BE 16-33) or of faulty interarm adjustment, or of insulation faults in the winding, or faults in the construction of the commutator, statical electronical converters.

There are a certain number of artifices by which the commutation of a machine can be improved:
– sandwich brushes (Technical Note STA BE 16-19) which limit circulating currents and control the skin well;
– the introduction of advanced brush or circumferential stagger (Technical Note STA BE 16-23);
– split or dual grade brushes where the elements of each are in a different grade.

DISTRIBUTION OF CURRENT IN THE BRUSHES

The current is not distributed uniformly across the whole of the contacts surface of the brush. In fact, it passes through a variable number of zones of comparatively very small surface area.

The collecting zones are constantly changing with time, and if everything goes well, they move to engage all parts of the contact surface equally.

It may happen that this equilibrium is interrupted. The areas of current passage are regrouped and diminish in number. Lining or threading appears on the skin (Technical Note STA BE 16-31) developing more clearly as the passage of current becomes more localised under the brush.

The causes of these phenomena are very diverse:
– External agents (dust, gas, excessive humidity, low temperature).
– Grade of brush not suitable for the running conditions of the machine (skin too thick, current density too high or too low, ventilation, etc.).

By an identical process, the current may be unequally distributed between brushes on the same arm on a commutator or along the same track on a ring. Considerable difference of brush pressure from one brush to another is often the origin of this fault.

CURRENT DENSITY

This is the average current per unit surface over the whole contact face. Its standardized symbol is J_B.

By convention the current density (J_B) in a brush is considered as being the quotient of the current carried by the brush in Amperes through the cross section in sq.cms and without regard to whether the brush is radial or inclined.

The current density (J_B) has a great influence on all conditions which affect the performance of brush operation: wear, friction, temperature, etc.

The values which we give as the permissible load for each brush grade are those which the brush can withstand in permanent use. However, these values vary with the characteristics of the machine and the method of ventilation.

A low current density can be much more disastrous to the motor than an excessive one.

From this standpoint, it is often useful to reduce the number of brushes on an arm of a machine in order to increase the current density in the remaining brushes during low-load running of long duration.

RESISTIVITY

There is no direct relationship between the electrical resistivity of a brush and its contact drop, especially when impregnated brushes are involved (Technical Note STA BE 16-22).

Generally, resistivity modifies only very little the electrical losses of the brush (Technical Note STA BE 16-8).

For laminated brush materials (BG, MC, CG, LFC, A), the resistivity values will be noticeably different if they are measured parallel or perpendicularly to the cleavage planes.

The split brush and even more the sandwich brush permits an artificial increase in the transverse resistance (Technical Note STA BE 16-19).

Note
The resistivity indicated in this catalogue, for each grade is the longitudinal resistivity, i.e. measured along "r" dimension.

PHYSICAL AND CHEMICAL ASPECTS (ENVIRONMENT)

HUMIDITY

(Technical Note STA BE 16-39)

Water, which is an essential constituent of the skin, is supplied by the ambient air. When the air is very dry, the skin obtained contains predominantly metallic oxides. As a result, high friction develops, together with sparking and brush wear which can be very rapid.

These unfavourable conditions become critical when the absolute humidity rate falls below a point which can be fixed at about 2 g/m^3, this is the case for:
– machines (Aircraft) which are likely to be used in rarified atmospheres at high altitudes.
– machines where the brushes are enclosed within a chamber filled with dry gas (hydrogen or nitrogen).
– totally enclosed motors (IP 55).

For such particular applications, we have brushes which have been especially treated. Please consult us.

ASPECTS OF COMMUTATOR SKINS

TECHNICAL NOTE ■ STA BE 16-31 GB

Set out below are the various common and typical aspects of skin conditions and commutator faults. Below each general heading is shown the character and significance of these different skin types and faults.

P - SKIN

a - Colour intensity

- P2 - P4 - P6: show normal skins.
  Uniform, light maroon (P2) to darker maroon (P6).
  The machine and brushes working well.

b - Aspect of Skin deposit

- P12: Streaky skin.
  Lines and bands of varying size alternately light and darker without wear of the copper.
  Most frequent cause: excessive humidity, oil vapours and agressive gases in the atmosphere - under loaded brushes.
- P14: Raw grooved skin.
  As P12, but with bands of the colour of raw copper or very slightly skinned. The metal is being attacked.
  Most frequent causes: the same as for streaky skin but more intense or prolonged.
  Also the brush grade may be unsuitable.
- P16: Patchy skin.
  Of blotchy appearance having irregular and diverse colorations and dimensions without character of symmetry.
  Most frequent causes: commutator deformed or dirty.

c - Patchiness due to mechanical causes

- P22: Isolated or regularly distributed blotches.
  Dark blotches having blurred boundaries.
  Most frequent causes: commutators out of truth (isolated blotch) or out of balance vibrations, defective bearings or alignment imperfect etc. (blotches regularly distributed in one or more zones of the commutator).
- P24: Dark blotches with sharp or irregular edges followed by lighter areas in alternating fashion with gradual reducing intensity of colour.
  Most frequent causes: a fault affecting one bar or group of bars causing radial movement of the brush.
- P26 - P28: Bars marked at their centre or at their edges.
  Shading at the centre of the bar or fringe marking at the edges.
  Most frequent causes: defective maintenance of commutator, poorly turned or trued.

d - Bar marking due to electrical causes

- P42: Alternate bars light and dark.
  On each side of a variable number of clear bars the dark bars can have an aspect of polished, mat or blackened appearance. This characteristic is reproduced all round the commutator in a repetitive manner.
  The most frequent causes are of electrical origin. They are associated with the coils on the armature being commutated at successive intervals, the difficulty increasing with the rank of conductors in each slot as in multiplex windings.
  This can be corrected by the use of a grade having a better commutating ability.

- P46: Marking at double pole pitch.
  Marking is clear or hazy, its colour dark, with mat or black appearance, successive markings at double pole pitch.
  Most frequent causes: faulty soldering at equalizers, risers or in coils.

B - BURNING

- B2 - B6: Metallic erosion, burning and dark patches at edge of bar due to the degree of sparking.

- B8: Metallic erosion (burning) at centre of bars.

- B10: Pitted skin.
  Small clear, light spots of variable number and random distribution over a normal skin.
  Cause: sparking under the brushes.

T - GHOSTING AND BANDING

Aspects of certain particular marking

- T 10: The brush image.
  A dark or black mark reproducing all or part of the contact face of the brush in exact outline on the commutator.
  Most frequent causes: prolonged periods at rest without current or momentary stall of the machine under voltage.

- T 12: Dark fringe due to high bar L 2.

- T 14: Dark fringe due to low bar L 4.

- T 16: Dark fringes due to high micas L 6.

- T 18: Dark bar edge patches due to metallic fins at edge of bars.

L - COMMUTATOR BAR FAULTS

- L 2: High bar.
- L 4: Low bar.
- L 6: High micas.
- L 8: Copper fins.
- L 10: Copper drag.

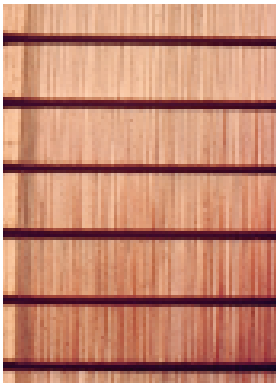
R - WEAR OF COMMUTATOR BARS

- R 2: Commutator with axial profile showing track growing with correct stagger. This wear may appear after a very long period of operation.

- R 4: Commutator showing abnormal wear of the metal through incorrect stagger, or grade unsuitable or various atmospheric pollutions.

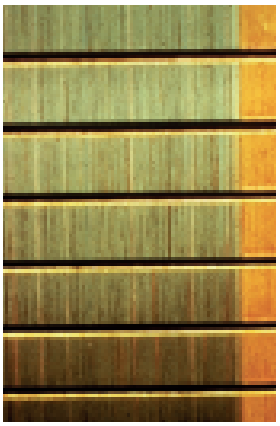
P - SKIN

variation in colour



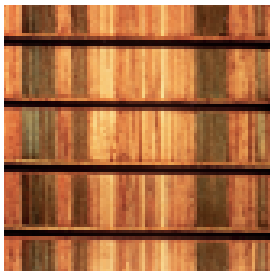
P 2

P 4



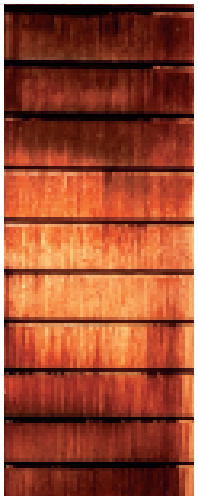
P 6

aspects of skin



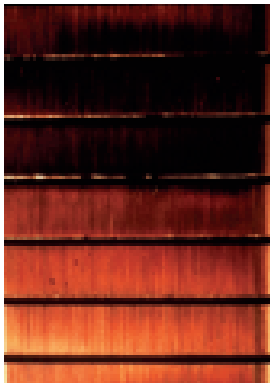
P 12

P 14

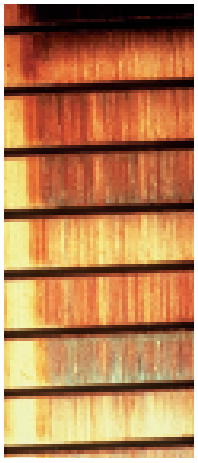


P 16

bar marking of mechanical origin



P 22



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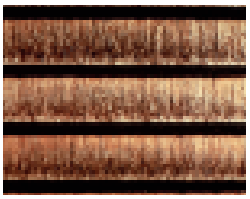

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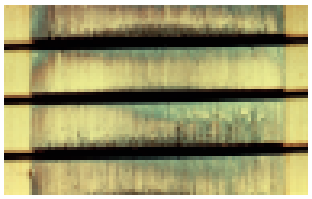
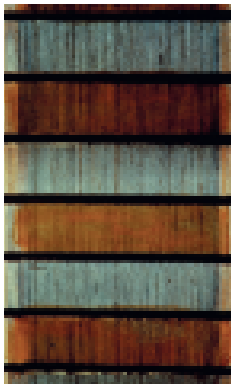


P 28

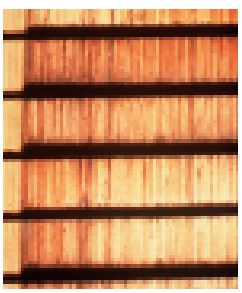
bar marking of electrical origin



P 42

P 46

B - BURNING



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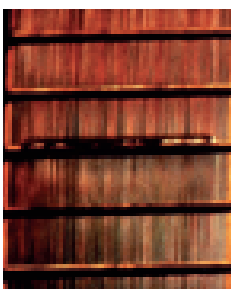
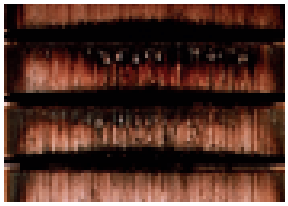


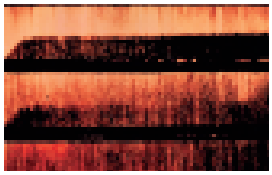
B 6

B 8

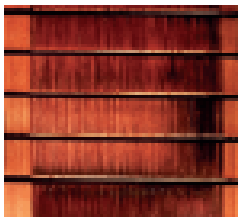


B 10

T - COMMUTATOR BAR MARKING



T 10



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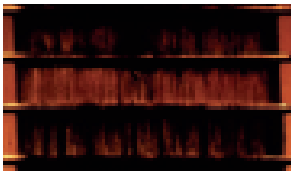
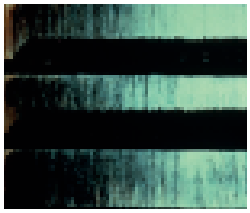
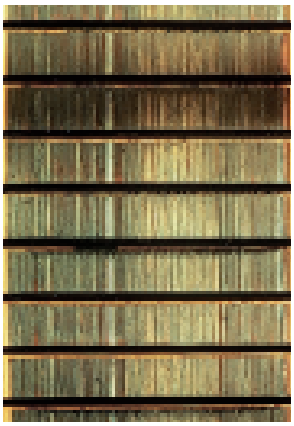


T 14



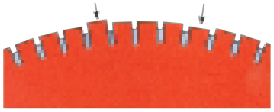
T 16



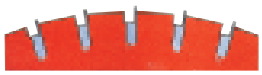
T 18

L - COMMUTATOR BAR DEFECTS

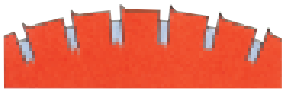
L 2 L 4



L 6

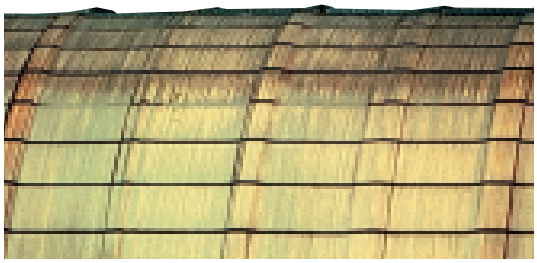


L 8



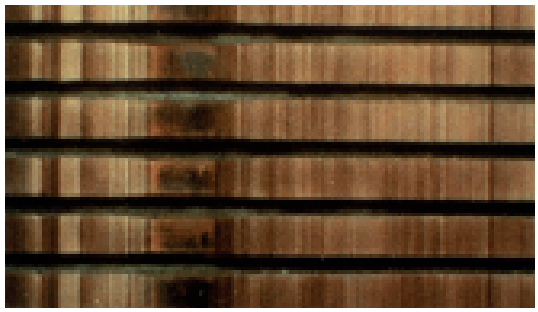
L 10

R - COMMUTATOR WEAR



R 2

R 4



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CARBONE LORRAINE

CARBONE LORRAINE
Immeuble la Fayette - 2/3, place des Vosges
TSA 38001 - La Défense 5
F-92919 PARIS LA DEFENSE Cedex
FRANCE
www.carbonelorraine.com

CARBONE LORRAINE
APPLICATIONS ELECTRIQUES
10, rue Roger Dumoulin
F-80084 AMIENS Cedex 2 - FRANCE
Tel. : +33 (0)3 22 54 45 00 | Fax : +33 (0)3 22 54 46 08
www.elec.carbonelorraine.com

BE 16-31 GB 6050

CORROSIVE GASES OR VAPOURS

Even though this may be in low proportions in the atmophere and especially if associated with humid conditions, it attacks the skin and detroys it. The commutator immediately becomes threaded and the brushes spark considerably.

Such vapours are chlorine and its compounds (chlorine solvents), ammonia, hydrogen sulphide, sulphur dioxide, products used for the hot distillation of silicones (Technical Note STA BE 16-45), etc.

Our treated impregnted brushes are an efficacious remedy for the difficulties presented by polluted atmospheres, because during operation they deposit on the rings or cummutators a thin and continuous film which protect the metal against the corrosive gases.

OILS AND HYDROCARBONS

The contamination of commutators, rings and brushes by gas oils, oil, fuel oil, etc., is caused by:
– projection of tiny drops or mist carried by the ventilating air;
– condensation of vapours developed at hot points;
– migrations from a bearing which is not properly sealed.

These oily contaminations always considerably disturb the otherwise satisfactory operation of a machine. Two incidents are frequent:
– the wedging of brushes in their box as a result of the formation of a thick grease when brush dust mixes with oil;
– deterioration of the rings, commutators and carbon brushes as a result of the deposition of a thick insulating grease on the brush tracks.
  This causes unequal distribution of current over the brush face, which then results in the formation of a skin having bands or deep grooves.

Amongst the possible remedies are deflectors, inversion of the ventilating direction, intake of fresh air from outside, oil repellent varnishes.

DUST

Dust is always harmful particularly when it is abrasive. It causes;
– wear and grooving of commutator or ring;
– rapid wear of brushes;
– furrowing of the brush faces and sides with a degree of wedging in the boxes. Dust grooves in particular will assist in curing these difficulties (Technical Note STA BE 16-13), but the best remedy is preventive; it consists in filtering the ventilating air.

With totally enclosed machines where the dust caused by brush wear (Technical Note STA BE 16-48) is recirculated continuously the same sort of difficulties arise.This fault is particularly worsened when metallic brushes of a high metal content are used.

For these applications, the use of brushes with a high metal content should be avoided.

In general, all machines which function in these dusty atmospheres, including totally enclosed machines, should be subjected to careful and frequent cleaning.

RECOMMENDATIONS FOR FITTING BRUSHES ON MACHINES

BRUSHES

– Do not mix two or more grades of brushes on the same machine as this would cause serious incompatibility.

– Make sure to eliminate the remaining skin before changing the brush grade.

– Verify that the brushes move freely in their holders without excessive clearance (see Technical Note STA BE 16-4).

– Verify, particularly, for brushes with bevelled contact face, that the brushes are not mounted (or remounted) the wrong way round. Same for dual brushes with metal layer.

BRUSH HOLDERS

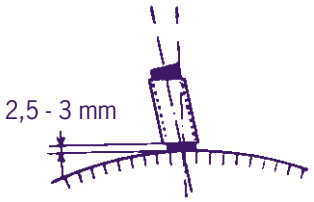


Fig. 1

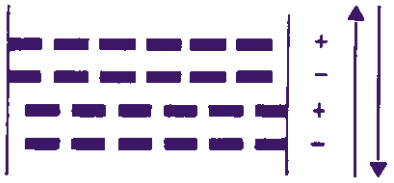


Fig. 2

– Ensure that the brush holder functions correctly and check that the interior of the box is in good condition.

– Adjust the distance of the brush holder from the commutator to between 2.5 and 3 mm (fig. 1).

– Place the brushes on parallel and equidistant tracks.

– When staggering of brushes is necessary, this should be done in pairs of arms so that there is always an equal number of positive and negative brushes on the same track (fig. 2).

– Align the leaving edges of the brushes on each of the arms to flush with the edge of a commutator bar.

– Verify that brushes of successive arms are an equal distance apart.

– Verify, by use of a dynamometer that the pressures are equal on all the brushes.

BRUSH SPRING PRESSURE (in kPa)

Groups of brush grades	On slip rings	On commutators	
		Stationary machines	Traction machines
Carbographitic		18-20	
Electrographitic	18-20	18-20	25-45
Electrographitic		18-25	25-55
Soft graphitic	13-20	13-18	
Metallic – normal speeds	18-20		
Metallic – speeds < 1 m/s	25-27		

Note : 1 kPa = 10 cN/cm² (centinewton/cm²) and is close to 10 g/cm².

COMMUTATORS AND SLIP RINGS

Fig. 1

Fig. 2

Check that they are well round and have no surface fault. If necessary, improve or rectify with the assistance of a surface rectifying attachment (see page 23).

Scrape or mill the micas of the commutators (fig. 1).

Chamfer the bar edges at 45° to 0.2 to 0.5 mm (fig. 2).

Clean up the surface with a “M” grain abrasive stone. Avoid the use of abrasive paper or cloth.

It is absolutely necessary to have a sufficient rugosity in order to get and maintain a correct skin.

Concerning abrasive stones and electrical machines maintenance tools see specific brochure.

Our motor maintenance service is at your disposal for any diagnostic or on site intervention.

THE BEDDING OF BRUSH CONTACT SURFACES

In order to exactly adjust the contact surfaces to the curvature of the ring or the commutator, use a pumice stone, applied whilst running at low or no load. The dust from the pumice acts as an abrasive which rapidly erodes the brush surface to the same curvature and contour as the commutator or ring.

Of course, it is absolutely necessary to use the “M” grain abrasive stone again after this operation.

When the quantity of material to be removed from the brush is considerable a rough bedding may be effected by the use of abrasive cloth, say grain 60, inserted between the contact faces and the commutator with the abrasive side up. The finished surface is completed by the subsequent application of a fine grade bedding stone (fig. 3).

Clean the contact faces, blow out in order to remove all the abrasive and brush dust.

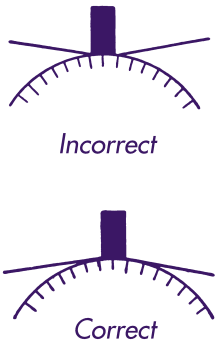


Fig. 3

PUTTING MACHINE INTO SERVICE

After having made sure that all the brushes are free in their holders, that the flexibles are well placed, and the terminals well secured, start up the machine, preferably at low load, and increase the load progressively until a skin is formed.

WAX

If the formation of a skin is slow and indifferent, a CARBONE LORRAINE wax stick may be used with advantage. A single light pass of the stick on a warm commutator or ring is often sufficient to attract a skin and advance the development of a satisfactory contact surface to ensure ultimate good performance.

MAINTENANCE KIT FOR COMMUTATORS AND SLIP RINGS *

To the maintenance staff responsible for supervision and maintenance of rings, commutators and brushes we offer a kit containing the following articles:

– Dynamometer: 0-2.5 daN for control of brush-holders.
– Illuminated magnifying glass to examine skins and brushes (batteries not included).
– Feeler gauge with 11 thickness feelers to measure clearance brush-brush-holder.
– 0-200 mm. gauge to measure brush wear.
– Insulating rod to observe brush vibrations.
– Bedding stone.
– Abrasive rubber to reduce excessive skin formation.
– Wax stick for treatment of newly turned commutator.
– Method of using the abrasive rubber and wax stick.
– Coton - tissue.

* Please contact us.

OTHER AVAILABLE SERVICES

SALES OF ACCESSORIES

for brushes utilization and electric machines maintenance.

– **Electronic dynamometers** for checking the forces applied by the brush holder pressure system.

– **Tools** for electrical machines maintenance:
  • grinding stones, flexible abrasives,
  • slotter, wax stick for initiating patina.

– **Direct drive mica indercutter.**

– **Stroboscope** for slip rings, commutators and brushes overhauling on rotating machines.

– **Brush alarm system junction box.**

TECHNICAL ASSISTANCE ON APPLICATIONS

International network offering local service and technical assistance.
Phone assistance.
Technical documentation on line on our website : www.elec.carbonelorraine.com

EXPERTISES

We can intervene all over the world.
Commutation expertises.
Measurement and diagnosis.

TRAININGS FOR MAINTENANCE OF ELECTRICAL MOTORS AND COMMUTATION.

For 20 years we have been teaching more than 1,000 technicians with two different trainings: STAGELEC (staff from different companies) and EXTELEC (staff from only one company on-site).

TECHNICAL ASSISTANCE FOR MAINTENANCE

On-site interventions, refurbishing of commutators, slip rings and brush holders. Please, contact us.

ON ORDERING BRUSHES

A brush can be defined from 4 characteristics:
– the grade (material and treatment), or brushes engraving,
– the shape and principal dimensions (see table page 12),
– the type of fittings and variant in method of attachment (see page 13).
– the application and motor characteristics.

In consequence any order must be precise in these 4 characteristics and from them identification of the brush is immediate.

However, there are other much simpler ways to define a brush.

1) Drawings catalogue

This is prepared by CARBONE LORRAINE from a survey of the brushes in use in the customers works. Each brush is completely detailed by sketch and by code number. To order it is sufficient to quote the code number appropriate to the brush required.

2) Identification by the brush holder

If the brush holders fitted are of CARBONE LORRAINE (DIETRICH & ex FERRAZ), it is enough to indicate the holder type number and its *t* and *a* dimensions and the grade required.

For modular brush holders (type MONG, MOSPI), it is necessary to indicate the height of the sheath (N, B, H or TH) which determines brush height. The shunt height which depends upon the arrangement of brush gear on the motor should also be indicated, as well as the screw diameter for the terminal.

For all other cases a brush sample or the drawing of the brush holder, as well as motor type and characteristics are necessary.

3) Sample brush

A sample brush of the type used generally allows the establishment of the principal dimensions and design. If a used sample is supplied the length may be in doubt and a suitable choice from the IEC series of values will then be made.

4) Brush drawing

The details necessary in the creation of a brush drawing are few in number if we set aside those details covered by Standard and the practices and norms of classical manufacture.

So that, with the exception of special cases, it is unnecessary to state:
– tolerances of the brush dimensions and flexible length,
– dimensions of chamfers,
– nature and thickness of the material used for attachments and connections,
– number section and composition of flexibles,
– methods of flexible connections and fastenings,
– depth of flexible connection into the brush,
– overall dimensions of terminals.

QUESTIONNAIRE

FOR THE CHOICE OF A SUITABLE BRUSH GRADE

(Text conforms with publication 136.3 of the I.E.C.)

NAME & ADDRESS of User .....

.....

.....

Letter - Report - Reference

Date :

● To permit the supply of the most appropriate brush would you please complete the following questionnaire. PLEASE NOTE - Where the question is followed by a straight line give the information asked for ● In the case of questions within a frame please strike out the inappropriate words ● The questions in blue are especially important.

1 Constructor of machine . . . .

2 Constructor type . . . .

3 Generator / Motor

DC / AC / Rectified AC — Reversible / Unidirectional

4 Converters

DC - AC or AC - DC

	Nominal	In Service	
		Normal	Max.
5 SPEED (r.p.m.)	.....	.....	.....
6 VOLTAGE (V)	.....	.....	.....
7 CURRENT (A)	.....	.....	.....
8 POWER (kW)	.....	.....	.....

9 DUTY . . . .

10 DUTY CYCLE (include % no load) .....

.....

11 Number of main poles . . . .

12 Excitation — Shunt / Separate / Series / Compound

13 Construction — Machine open / Protected / Closed

14 Ambient Temperature (°C) . . . .

15 Relative Humidity (%) . . . .

16 Oil Vapours . . . .

17 Corrosive gases - which ? . . . .

18 Dust . . . .

19 Vibration . . . .

20 DIAMETER OF COMMUTATOR OR RINGS (mm) .....

21 Width of rings (mm) . . . .

22 Number of bars . . . .

23 ARE MICAS RECESSED ? . . . .

30 RING MATERIAL . . . .

31 Are rings helically grooved . . . .

32 Are rings inboard or outboard . . . .

33 ARE RINGS TOTALLY DEVELOPED

35 RING CURRENT DC / AC (A) .....

36 Temperature in service Commutator / Ring °C .....

37 SURFACE STATE COMMUTATOR OF RINGS

Good / polished / Matt — Smooth / Worn / Grooved — Uniformed Marked

Marks Regular / Irregular — Burnt

Colour Light / Medium / Dark

38 Date of last stoning of the Commutator / of the rings .....

39 NUMBER OF BRUSH ARMS PER COMMUTATOR . . . .

40 NUMBER OF BRUSHES PER ARM .....

41 NUMBER OF RINGS . . . .

42 NUMBER OF BRUSHES PER RING

43 BRUSH DIMENSIONS (mm) Fig. 1 2

t = ... a = ... r = ...

44 ANGLE OF INCLINAISON α OF THE BRUSH Fig. 3 4 5 α = ...°

ANGLE OF TOP BEVEL β OF THE BRUSH Fig. 10 β = ...°

45 SPLIT BRUSHES Fig. 6 7 8 9

46 Are the brushes in the arms In Line / Staggered .....

and by how much ? . . . .

47 Spring force acting on the brush daN (kg).....

48 MAKE AND GRADE OF BRUSH IN USE .....

.....

49 What is the average brush life hours .....

50 WHAT PROBLEMS (IF ANY) ARE PRESENT ? .....

.....

.....

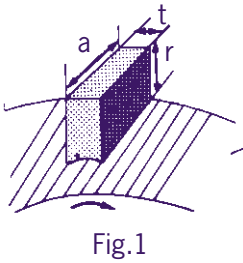


Fig.1

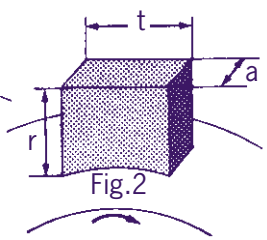


Fig.2

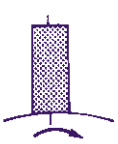


Fig.3

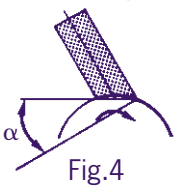


Fig.4

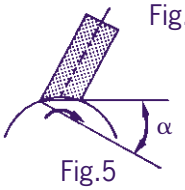


Fig.5


Single box Single finger Split brush

Fig.6


Single box Two fingers Split brush

Fig.7


Tandem box Two fingers Tandem brushes

Fig.8

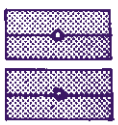

Tandem box Two fingers split brush in each box

Fig.9

ISO 9001: 2000 | ISO 14001

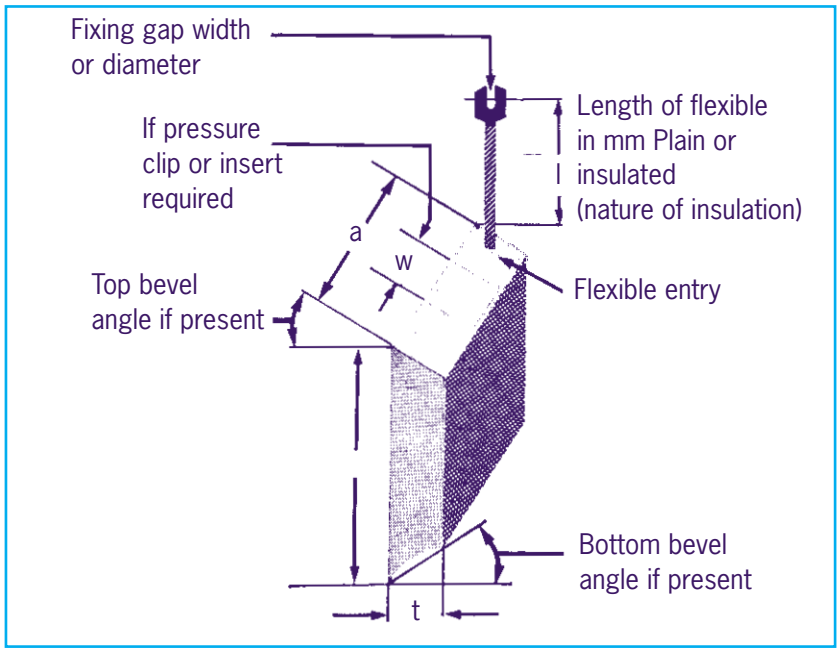
CARBONE LORRAINE

WHEN POSSIBLE SEND US A SAMPLE OF THE BRUSH IN USE
a partly worn one for preference - or a detailed sketch of the brush with its flexible and terminal as shown in the sample sketch at the foot of this page.

SKETCH of BRUSH

Length of flexible mm		Diameter or width of fixing gap mm	

ESSENTIAL INFORMATION for the MANUFACTURE of A BRUSH
Fig. 10



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CARBONE LORRAINE
Immeuble la Fayette - 2/3, place des Vosges
TSA 38001 - La Défense 5
F-92919 PARIS LA DEFENSE Cedex
FRANCE
www.carbonelorraine.com

CARBONE LORRAINE
APPLICATIONS ELECTRIQUES
10, rue Roger Dumoulin
F-80084 AMIENS Cedex 2 - FRANCE
Tel. : +33 (0)3 22 54 45 00 | Fax : +33 (0)3 22 54 46 08
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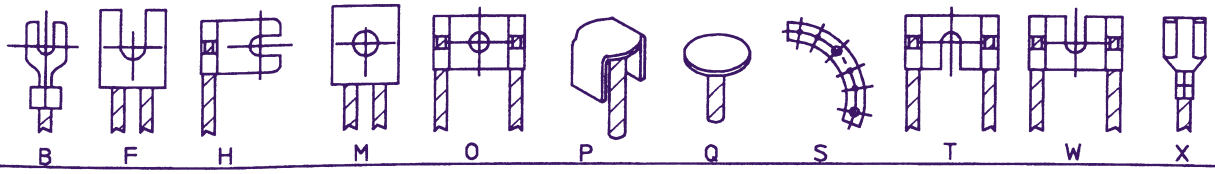
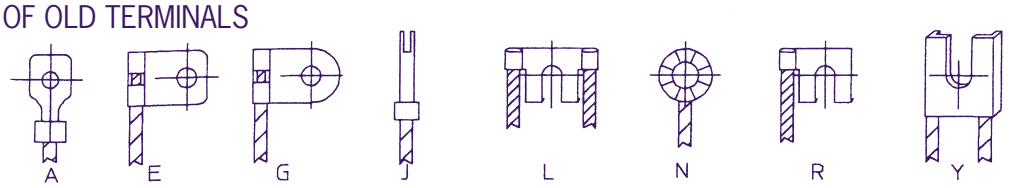
STANDARD SHAPES

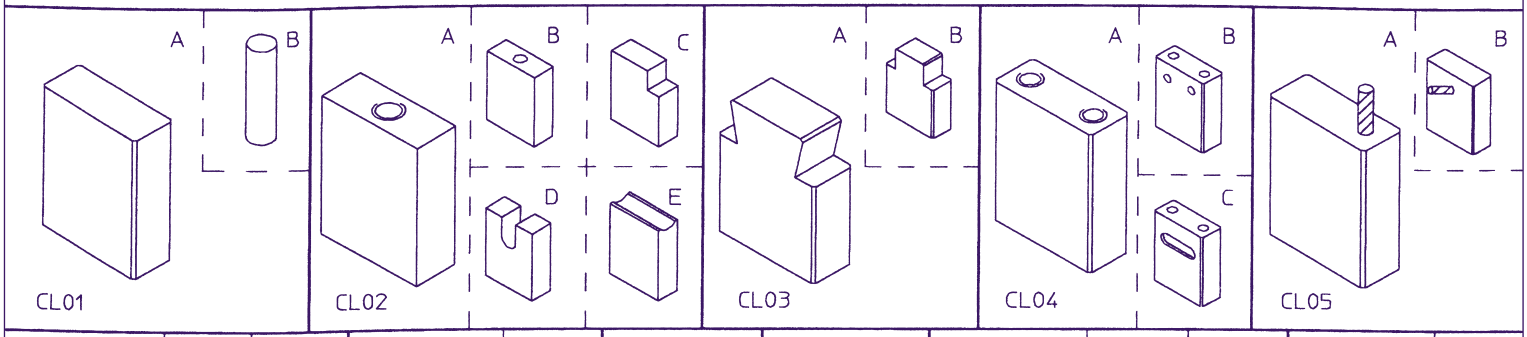
SHAPES OF NEW TERMINALS (recommended)

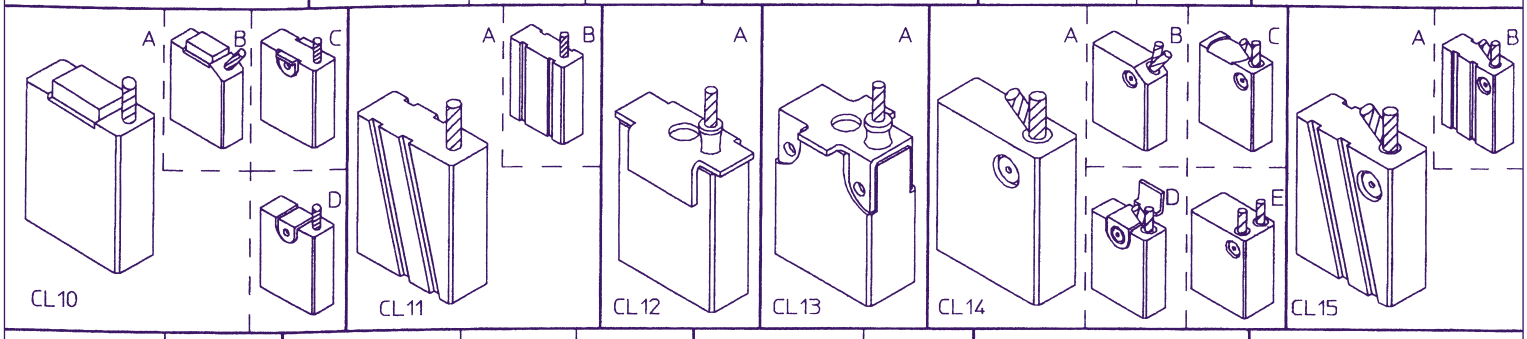


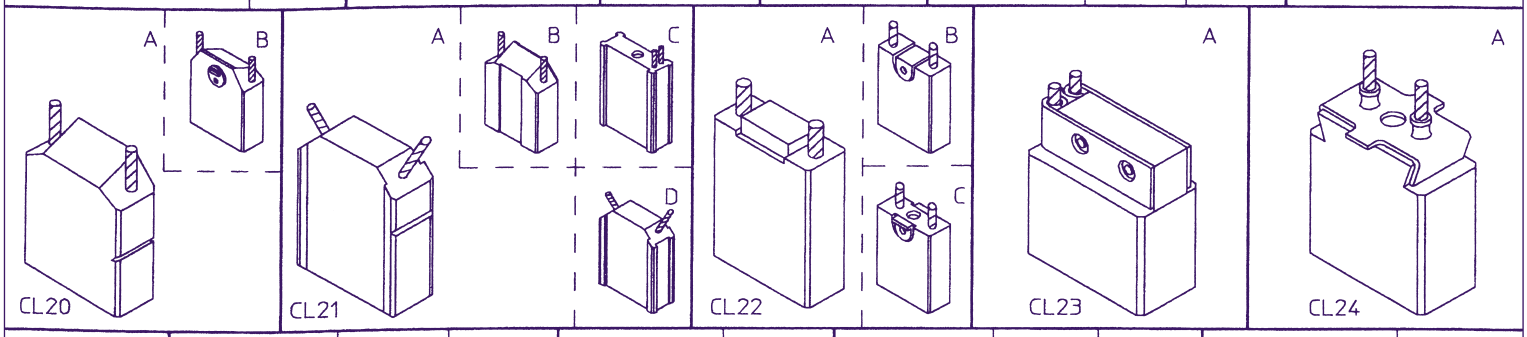
Special shapes of terminals

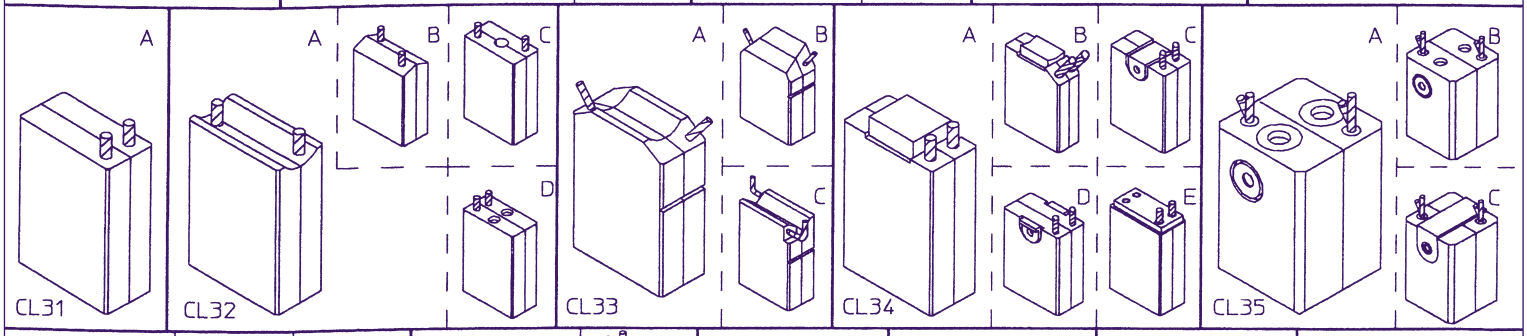
SHAPES OF OLD TERMINALS

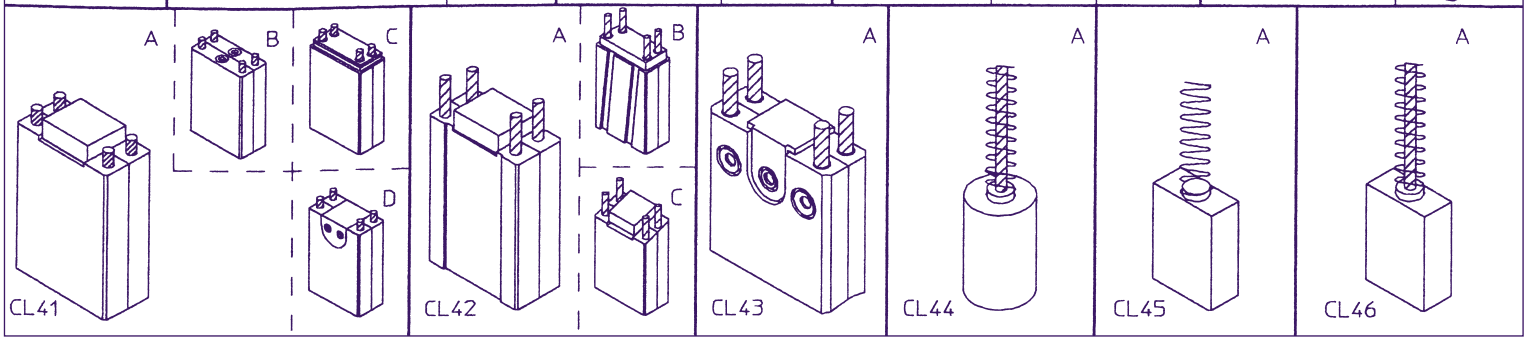


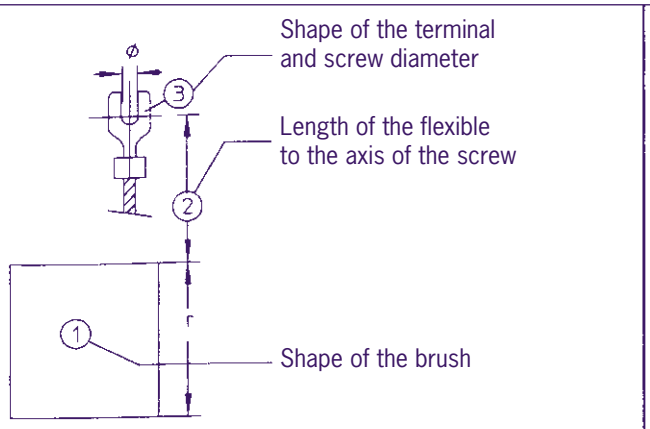




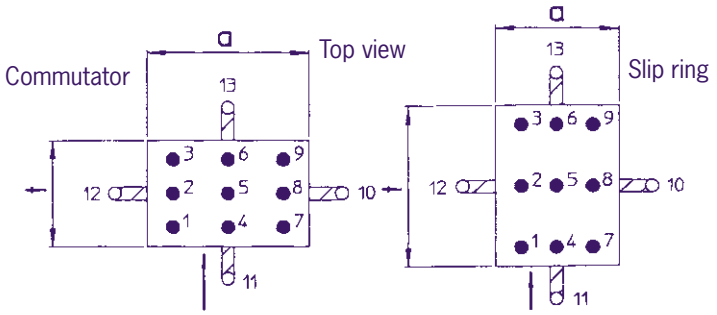




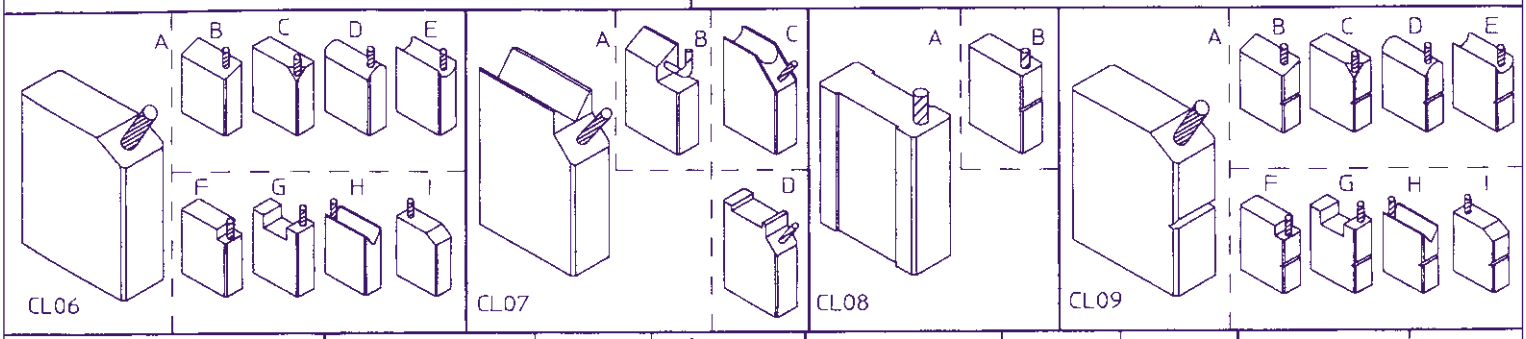


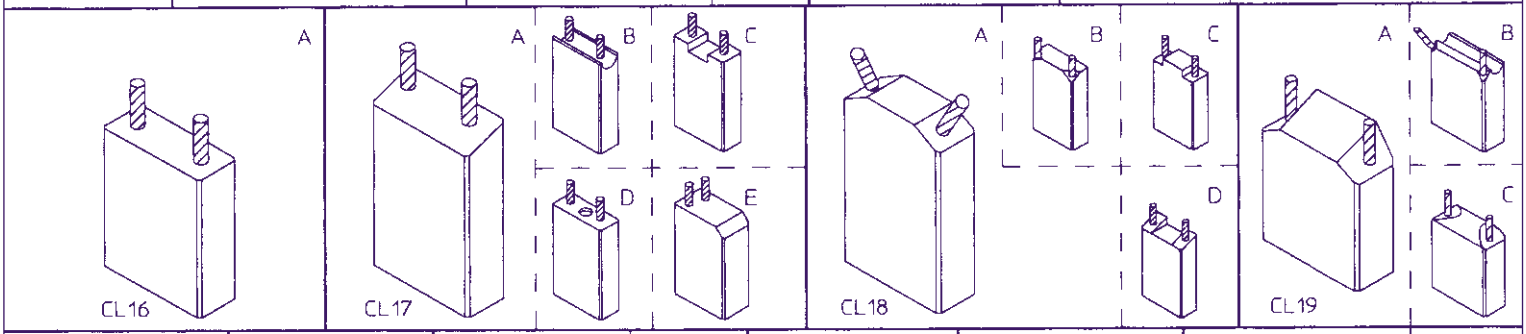


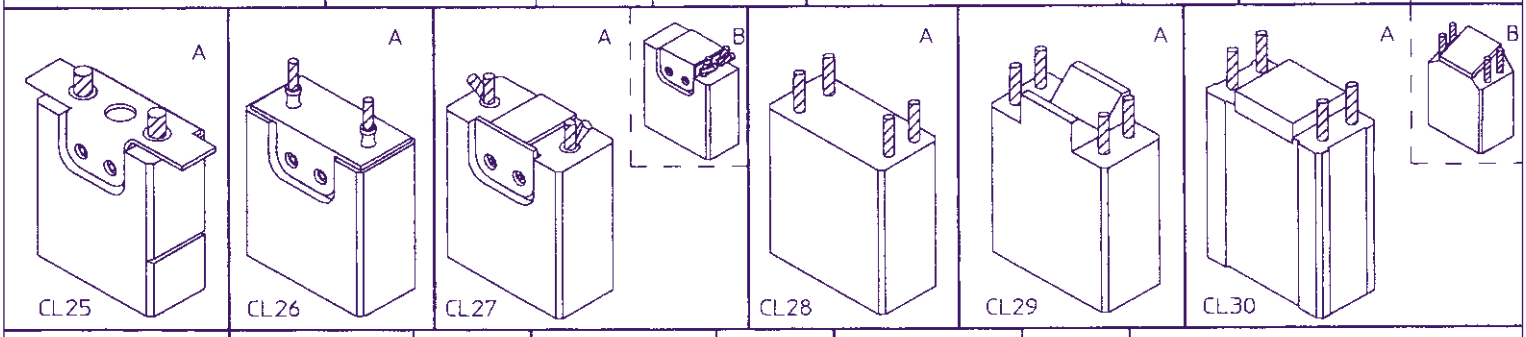
SHUNT LOCATION

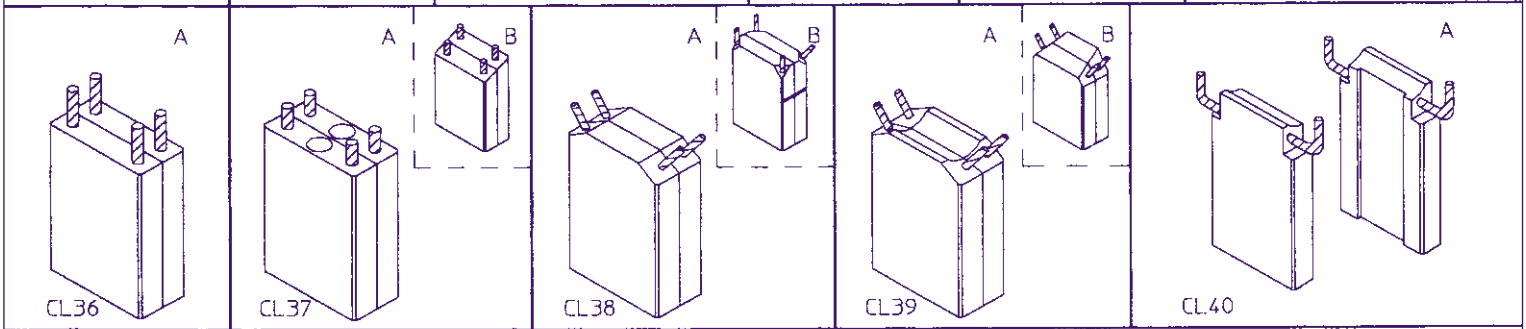


Shapes in accordance with NEMA standard (National Electrical Manufacturers Association) N° CB-1-1995









Special shapes

CL47

SANDWICH

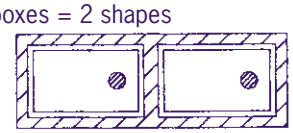
Shape above with a “S” suffix

Be careful: the number of wafers is multiplied by 2

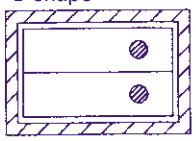
The drawings represent 1 shape per box

For example

Brush Pair
2 boxes = 2 shapes



Split brush
1 box = 1 shape

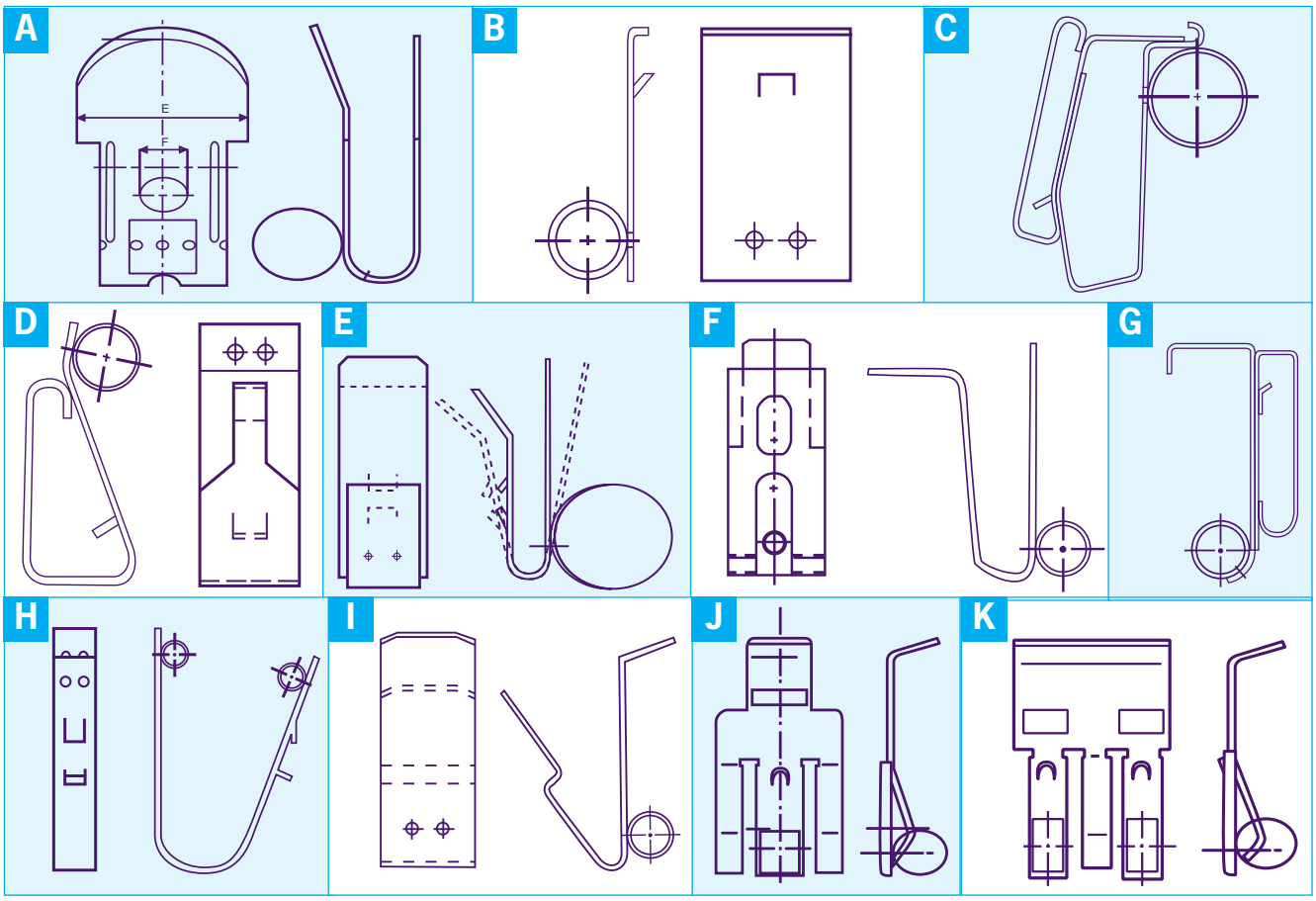


QUESTIONNAIRE

CHOICE OF THE BRUSH HOLDER PRESSURE SYSTEM

Company..... Surname.....
Address..... First name.....
..... Town..... Post Code.....
..... Tel..... Fax.....
..... E-mail.....

Identification of the spring and spring carriers for European models



Indicate the letter corresponding to your need :

If the spring you need is not shown above, please provide a sketch on the reverse side of the form, showing front and side views or alternatively send us a sample. Minimum order quantity: 4 pieces.

Dimensions and characteristics

Brush size	t:.....mm	a:.....mm	r:.....mm
Spring	Diameter:.....mm	.....	Width:.....mm
Spring carrier	Width:.....mm	Heigth:.....mm	Thickness:.....mm
	Material:.....		Insulate:.....
Brush holder	Width:.....mm	Length:.....mm	
	Dimension from bottom of the carrier to the location pin:		.....mm

Other information

Carrier engraving:..... Quantity:..... Delivery with brushes: YES NO

ISO 9001: 2000 | ISO 14001

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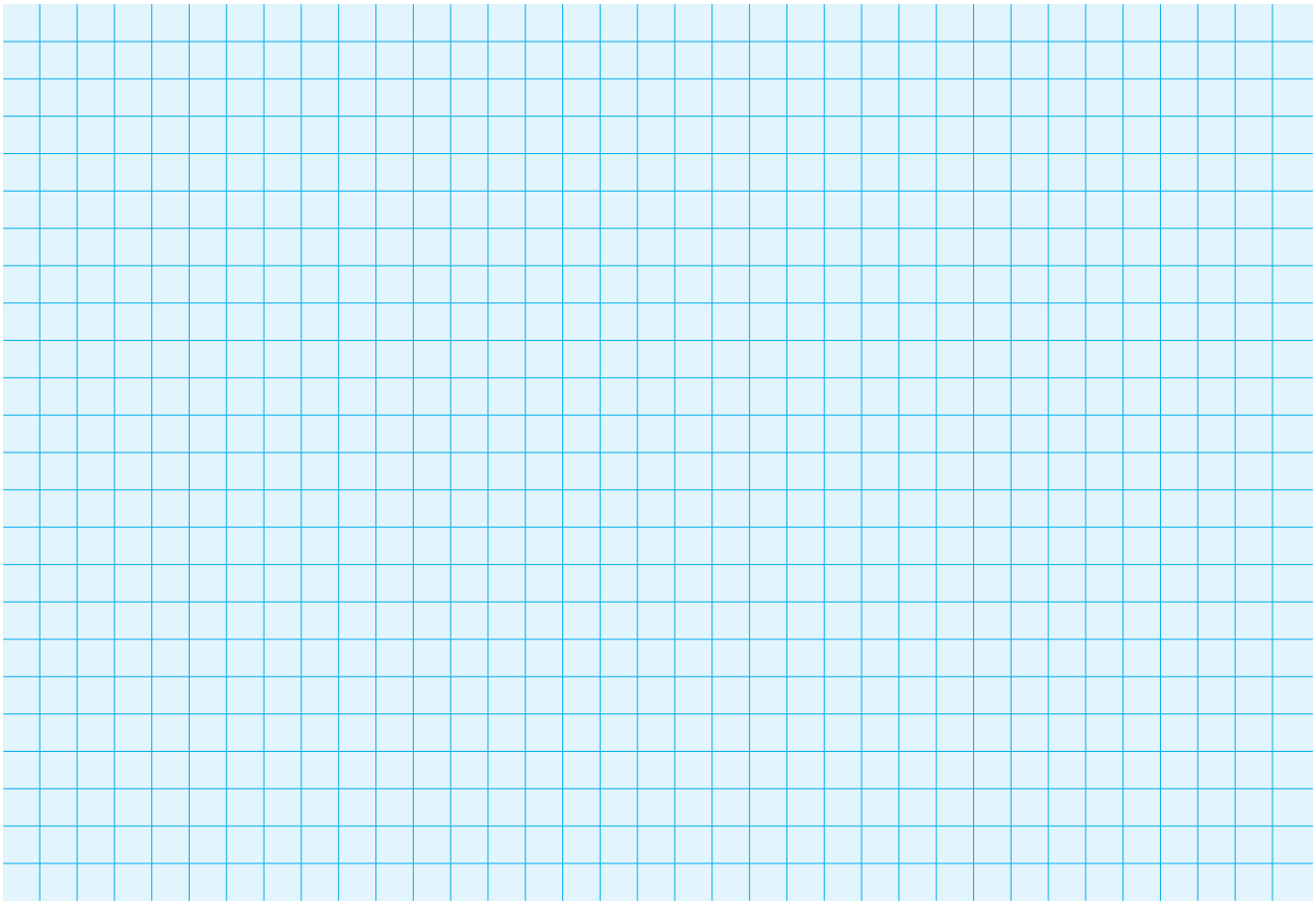
Sketch for front and side views



Special request

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TSA 38001 - La Défense 5
F-92919 PARIS LA DEFENSE Cedex
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In addition to the present Technical Guide, other booklets can be supplied on request for exemple :

- **ASPECTS OF COMMUTATOR SKINS** ..... BE 525

- **INDUSTRIAL CURRENT COLLECTION** ..... BE 11

- **SMALL BRUSHES AND SPECIAL APPLICATIONS**

Brush grades for electrical motors, hand tools and home appliances ..... BC 30-02/03/04
Brush grades for automobile electrical equipment ..... BC 30-02/05/06
Silver graphite brushes ..... BE 205
Brushes for aeronautical and space applications ..... BE 206

- **PREVENTIVE MAINTENANCE** ..... BE 15

- **STA TECHNICAL NOTES ON**

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Since its foundation in 1892, CARBONE LORRAINE has built up an international reputation by creating subsidiaries on all continents. Today with industrial and commercial plants scattered in more than 30 countries, agencies and representatives in more than 70 countries and 250 commercial contacts throughout the world, CARBONE LORRAINE offers its customers everywhere reliable high technology products and the service of its experienced technicians.

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