representative
of Mersen
in Poland

ELEKTROCARBON
www.elektrocarbon.pl

CATALOGUE

BRUSH-HOLDER PLUG SETS

MERSEN

Table of Contents

1 Introduction

Brush-holder plug sets transmit DC excitation currents to rotating slip rings which are located on synchronous generators. The carbon brushes can be changed while the generator is still running; therefore the machine does not have to be shut down.

With our large selection of brush-holder plug sets, we are able to find a suitable solution for most existing facilities. Moreover, close cooperation between our customers and our engineering staff allows us to develop new projects with innovative solutions, optimally suited to the customers' individual requirements. The entire manufacturing process (from design, tool making, casting, technical processing to assembly) is done in-house and allows us to react with great flexibility to all demands coming from the market.

We at MERSEN Austria Hittisau Ges.m.b.H. have been manufacturing this type of brush-holder for over 35 years. We have continuously improved our products to keep up with the demands of the market, innovation and ingenuity are our strengths.

2 System Description

2.1 Subsystems and Components

Our brush-holder plug sets are made up of two distinct subsystems: the adapter and the brush-holder plug-set. The adapter provides the mechanical and electrical connection from the brush-holder plug set to the brush rocker and then to the bus. Adapters are available in different designs: either clamping pieces (a), with bolts (b) or as bars (c).

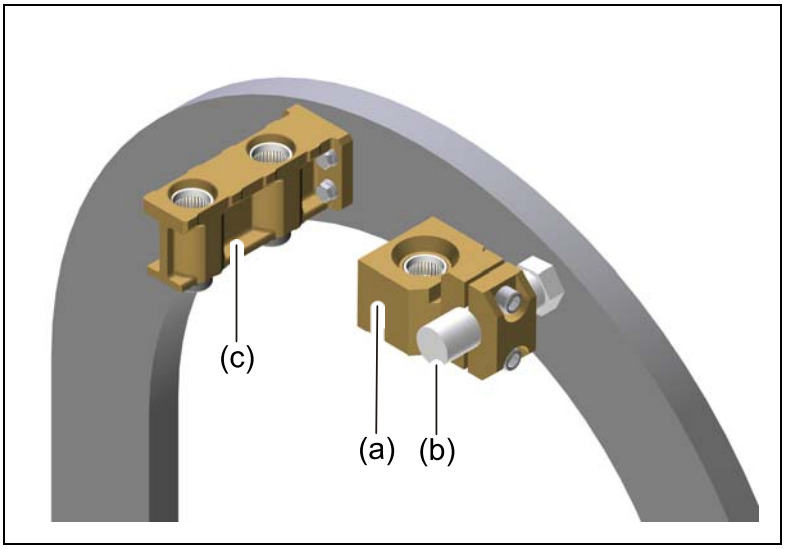
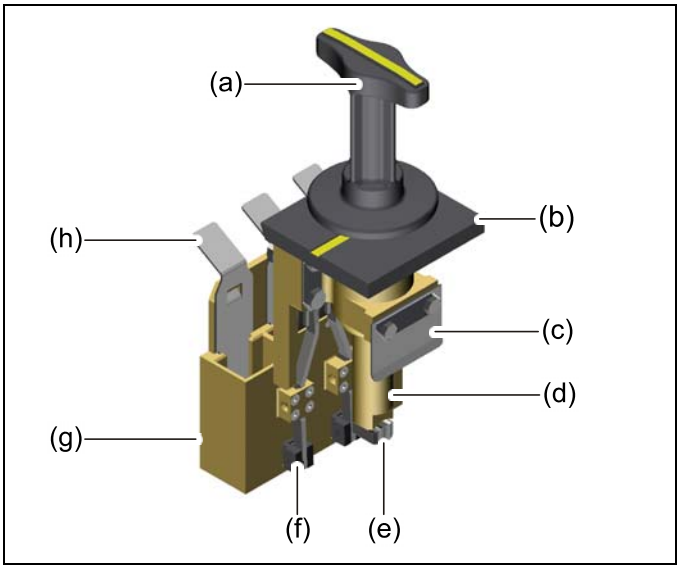


Illustration 2.1 Adapter Designs

The subsystem “brush-holder plug set” (Illustration 2.2) consists of several components: the spring clip, locating cone, lock and bolt guarantee a solid, vibration-resistant connection.



(a) Insulating Handle
(b) Contact protection plate
(c) Support spring
(d) Contact bolt
(e) Spindle
(f) Brush clamping lever
(g) Brush-holder
(h) Spring clip

Illustration 2.2 Brush-Holder Plug Set

2.2 Function

By turning the handle 90°, the connection is locked (1) or unlocked (2). The brush clamping lever prevents the carbon brush from slipping out while unlocked (2).

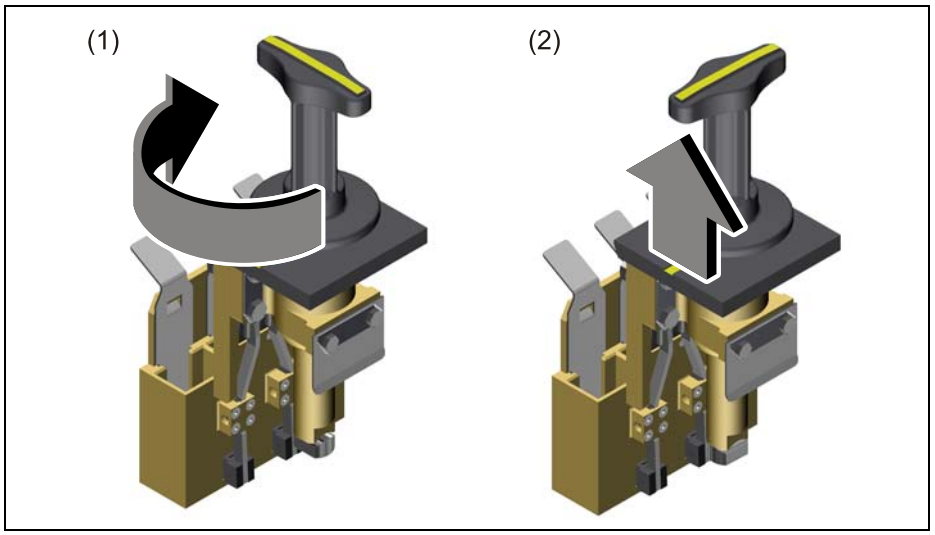


Illustration 2.3 Function

2.3 Brush Clamping

To prevent the carbon brushes (b) from accidently slipping out while the plug set is being replaced they are secured by the brush clamping lever (a). Each carbon brush is held in position by its own clamping lever.

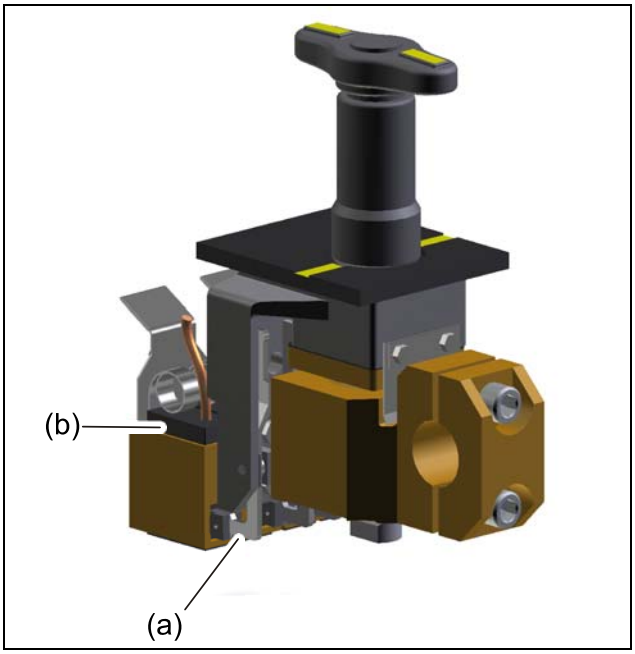
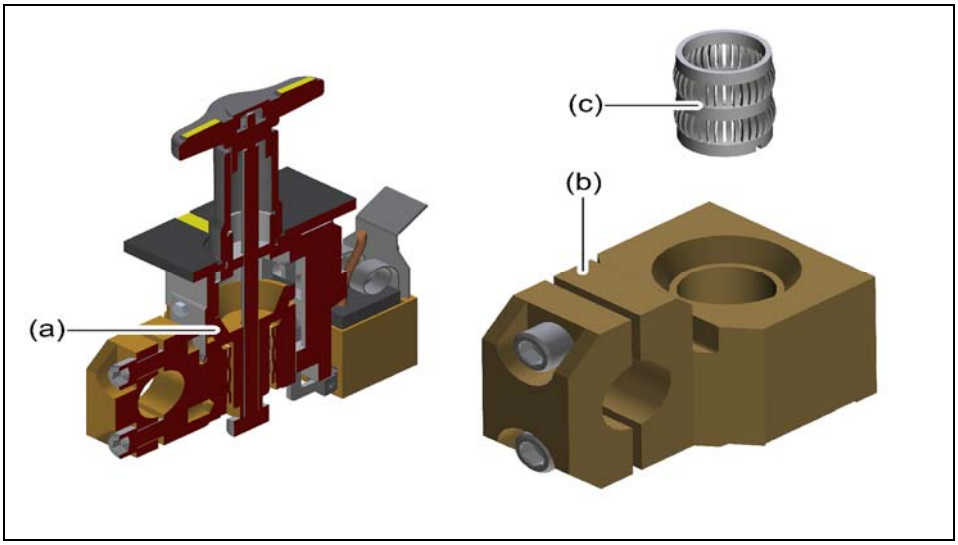


Illustration 2.4 Brush Clamp Lever

2.4 Electrical Connections

A multi-contact socket (MC socket) is fitted between both subsystems to keep the electric resistance between them as low as possible.



(a) Contact bolt
(b) Adapter (clamp)
(c) MC socket

Illustration 2.5 Multi Contact Socket (MC socket)

The MC socket integrated into the MERSEN systems ensures an even current distribution.

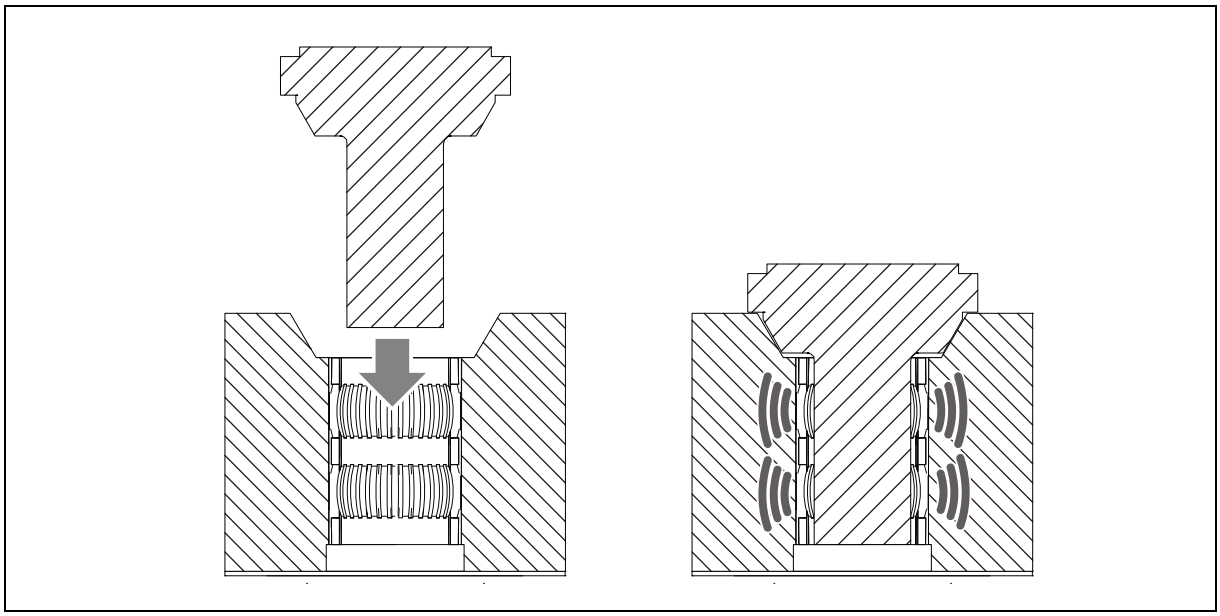
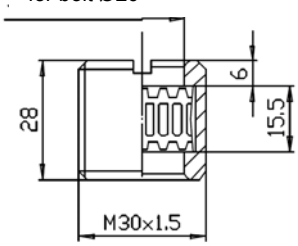


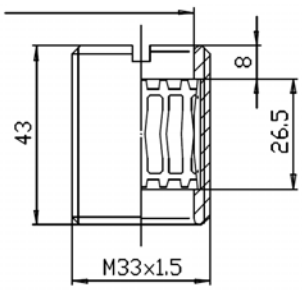
Illustration 2.6 Cross Sectional View of the MC Socket and its Current Distribution

for bolt Ø20



Rated for 400 A continuous current
Load temperature at 80°C
approx. 300 Ampere

for bolt Ø25



Rated for 600 A continuous current
Load temperature at 80°C
approx. 500 Ampere

2.5 Contact without MC Sockets

Some problems which may occur by not using MC sockets are shown in Illustration 2.7. Poor current transfer could, for example, cause poor current distribution between the individual brushes, with increased heating, sparking, material erasion etc.

MC sockets are a standard component of the MERSEN brush-holder plug set solutions.

Example of a “non-elastic” contact system vs. a MERSEN system:

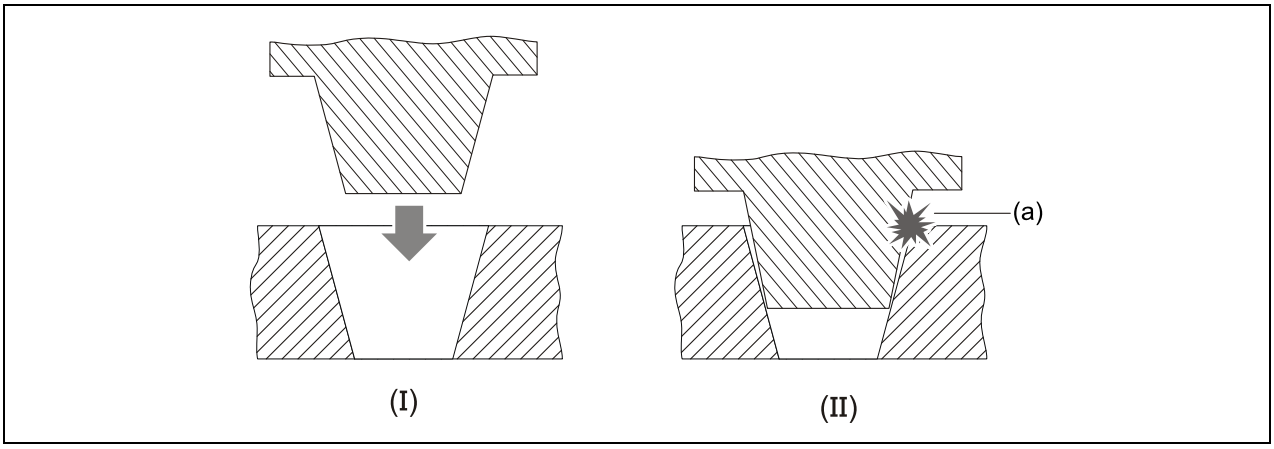


Illustration 2.7 Contact Surfaces without MC Sockets

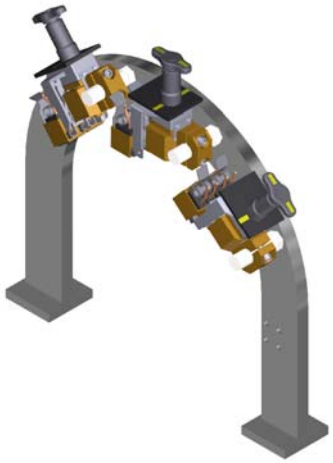
The tight manufacturing tolerances barely allow sufficient surface contact. If the contact surfaces are not matched perfectly, it can cause sparking (a).

In many cases this will cause the current to concentrate in selected areas and high variations in transfer resistance will occur. Consequently, the current is no longer shared evenly between the individual plug sets.

2.6 Installation Options

A connection with a bolt and clamping system is ideal for retrofit solutions (Illustration 2.9). Here the adapter (clamping piece) is fitted individually. Using a rod allows simple, axial adjustment of the brush-holders which can be axially staggered.

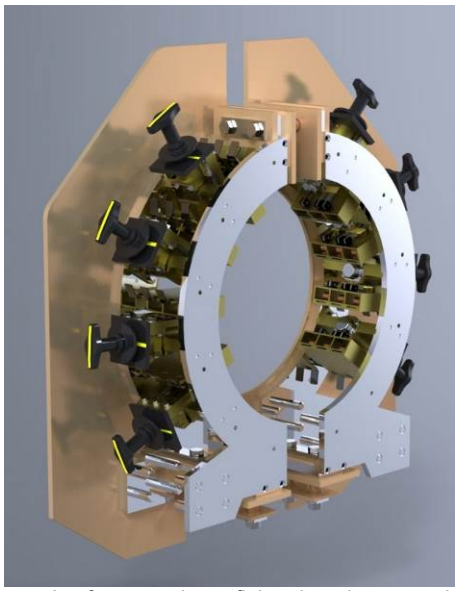
Attachment with plug-in bar



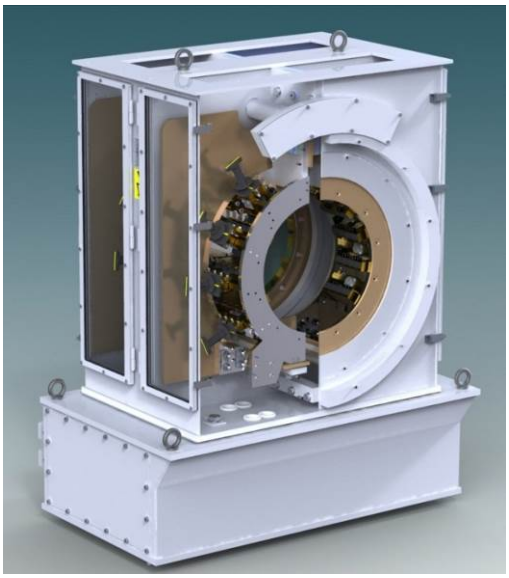
Attachment with rod, bolt and clamp

Illustration 2.8 Installation

2.7 Retrofit Solutions



Example of an actual retrofit brush rocker assembly



Example of an actual complete retrofit solution with housing

Illustration 2.9 Retrofit Solutions

3 Brush-Holders

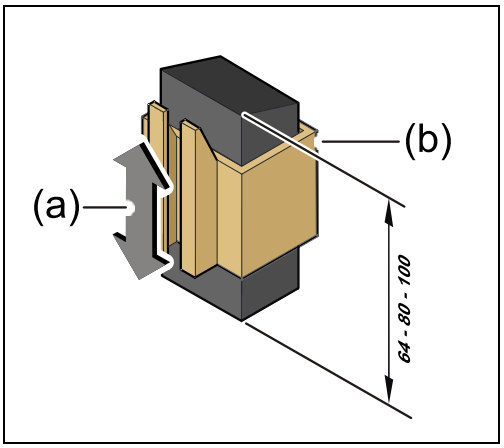


Illustration 3.1 Brush-holder

The brush-holder is adjustable in the radial position (a). The brush-holders (b) are made of brass or corrosion-resistant compounded brass. Nickel or tin plating, as a protection against saline environments, is optional.

3.1 Pressure Systems

The plug brush-holders are equipped with a self-recoiling spring pressure system. This provides constant brush pressure over the entire brush usable length. The individual pressure systems are easily replaceable. We recommend replacing the pressure systems every 5 to 6 years to ensure reliable operation. Any damaged, overheated, burnt spring clips should be immediately replaced.

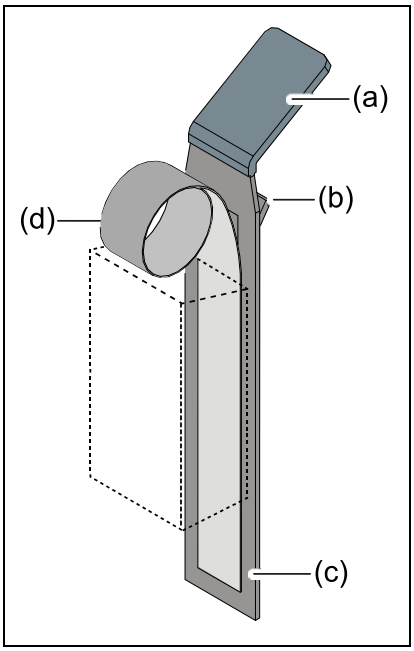


Illustration 3.2 Recoiling Spring Pressure System (Spring Clip)

(a) = insulated clip

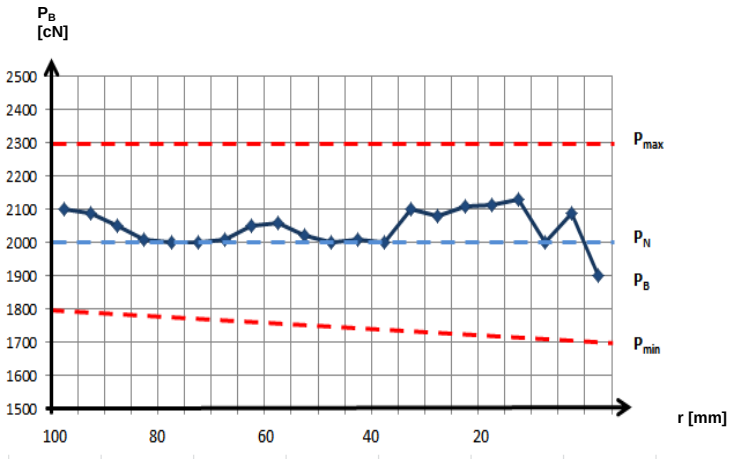
(b) = retaining tab

(c) = spring clip, corrosion-resistant

(d) = recoiling spring, corrosion-resistant

3.2 Brush Pressure Measurement

Over the course of the spring's life, the spring force should not deviate significantly from the nominal value. The maximum permissible, initial brush length should be as long as possible. The optimum contact pressure of the carbon brush depends on the brush cross section, brush material and machine application.



- P_B = brush pressure
- P_N = nominal brush pressure
- P_{max} = upper tolerance
- P_{min} = lower tolerance
- r = carbon length

Illustration 3.3 Pressure Diagram

The unit cN is stamped on the spring clip and equates closely to grams e.g. 2000 cN = 2000 grams.

3.3 Carbon Brushes

While carbon brushes with flat top surfaces are used in bi-directional machines, uni-directional machines (Illustration 3.4) typically use carbon brushes with an angled brush top.

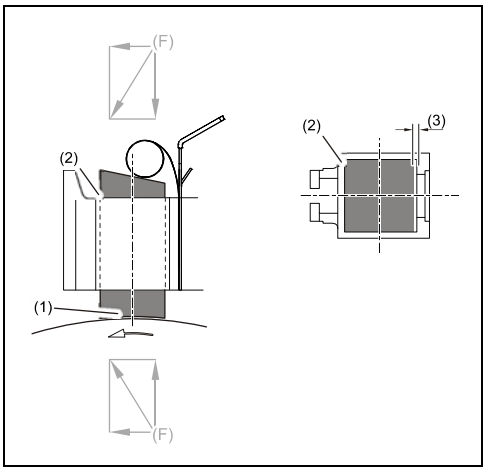


Illustration 3.4 Effects of Rotational Direction

Effects of Machine Rotation

The interaction of the tangential forces (F) on both ends of the brush have a stabilizing effect. On the top side, the rotational direction causes a clearance of the brush on one side (3), while on the bottom side, the brush sits snug on the slip ring (2). The friction between slip ring and brush (1) causes heat to dissipate from brush to brush-holder due to the snug contact (2).

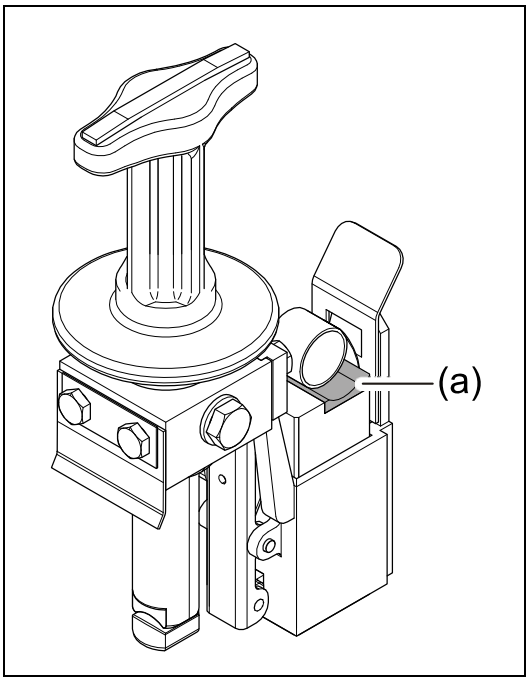


Illustration 3.5 Insulating Pad

Insulating Component

To prevent unwanted current flow between carbon brush and recoiling spring, the brush head is fitted with an insulated pad (a).

4 Brush Wear Indicators

4.1 Visual Indication

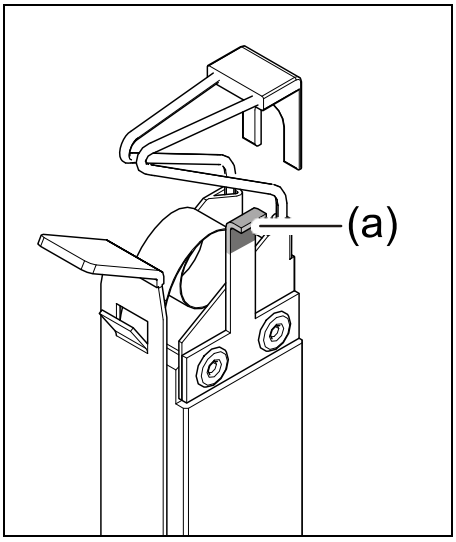


Illustration 4.1 Visual Brush Wear Indicator

The time for replacement of a carbon brush is visibly seen by the position of the red marking (a) against the brush box. Once this position has been reached, approx. 500 operating hours remain until the brush is stopped by the brush indicator.

4.2 Micro Switches

Each brush can be monitored separately using a micro switch. Which at signal activation indicates that a brush is worn, with a remaining usable brush wear length of 3 to 4 mm. Important: The brush is not stopped immediately!

The switches are positioned in series - i.e. when signaled - the circuit in the monitoring system is interrupted. The switch is activated by activators which are mounted on the brush. The switching elements and the micro-switch are attached to the plug-in bar. As a result there is no connection between the micro-switch and the plug brush-holder.

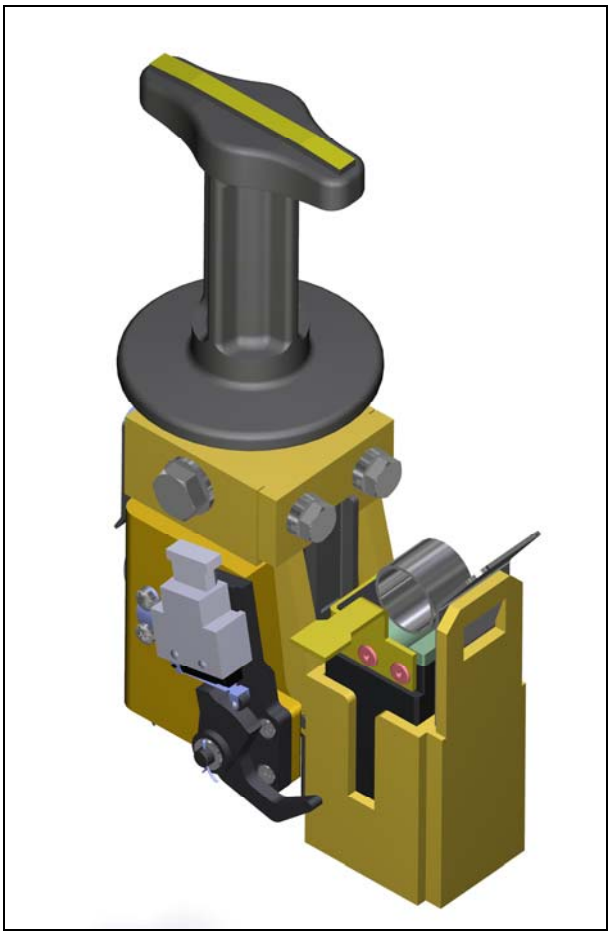
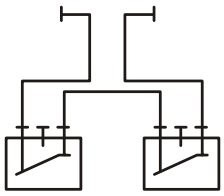


Illustration 4.2 Plug Device with Micro-Switch and Actuator

Wiring Diagram for Brush Wear Monitoring



Recommended current and voltage:

DC
max.: 6A / 24V
min.: 10mA / not below 24V

AC
max.: 6A / 250V
min.: 100mA / 24V

We recommend AC for permanently closed contacts.

5 Carbon Brush Replacement

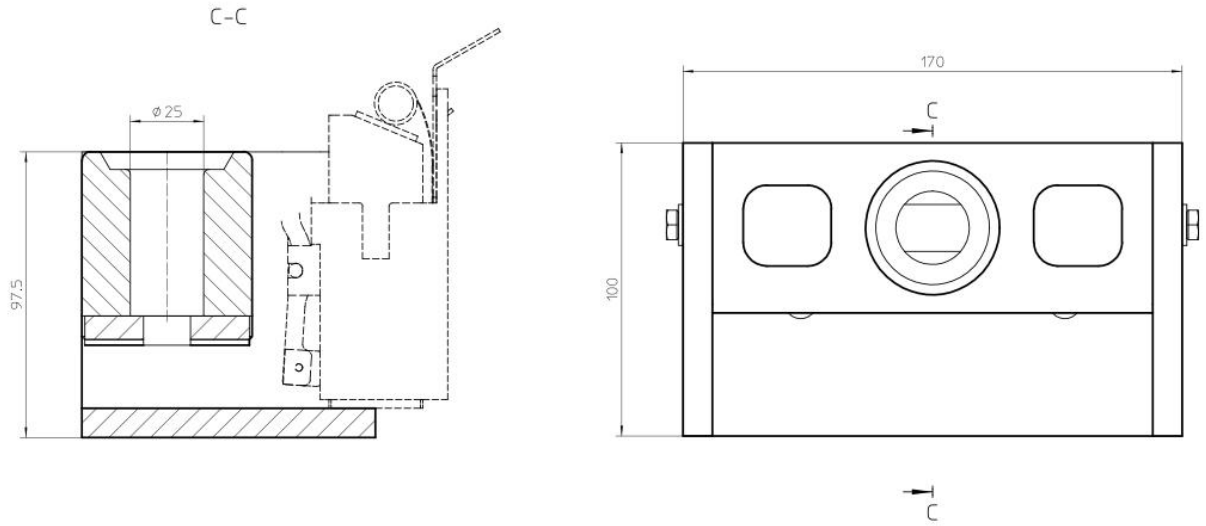
MERSEN has developed a special exchange device in case the carbon brush has to be replaced. The exchange device is used to adjust the position of the carbon brush upon insertion. Using the exchange device to replace the carbon brush also prevents the carbon brush and the slip ring from damage caused by uncontrolled impacts of carbon brush and slip ring.

An explanation of this procedure where in this catalogue you can find the matching exchange device for your plug brush-holder and how the process of replacing the carbon brush while using the exchange device works, follows in 5.1 Exchange Device and 5.2 Procedure.

5.1 Exchange Device

For each plug brush-holder plug-set you can find the matching exchange device – as shown in the following example – in the last column of each table.

Type	n	t	a	r	d	l	g	w	e	P (cN/cm²)	P (cN/cm²)	Brush Stop	Exchange Device
A 600-SV1118	2	32	32	64	82	153	291	43	81	200		yes	PM48
A 600-SV1181	2	32	40	80	82	105	243	51	100	150	180	yes	PM47
A 600-SV1126	3	32	40	80	82	105	243	51	150	150	180	yes	PM47
A 600-SV1423 R.1	2	32	40	80	75	122	240	52.5	102.5	150	180	no	
A 600-SV1423 R.2	3	32	40	80	75	122	240	52.5	155	150	180	no	



5.2 Procedure

MERSEN has developed special material-conserving brush exchange devices which allow easy replacement of brushes.

Step 1: Insert plug-set brush-holder into the exchange device

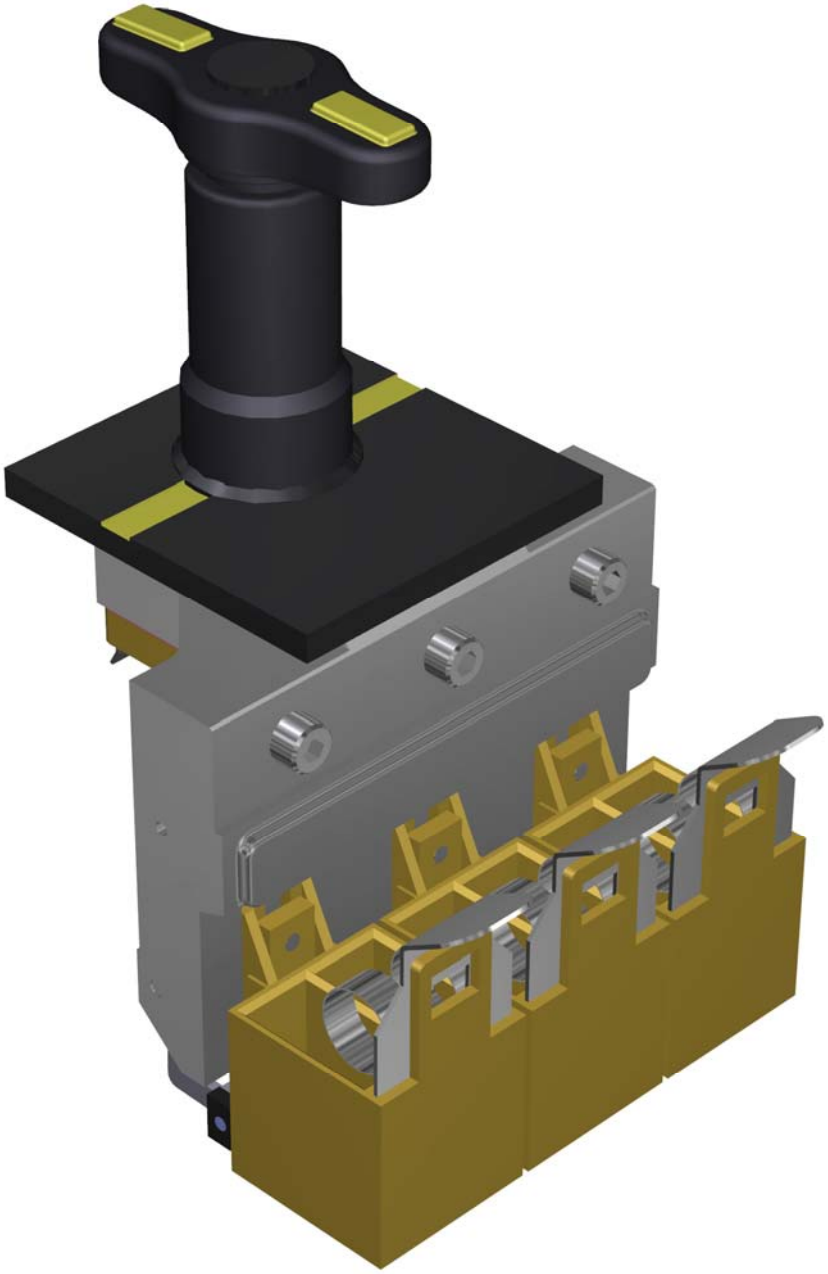
Step 2: Turn handle to unlock the brush

Step 3: Change brush, re-connect terminal, turn handle and retrieve plug-set from the exchange device

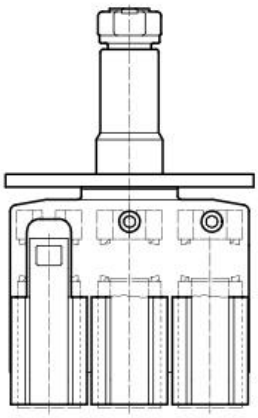
Illustration 5.1 Brush Replacement

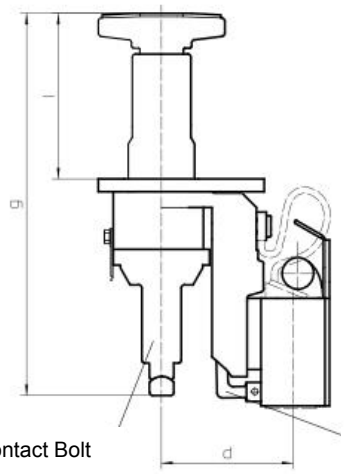
6 Design A 600

- ➔ Nominal current max. 600 ampere
- ➔ 25mm bolt diameter



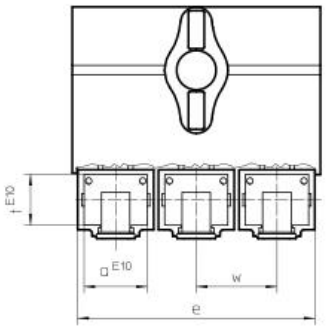
6.1 Brush-Holder Plug Set Type Set A 600

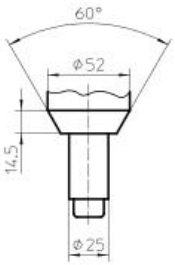




Contact Bolt

Brush Stop





Type	n	t	a	r	d	l	g	w	e	P (cN/cm²)	P (cN/cm²)	Brush Stop	Exchange Device
A 600-SV1118	2	32	32	64	82	153	291	43	81	200		yes	PM48
A 600-SV1181	2	32	40	80	82	105	243	51	100	150	180	yes	PM47
A 600-SV1126	3	32	40	80	82	105	243	51	150	150	180	yes	PM47
A 600-SV1423 R.1	2	32	40	80	75	122	240	52.5	102.5	150	180	no	
A 600-SV1423 R.2	3	32	40	80	75	122	240	52.5	155	150	180	no	

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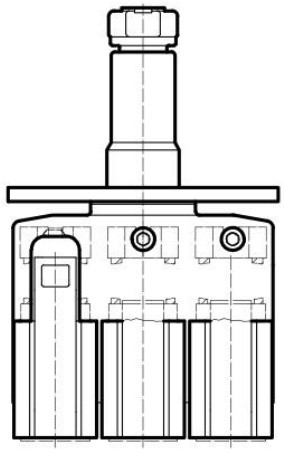
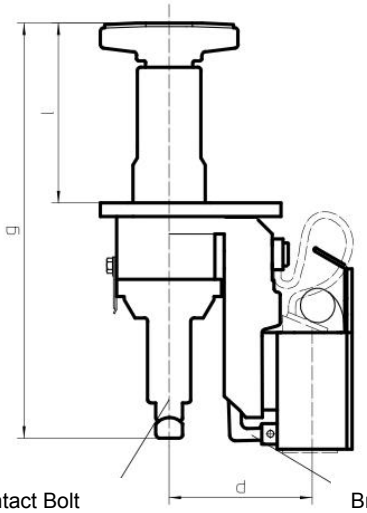
bold type / orange background = preferable types

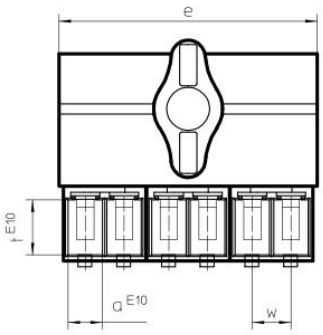
6.2 Brush-Holder Plug Set Type Set A 600

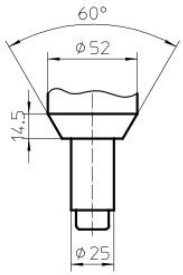




Contact Bolt

Brush Stop





Type	n	t	a	r	d	l	G	w	e	P (cN/cm²)	P (cN/cm²)	P (cN/cm²)	Brush Stop	Exchange Device
A 600-SV1419 R.1	4	32	20	80	69	112	247	23	97	150	130	180	no	
A 600-SV1419 R.2	6	32	20	80	69	112	247	23	145	150	130	180	no	
A 600-SV1158	4	40	20	64	86	103	241	23	100	180	160	250	yes	PM48
A 600-SV1040	6	40	20	64	86	103	241	23	151	180	160	250	yes	PM48
A 600-SV1144	2	1 ½“	1“	4“	90	103	260	29	61	140			yes	PM48
A 600-SV1145	3	1 ½“	1“	4“	90	103	260	29	90	140			yes	PM48
A 600-SV1147	4	1 ½“	1“	4“	90	103	260	29	118	140			yes	PM48

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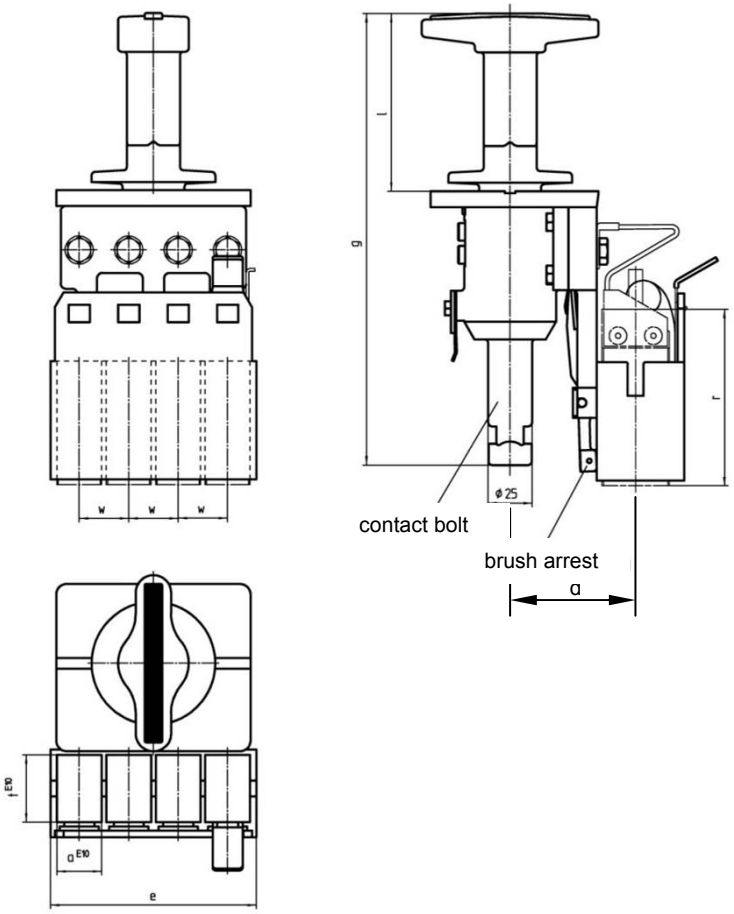
bold type / orange background = preferable types

6.3 Brush-Holder Plug Set Type Set A 600

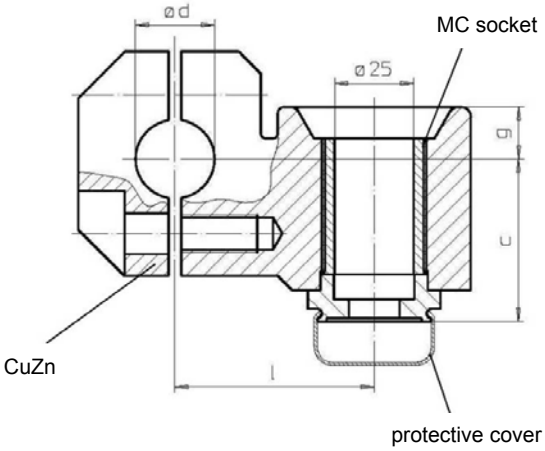


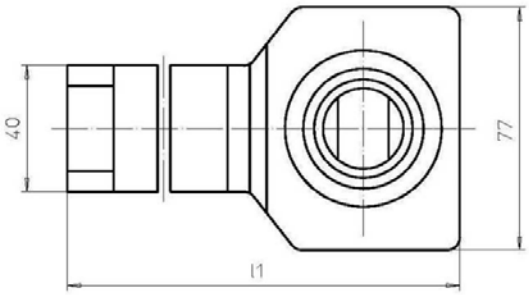
Type	n	t	a	r	d	l	g	w	e	P (cN/cm²)	Brush Stop	Exchange Device
A 600-SV1241	4	1 ½“	1“	4“	71	100	256	28,4	117	140	yes	
A 600-SV1192	4	32	25	100	71	100	256	28,4	116	140	yes	PM67

6.4 Adapter (Clamping Piece) for Type A 600

➔ For brush-holder plug set Type A 600

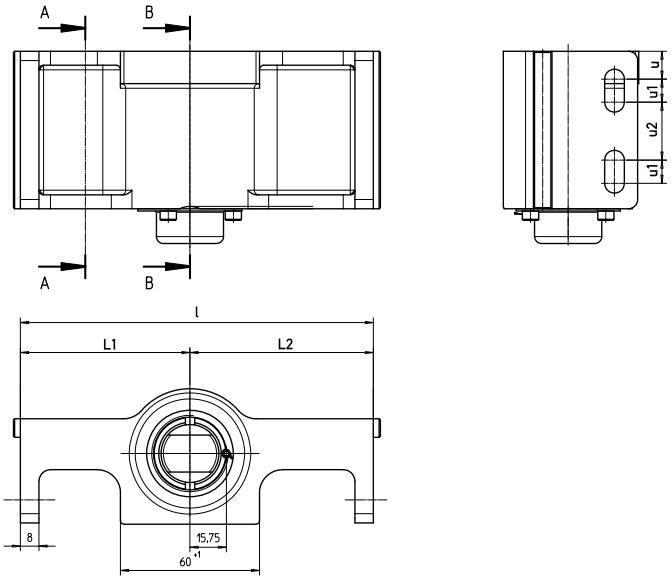
➔ Made of CuZn





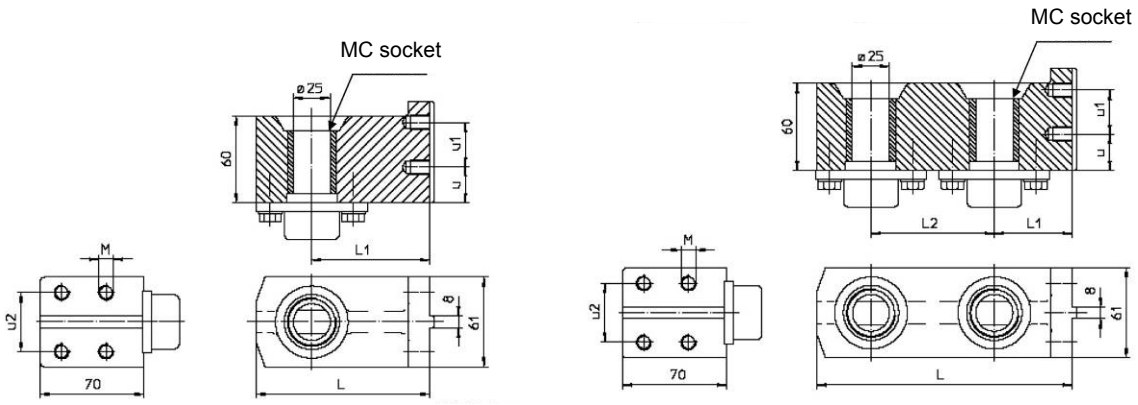
Type	d	L	L1	g	c	MC Socket
A 600-SV1138	25	63	124	16.5	51.5	600 A
A 600-SV1130	32	62	124	21.6	46.5	600 A

6.5 Plug-In Bar for Type A 600



Type	L	L1	L2	u	u1	u2	M	MC Socket
A 600-SV1251	152.4	79.2	73.2	12	10	25	8.5	600 A
A 600-SV1252	152.4	73.2	79.2	12	10	25	8.5	600 A
A 600-SV1284	132	76	76	12	10	20	8.5	600 A
A 600-SV1371	166	83	83	12	10	25	8.5	600 A

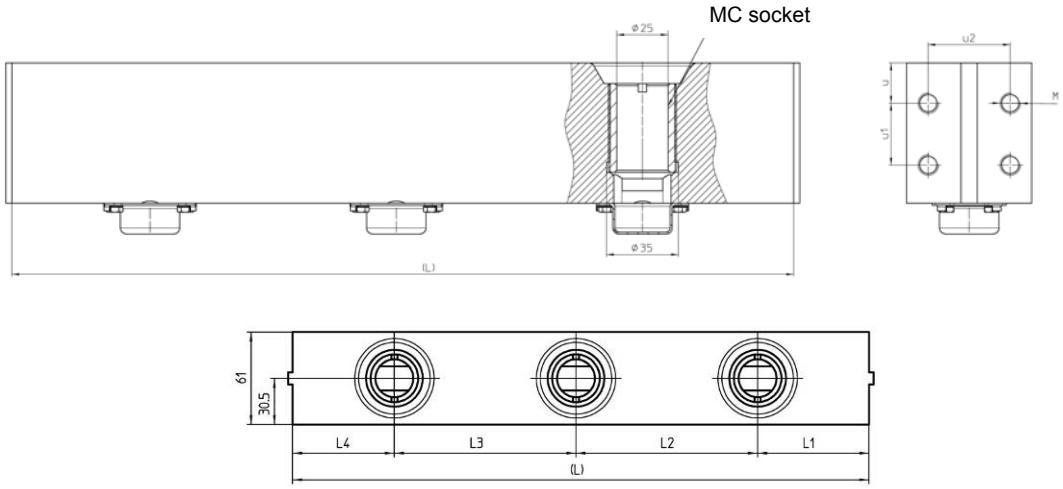
6.6 Plug-In Bar for Type A 600



Type	N	L	L1	L2	u	u1	u2	M	MC Socket
A 600-SV1148	1	117	79.5	-	25.5	30	40	10	600 A
A 600-SV1142	2	172	52.4	83	25.5	30	40	10	600 A

6.7 Plug-In Bar for Type A 600

➔ Double-sided attachment



Type	n	L	L1	L2	L3	L4	u	u2	M	MC Socket
A 600-SV1244	3	381	73.7	120	120	67.3	19.5	40	10	600 A

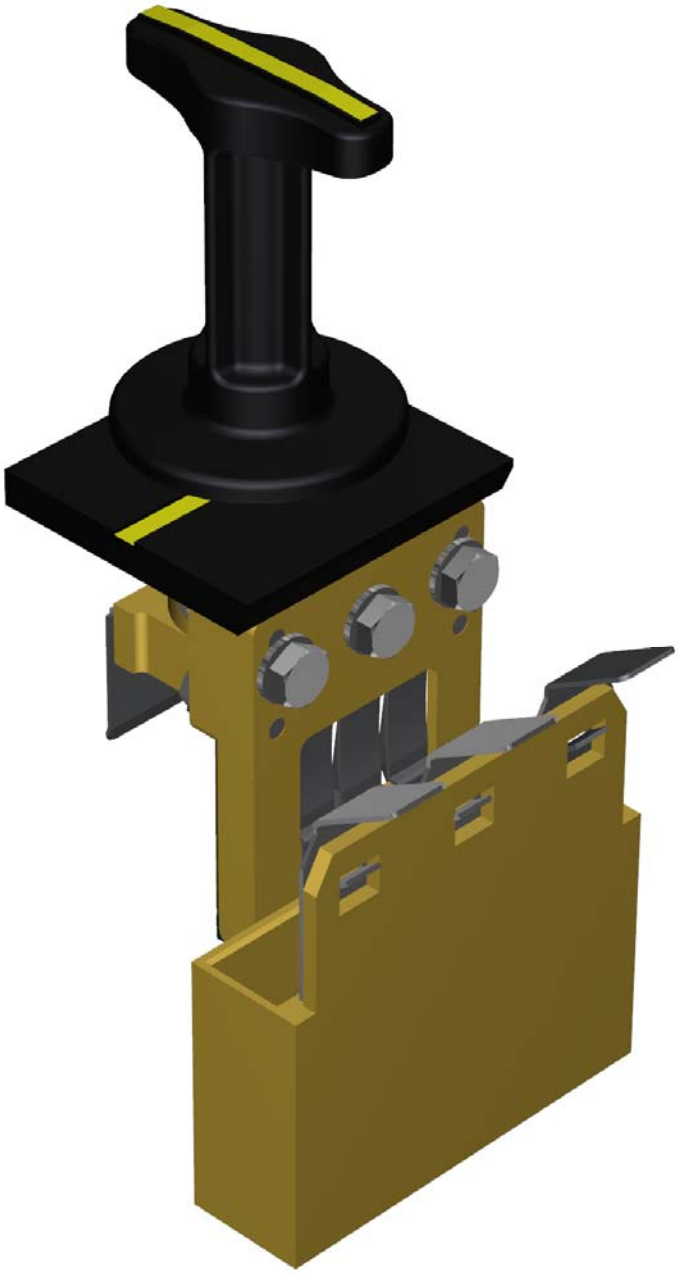
6.8 Brush-Holder Plug Set Type W20974 / GME0947032 (Special Design)

➔ Brush-holder plug set for ABB machines. Nominal current max. 600 A.

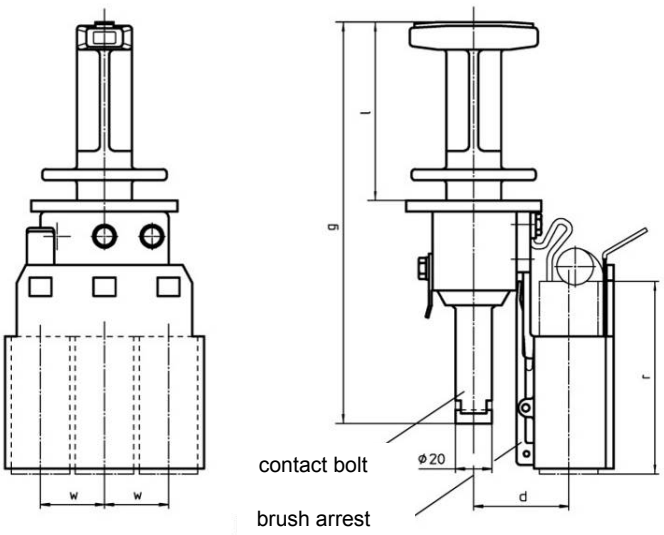
Type	n	t	a	r	A	B	C	P (cN/cm²)	P (cN/cm²)	Brush Arrest
W2 09474	2	1 ½“	1 ½“	80	77	75	100.5	150	110	no
W2 09474	3	1 ½“	1 ½“	80	77	75	153	150	110	no
W2 09474	2	1 ½“	1 ½“	80	77	75	100.5	150	110	yes
W2 09474	3	1 ½“	1 ½“	80	77	75	153	150	110	yes
GME0 947032 R2	2	32	40	80	77	75	102.5	150	110	no
GME0 947032 R3	3	32	40	80	77	75	155	150	110	no
GME0 947032 R2	2	32	40	80	77	75	102.5	150	110	yes
GME0 947032 R3	3	32	40	80	77	75	155	150	110	yes

7 Design B 400

- ➔ Nominal current max. 400 Ampere
- ➔ 20mm bolt diameter

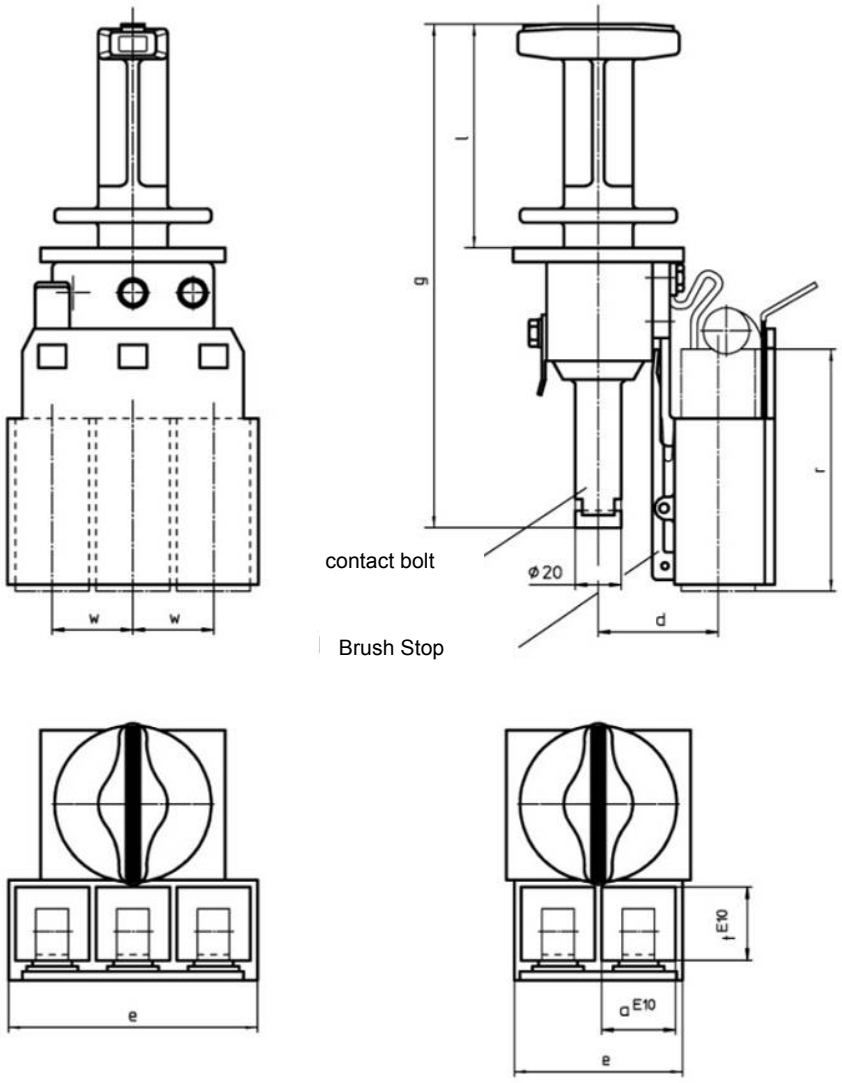


7.1 Brush-Holder Plug Set Type B 400



Type	n	t	a	r	d	l	q	w	e	P (cN/cm²)	Brush Stop	Exchange Device
B 400-SV1219	2	20	32	100	46.5	100	227	35	73	140	yes	PM72
B 400-SV1269	3	20	32	100	46.5	100	227	35	108	140	yes	PM72
B 400-SV1294	4	20	32	100	46.5	100	227	35	143	140	yes	PM72
B 400-SV1319	2	25	32	100	48.5	100	227	35	73	140	yes	PM72
B 400-SV1320	3	25	32	100	49	100	227	35	108	140	yes	PM72
B 400-SV1225	2	32	32	100	52	100	227	35	73	140	yes	PM72
B 400-SV1211	3	32	32	100	52	100	227	35	108	140	yes	PM72
B 400-SV1398	2	32	20	100	52.5	100	227	23	49	180	yes	PM72
B 400-SV1397	3	32	20	100	52.5	100	227	23	72	180	yes	PM72
B 400-SV1399	4	32	20	100	52.5	100	227	23	95	180	yes	PM72

7.2 Brush-Holder Plug Set Type B 400



Type	n	t	a	r	d	l	q	w	e	P (cN/cm²)	Brush Stop	Exchange Device
B 400-SV1236	2	1 ¼"	¾"	4"	52	100	227	22	48	140	yes	PM72
B 400-SV1237	3	1 ¼"	¾"	4"	52	100	227	22	70	140	yes	PM72
B 400-SV1232	2	1 ½"	1"	4"	55	100	227	28.4	61	140	yes	PM72
B 400-SV1282	3	1 ½"	1"	4"	55	100	227	28.4	89	140	yes	PM72

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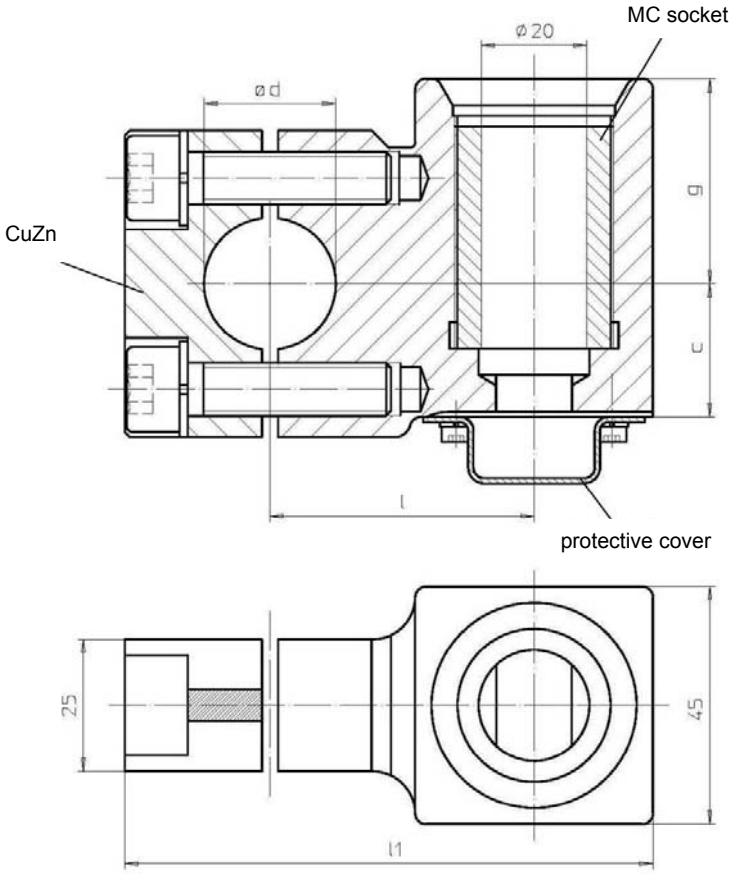
bold type / orange background = preferable types

7.3 Adapter (Clamping Piece) for Brush-Holder Plug Set Type B 400 and C 250

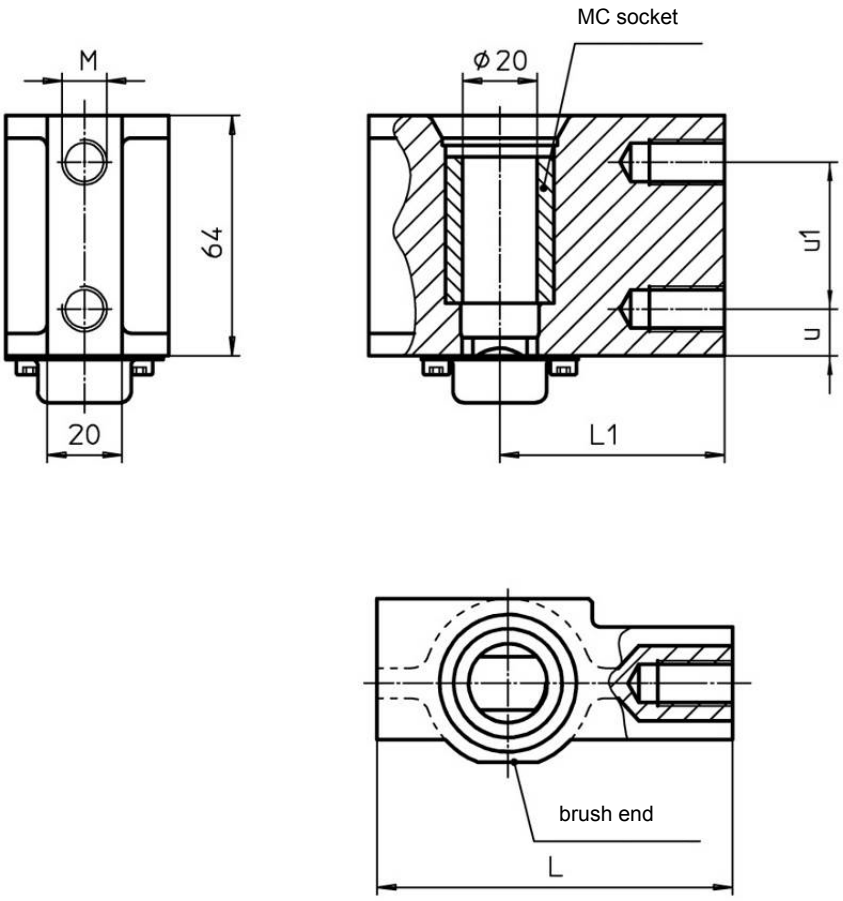
➔ Made of CuZn



Type	d	L	L1	g	c	MC Socket
B 400- & C 250-SV1369	25	50	100	38.75	25.25	400A
B 400- & C 250-SV1400	20-32	38.63	90-112	15-67	0-50	400A

7.4 Plug-In Bar for Brush-Holder Plug Set Types B 400 and C 250

➔ One-sided attachment

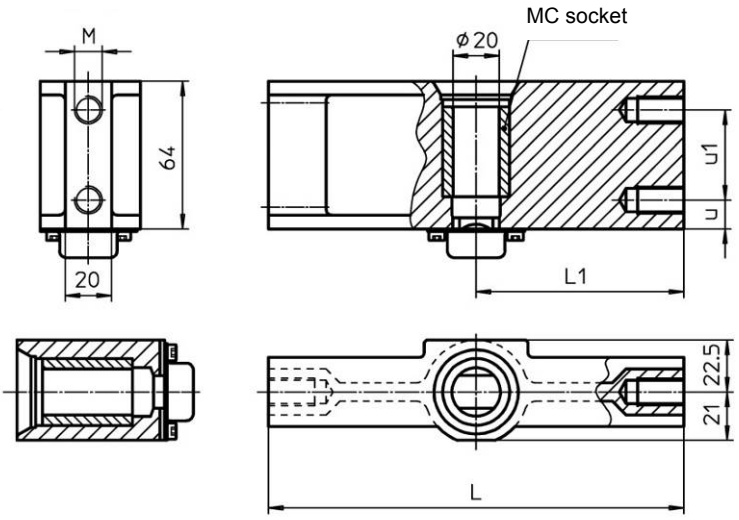


Type	d	L1	u	u1	m	MC Socket
B 400- & C 250-SV1312	90	65	9.5	45	12	400A
B 400- & C 250-SV1345	62	37	9.5	45	8	400A
B 400- & C 250-SV1383	105	80	9.5	45	12	400A

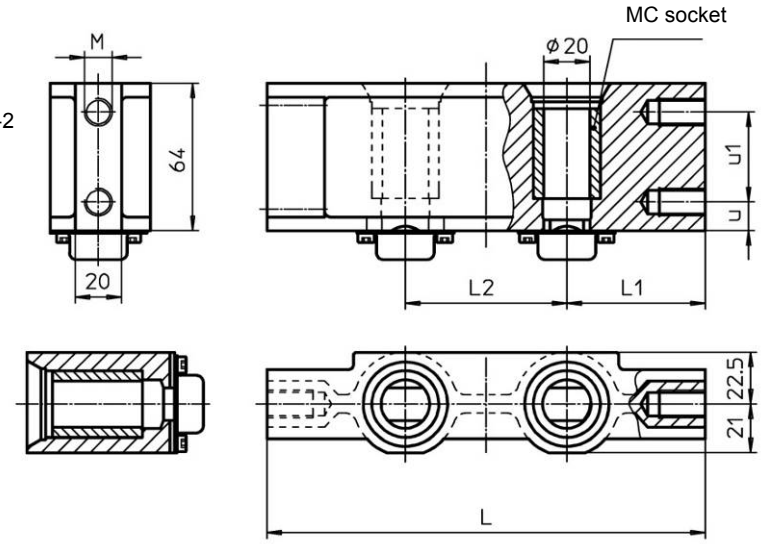
7.5 Plug-In Bar for Brush-Holder Plug Set Types B 400 and C 250

➔ Double-sided attachment

Type LB 400 B-1



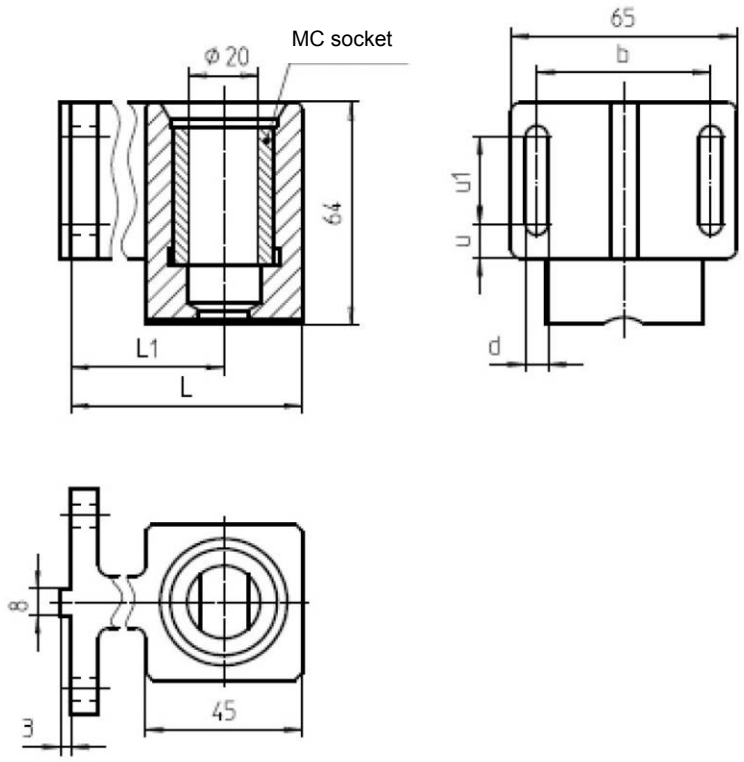
Type LB 400 B-2



Type	n	L	L1	L2	u	u1	M	MC Socket
B 400- & C 250-SV 1193	1	220	110	45	9.5	45	12	400 A
B 400- & C 250-SV 1195	2	220	65	90	9.5	45	12	400 A

7.6 Plug-In Bar for Brush-Holder Plug Set Types B 400 and C 250

➔ One-sided attachment

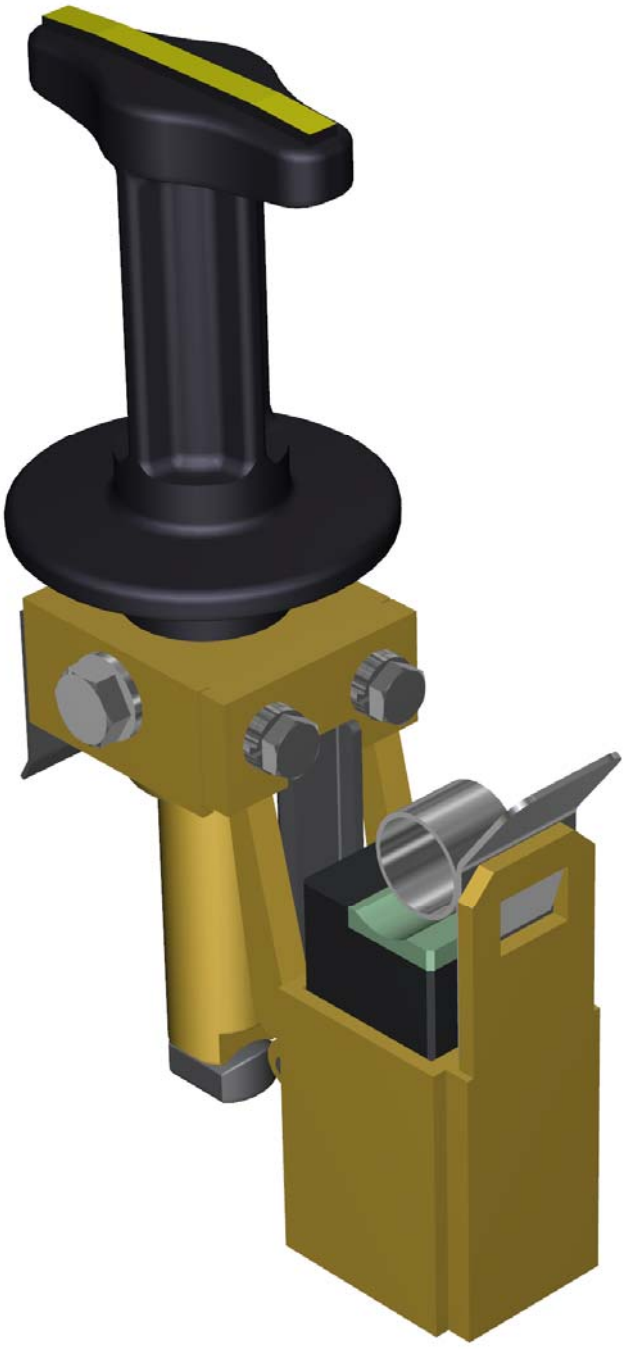


Type	L	L1	u	u1	d	b	MC Socket
B 400- & C 250-SV 1179-1	47.5	25	10	25	6.5	50	400 A

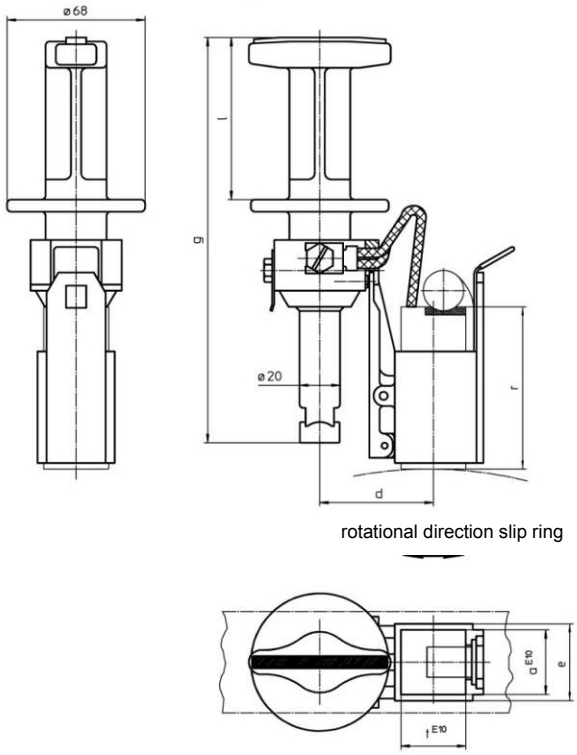
8 Design C 250

➔ Nominal current max. 250 Ampere

➔ Bolt diameter: 20mm



8.1 Brush-Holder Plug Set Type C 250 Mono Tangential



Type	n	t	a	r	d	l	q	e	P (cN/cm²)	Brush Stop
C 250-SV1310	1	20	32	80	50	80	200	38	200	yes
C 250-SV1321	1	25	32	80	52.5	80	200	38	200	yes
C 250-SV1386	1	32	25	80	56	80	200	31	200	yes
C 250-SV1346	1	32	32	80	56	80	200	38	200	yes
C 250-SV1396	1	32	20	80	55.5	80	200	31	180	yes

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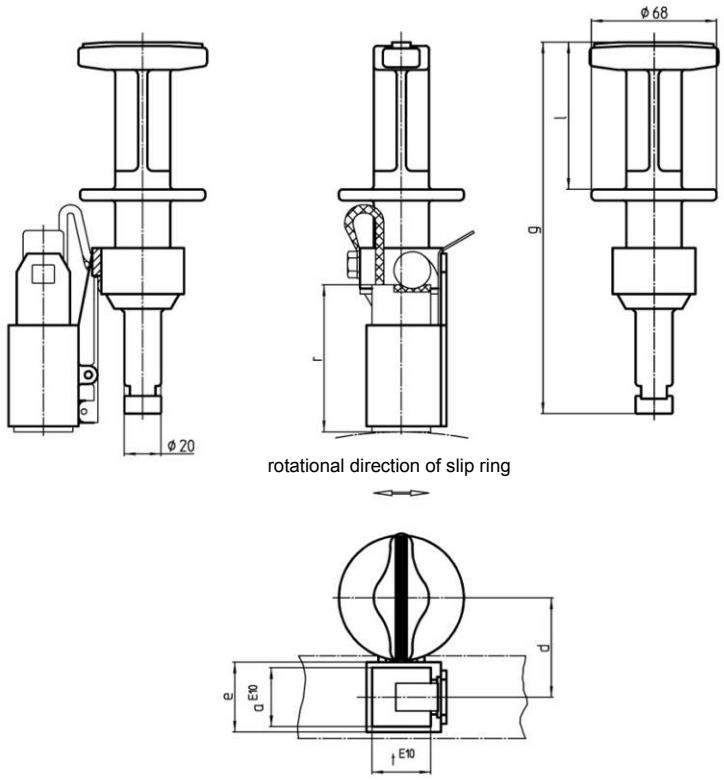
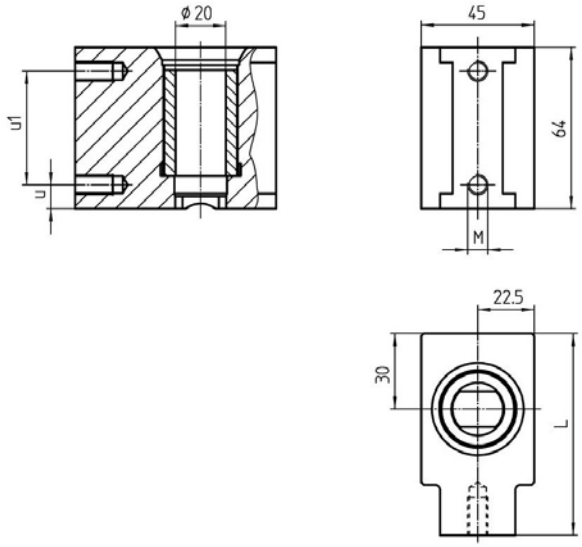
8.2 Brush-Holder Plug Set Type C 250 Mono Axial



Type	n	t	a	r	d	l	q	e	P (cN/cm²)	Brush Stop
C 250-SV1188	1	32	25	80	52	80	200	38	200	yes

8.3 Plug-In Bar for Type C 250 Mono Tangential / Axial



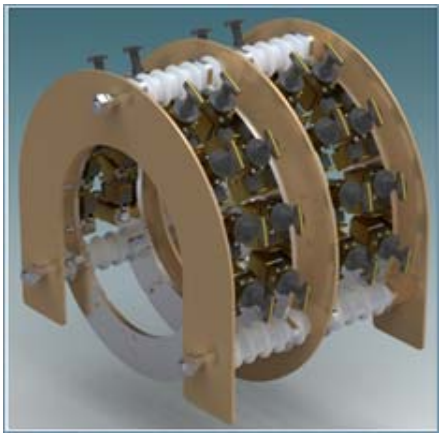
Type	Design	Brush Position	MC Socket
C 250-SV1315 A or C	tangential	A or C	400 A
C 250-SV1351B	axial	B	400 A

9 Retrofitting of Machines

Adapters in either bolted bar designs or bar and adapter connections, customized to fit the individual machine requirements, allow MERSEN brush-holder plug sets to retrofit most existing generators.

Machines can also be retrofitted to accept our plug devices by modifying the existing adapter (clamping piece, bar) to suit the given mounting conditions.

Example



10 How to select the correct brush-holder plug-set

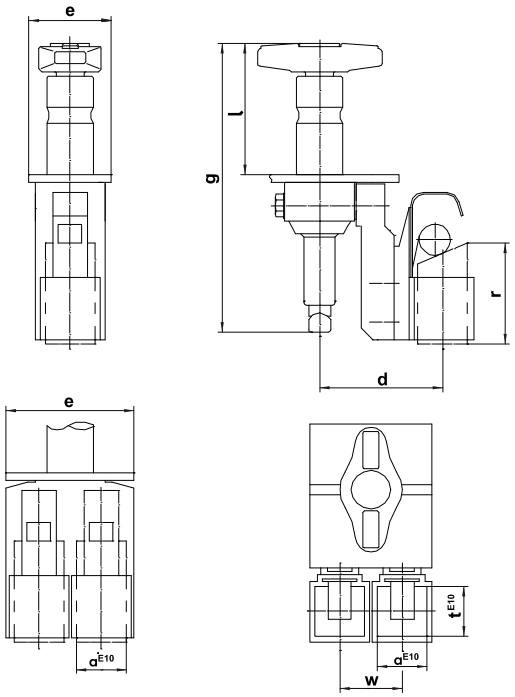
1. For slip rings with spiral groove the axial-measurement of the carbon brush has to be the same or a multiple of the pitch of the spiral groove to ensure optimum brush performance

   Example:

   Spiral groove: 10mm pitch

   → A-Axial of the carbon brush: 10, 20, 40mm is possible
2. Measurement of the slip ring width and pitch determines maximum width of the plug brush-holder
3. Calculating the quantity of carbon brushes required depends on the maximum current load of the machine and the current density capability of the carbon brush grade.
4. At least 4 plug brush-holders have to be installed on each slip ring so that no overloading of the carbon brushes occurs while replacement is taking place.
5. Review the carbon brush coverage-rate of the slip ring with the internal calculation template of MERSEN.

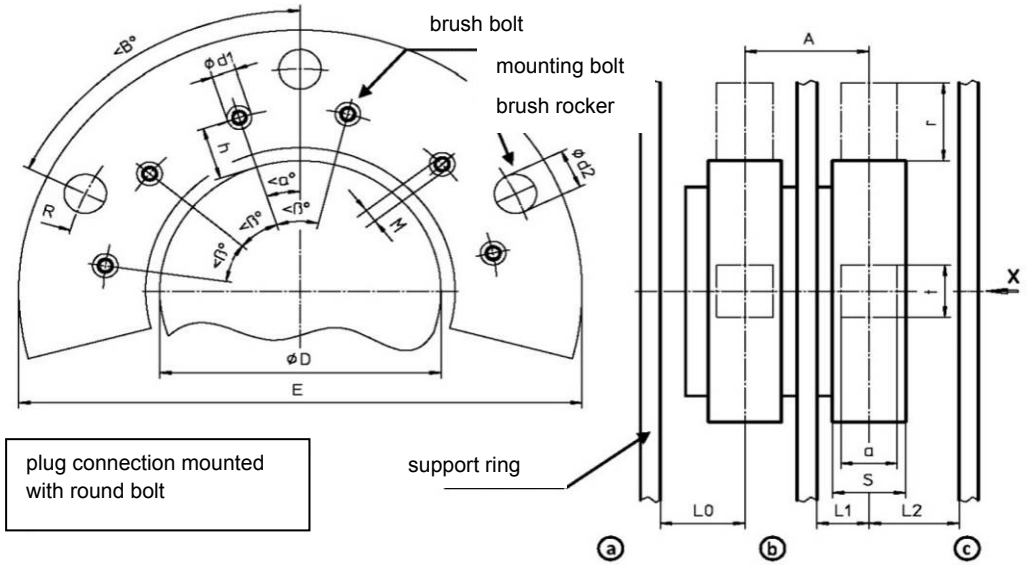
10.1 Explanation of Drawings



Carbon Brush Size (E10):

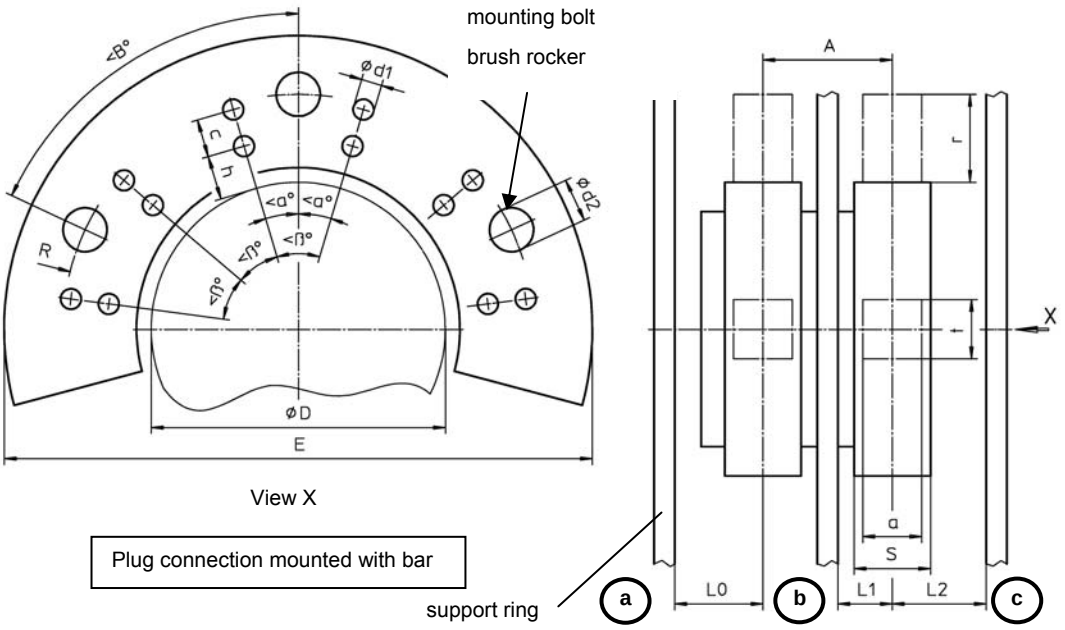
t	→	tangential
a	→	axial
r	→	Brush length
w	→	Spacing between carbon brushes
g	→	Total height of clamping piece with handle
l	→	Height of handle
e	→	Length/width of contact protection
d	→	c/l plug set to c/l brush

10.2 Bolt Attachment



Slip Ring:	Slip ring diameter	ØD		mm
	Slip ring width	S		mm
	Spacing from slip ring to slip ring	A		mm
Mounting:	Installation space for plug device	E		mm
Brush Bolts:	Spacing from slip ring to brush bolts	h		mm
	Bolt diameter	d1		mm
	Bolt thread	M		°
	Angle center of axis to bolt	<α°		°
	Angle between bolt to bolt	<β°		
Retainer Bolt:	Position bolt center	R		mm
	Angle center of axis to bolt	<B		°
	Bolt diameter	d2		mm
Electrical:	Max. load	I max		A
	Brush cross section	t x a x r		mm
	Number of brushes	nB		Units
	Number of plug devices	nB		Units
	Nominal voltage	V		V
	Testing voltage	V		V

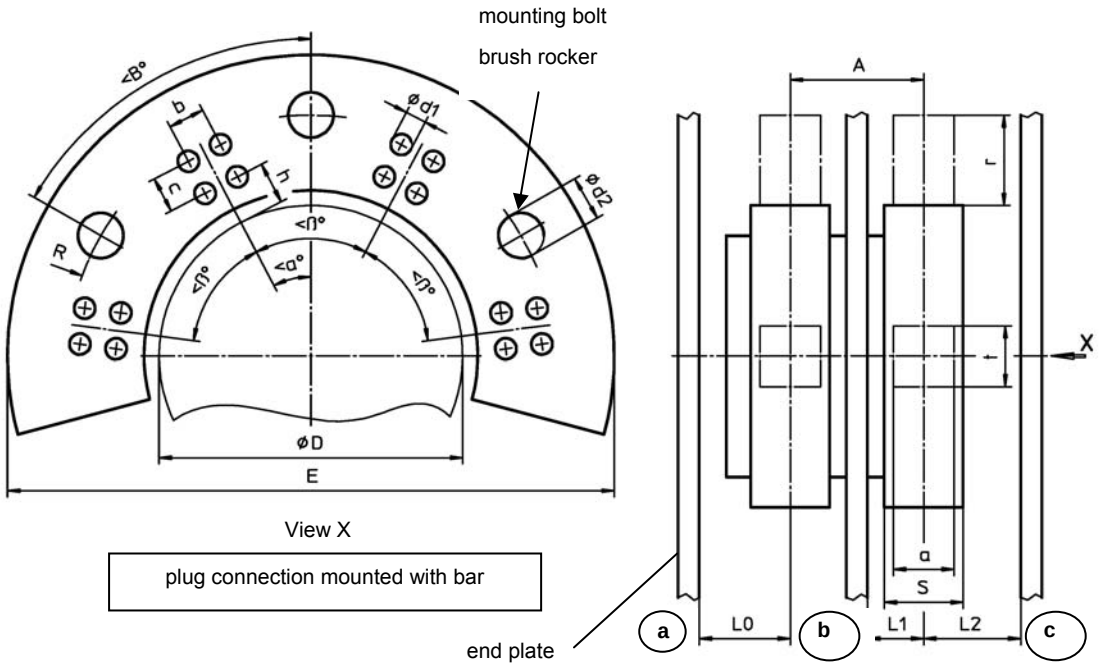
10.3 Bar Connection with 2 Bolts



Plug connection mounted with bar

Slip Ring:	Slip ring diameter	ØD		mm
	Slip ring width	S		mm
	Spacing from slip ring to slip ring	A		mm
Mounting:	Installation space for plug device	E		mm
Bar:	Spacing from slip ring – bore of bar	h		mm
	- Bore spacing	b		mm
	- Bore spacing	c		mm
	Angle center of axis / bar	<α°		°
	Angle between bars	<β°		°
	Diameter / thread	d1		mm
Retainer Bolt:	Position mounting bolt	R		mm
	Angle center of axis	<B		°
	Bolt diameter	d2		mm
Electrical:	Max. load	I max		A
	Brush cross section	t x a x r		mm
	Number of brushes/bar	nB		Units
	Number of plug devices	nB		Units
	Nominal voltage	V		V
	Testing voltage	V		V

10.4 Bar Connection with 4 Bolts



Slip Ring:	Slip ring diameter	ØD		mm
	Slip ring width	S		mm
	Spacing from slip ring to slip ring	A		mm
Position of Brush Clip:	Distance end plate a – slip ring center	L0		mm
	Distance end plate b – slip ring center	L1		mm
	Distance end plate c – slip ring center	L2		mm
Mounting:	Installation space for plug device	E		mm
Lineal:	Spacing slip ring – bore of bar	h		mm
	- Bore spacing	b		mm
	- Bore spacing	c		mm
	Angle center of axis / bar	<α°		°
	Angle between bars	<β°		°
	Diameter / thread	d1		mm
Retainer Bolt:	Position mounting bolt	R		mm
	Angle center of axis	<B		°
	Bolt diameter	d2		mm
Electrical:	Max. load	I max		A
	Brush cross section	t x a x r		mm
	Number of brushes	nB		Units
	Number of plug devices	nB		Units
	Nominal voltage	V		V
	Testing voltage	V		V

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