TECHNICAL INFORMATION

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SHORT CIRCUITING DEVICE FOR UNDERGROUND RAILWAYS

ARGUS ELEKTROTECHNIK
ALOIS SCHIFFMANN GMBH

Why use short circuiters ...

There is the danger of accidents caused by electric current when persons stay on the track of underground railways. The stay of these individuals may be planned, intended and admissible, but it may as well be unplanned, unintended and inadmissible. In both cases the danger of accidents needs to be reduced as fast and as effective as possible.
Examples for a planned stay of individuals on a track:

- Fixation of billboards in underground stations
- Track inspection
- Collection of rubbish and cleaning works
- Repair and exchange works

Usually for these operations a time of day with reduced train frequency or no trains at all is chosen and the current rail will remain de-energised and free of voltage. Basis of this labour (in Germany) are the five safety rules for de-energised electric installations. After disconnection, protection against re-connection, and determination of absence of voltage, the next step is to earth and short circuit.
Unfortunately there are also cases of unplanned and unpermitted stay of persons on the track, for instance:

- Accidents of individuals and rescue operations
- Vandalism
- Evacuation procedures

Even in such events a quickest possible prevention of accidents caused by electric current (body contact and arcing) is necessary. Just time is too short for planning and accomplishment of adequate steps. Disconnection of the current rail needs to be compelled by short circuiting the current rail with the closest running rail. Then within milliseconds a current rise is registered and identified as a short circuit in the rectifier. This leads to the activation of several safety devices and in the end to the disconnection of the current rail.

ARCUS Short Circuiters are suitable for use on de-energised current rails as well as live current rails, due to their design and contact principle. Either the short circuiters are stored in the trains, in the underground station or in the special cars of the firebrigade. Train drivers, clearance personnel on stations, and fire fighters are familiar with its usage and will know where the nearest short circuiter can be found.

Design for power supply from top or bottom side ...

Worldwide there are different systems for the power supply of underground railways. On the one hand there are underground railways with overhead contacts (contact wire), on the other hand there are underground railways with third rail (current rail). In certain cases even both systems are combined.

ARCUS Short Circuiters are designed for underground railways with third rail. Power is supplied from this lateral, parallel rail either from the top side or from the bottom side of the rail. This leads to two different designs of short circuiters.

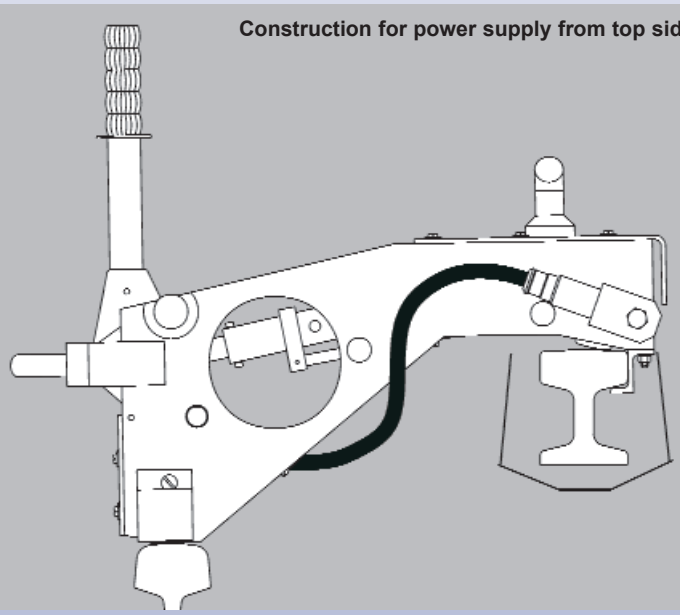
A small number of underground trains obtains power from the top side of the current rail. The lateral current collector of the train keeps the top side of the current rail metallic bright and widely free of disturbing surface layers such as dirt or corrosion. Because the top side of the running rail is free of layers due to permanent train driving, it is possible to contact bare steel surfaces by setting the short circuiter on top of the rails.

A vast number of underground trains is supplied by power from the bottom side of the rail.
With this system the top side of the running rail and the bottom side of the current rail are suitable as contact surfaces for a short circuiter. Yet this device is not simply placed onto the rails from the top side but needs to be clamped between running and current rail. This requires a totally different design.

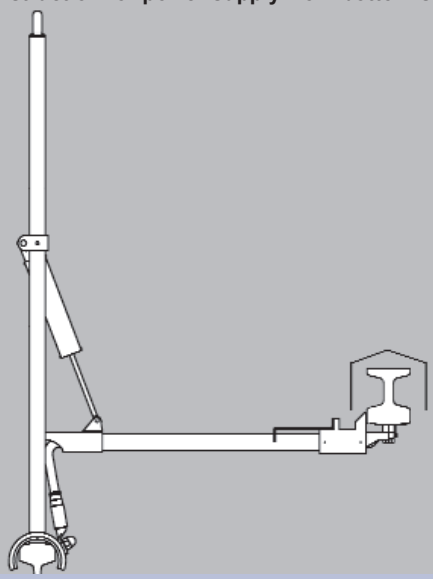
Both designs are manufactured to suit the specific customer requirements for the respective rail system. Furthermore it is possible to consider additional features upon customer's request, such as an earthing cable for potential equalisation between running rails.

To adapt the short circuiter to suit your requirements, we need some detailed information. For this purpose we have prepared a questionnaire (→ page 11) which we would ask you to complete with all data and return to us together with your enquiry.

Construction for power supply from top side



Construction for power supply from bottom side



Construction and function

Both devices, either for power supply from top or from bottom side, after placement onto running and current rail only have electric contact to the running rail. Until then there is no conductive electric connection to the current rail. By operating a lever, a spring force is built up which leads to a sudden contact of the current rail after a certain lever position is obtained. This way arcing and burnings on the rail top are mostly prevented. Current flow between running rail contact and current rail contact takes place by means of one or several flexible PVC-insulated copper cables (earthing lead).

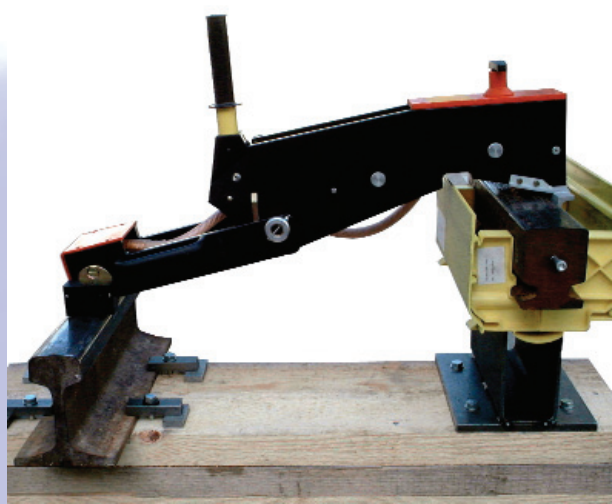
As the design of both types of device is strongly differing, the main features are described as follows.

Design for power supply from top side

This short circuiter consists of a very compact housing made of several plastic plates, in between contacts and contact mechanism are arranged.

The running rail contact consists of a springy stored copper block, which is held by a magnet on the running rail. As soon as the short circuiter is set onto the rails, a conductive electric connection exists towards the running rail.

The current rail contact as well is a copper block which is mounted to a pivoting compensator. This compensator is connected to the tension spring which is preloaded by an operating lever. At a certain lever position the preloaded force comes free and turns the compensator downwards as quick as a flash, until the contact block hits the surface of the current rail. The required counterforce is secured by a hook that grips underneath the head of the current rail.



Design for power supply from bottom side

This short circuiter is provided with a frame of glassfibre-reinforced synthetic tubes that are partly loosely joined and carry contacts and contact mechanism.

The contact to the running rail consists of an aluminium shell into which aluminium contact rings are set. There is electric contact to the running rail at the moment when the device is placed onto it.

Devices suitable for short circuit currents up to 30 kA (see picture to the right) are provided with a current rail contact made of one copper block which is linked to a movable arm, together with a slighty higher block of plastic material.
This arm is connected to the tension spring which is preloaded by an operating lever.
During operation, first the block of synthetic material makes contact on the surface of the current rail - the copper block is still without electric contact.
While the tension spring gets increasingly preloaded, the synthetic block approaches the edge of the rail surface.
Then the synthetic block slips over the rail edge and makes way for the copper block to suddenly hit the surface of the current rail. The synthetic block remains on the lateral side of the rail head and forms a support for the contact force.

Short circuiters designed for short circuit currents up to max. 100 kA (see left picture), consist of three silver-plated, loosely joined copper blocks. The synthetic blocks are hook-shaped. Thus they generate form-closure with the head of the current rail (see page 6, pict. 2).

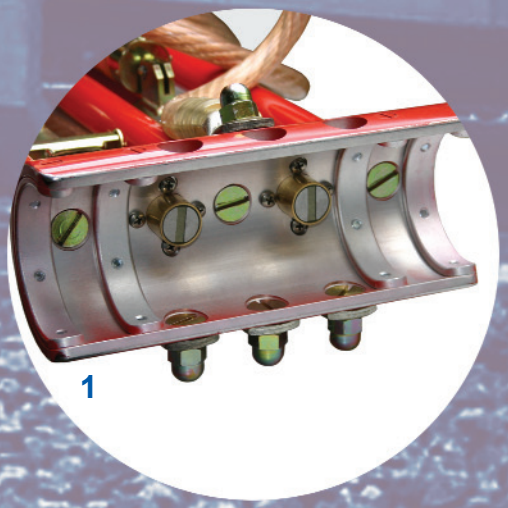
On both models those parts to take up voltage are either covered to a vast extent, or they are far enough at a distance of parts the user is to operate.

Function principle

Like all devices for earthing and short circuiting the short circuiter for underground railways also requires a reliable electric and mechanic connection between connection elements (copper blocks and aluminium rings) and the connection points (current and running rail).

The reliable mechanic connection firstly is obtained by design and production of ARCUS Short Circuiters to the requirements of the installation. Secondly a rail connection is formed which to a certain extent is either form-fit or force-fit.

The reliable electric connection is obtained by choice of material and form of connection elements. The aluminium rings (1) of the construction for power supply from the bottom side is shaped to suit all known running rail profiles in Germany and many other countries (for instance UIC54, S49, S64 and others). The copper blocks (picture 2, silver-plated) of both designs are equipped with a spherical contact surface and are movably stored to have optimum contact to the rail surface, so to reach a large number of contact points. These contact points are permanently maintained by the force of the tension spring (3). Yet it may happen, especially in case of emergency, that the short circuiter is placed on a rail section without optimum conditions.
This may be a wavy, rough, soiled or corroded rail surface. At such points increased sparking and arcing, furthermore burnings on the rail, are possible. Thus it is recommended to briefly examine the rail section to which the short circuiter will be placed before each usage. As the case may be, a slight shifting of the device is sufficient to clearly improve the contact conditions.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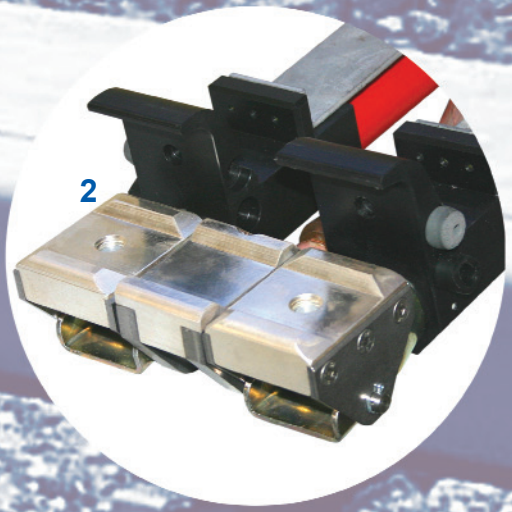
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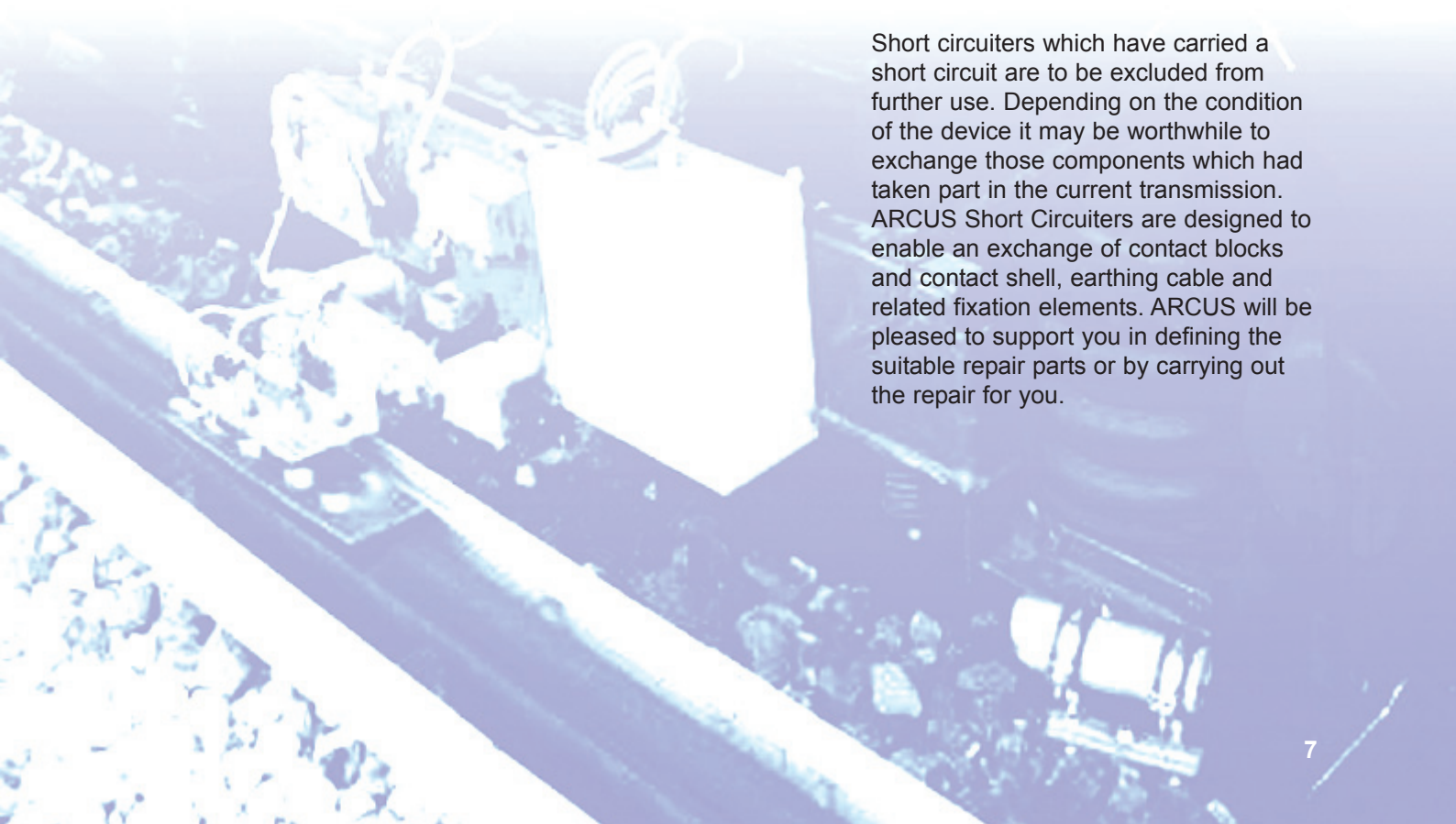
3

Function principle (continued)

In the moment of making contact with the current rail in any case sparking is to be expected (even the disconnected current rail carries residual voltages), so it is recommended to avert face and upper part of the body when contact is made.
If possible, protective clothing and a suitable hearing protection against eventuel explosion-like bang have to be worn.
Further details can be found in the instruction for use which is supplied with each device.

Repeated usage ...



Short circuiters which have carried a short circuit are to be excluded from further use. Depending on the condition of the device it may be worthwhile to exchange those components which had taken part in the current transmission. ARCUS Short Circuiters are designed to enable an exchange of contact blocks and contact shell, earthing cable and related fixation elements. ARCUS will be pleased to support you in defining the suitable repair parts or by carrying out the repair for you.

Storage, transport, maintenance

Storage and transport

Folded for transport and storage, both types of short circuiters are compact and handy. It is simple to store them in suitable boxes or on a car to bring them to usage site fast and easily.
Depending on constructing, ARCUS Short circuiter weigh between 5 and 16 kg.

Maintenance

In general ARCUS Short Circuiters are maintenance-free. Materials and surface treatment widely exclude corrosion. Still permanent transport in a vehicle and associated vibration, acceleration forces, climatic variation may lead to loose or damaged parts. Thus it is recommendable to carry out a visual inspection of the device in regular intervals. During this process also the proper function of all movable parts, especially the contact mechanism, should be examined. A disconnected track section or a rail model are suitable for this purpose.

STANDARDS AND TESTS

Up to now there is no standard for devices for earthing and short circuiting in underground rail tracks. ARCUS Short Circuiter belong to the large group of portable devices for earthing and short circuiting.

Yet the applicable standard DIN VDE 0683 part 1, now DIN EN 61230 or IEC 61230, does not address the issue of characteristics of short circuiters. Neither the specific design of short circuiters, nor the fact that a short-circuit can be introduced by them, are considered. Consequently there is no standardised test installation and no test procedure for short circuiters.

To still be able to prove that the short circuiter is safe and short-circuit proof, one draws on a statement of the standard that tests are to represent the conditions under which the short circuiter usually is used. Furthermore the appreciably most disadvantageous conditions are to be considered in the test. Consequently this means that the proof of short-circuit strength is to be adduced on the track of the respective customer. Only these conditions correspond to the test principle.

Consequently there is no certificate about the type test passed at an accredited test institute. Each customer is to verify by himself (on a sample) whether the short-circuit strength of the short circuiter is sufficient for his purposes. ARCUS as a manufacturer is not able to confirm values of short-circuit strength because these depend on the conditions of usage.

Depending on whether a short circuiter is close to a current feeder or at a distance, a short circuiter is used when current is switched onto it or to de-energise, or whether rails are bare and smooth or corroded and uneven, the values for short-circuit strength will be differing totally.

To still give an idea of the device's capacity, in the following we state the values of short-circuit tests carried out in 1973 at the Munich Underground for determination of track switch selectivity:

- Current rail 700 V DC
- Current switched onto installed device: max. 30.5 kA, 23 ms
- Installation of device when voltage is present: 28.5 kA, 23 ms

These values are valid for the model "current rail contact from bottom side", type Munich,
our type number 515 105.

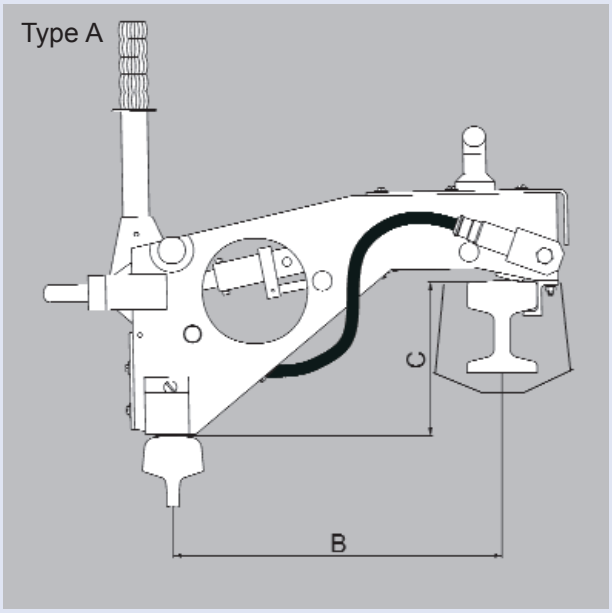
Latest tests were carried out in June 2006 at the IPH in Berlin. For this purpose a 1.4 m long rail model of Metro Taipei (Taiwan) was used. Tests were carried out by both switching onto the installed short circuiter and installation of the short circuiter with live current rail, with the following values:

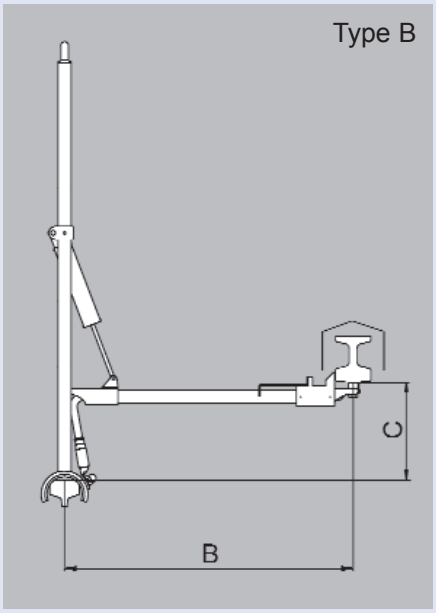
- Current rail 750 V DC
- Short circuit current 100 kA / 35 ms

These values are valid for the model "current rail contact from bottom side", type Taipei,
our type number 597 519.

Under all other aspects the devices are designed to suit the requirements of the valid standard as far as possible, so that there is no increased risk for individuals and electric installations.

Survey of types





Selection of Types:				
Design	**B [mm]**	**C [mm]**	**Rail track system**	**Type number**
Type A	370	56, 76, 116	Siemens Wildenrath, Germany	597 414
Type A	370-385	170-230	Berlin, Germany	598 745
Type A	625	160	Rotem, Korea	597 456
Type A	634	160	Athen, Greece	597 319
Type B	449	200	Hamburg, Germany	598 365
Type B	452	230	Rotterdam, the Netherlands	597 209
Type B	452	230	Rotterdam, the Netherlands	597 571
Type B	512	170	Berlin, Germany	598 698
Type B	550	195	Docklands, Great Britain	598 760
Type B	564	170	Taipei, Taiwan	597 519
Type B	594	192	Munich, Germany	597 662
Type B	594	192	Munich, Germany	515 105
Type B	594	192	Vienna, Austria	597 584
Type B	655	160	Prague, Czech Republic	597 155
Type B	655	222	Amsterdam, the Netherlands	598 532
Type B	655	222	Amsterdam, the Netherlands	597 427
Type B	660	150	Stockholm, Sweden	597 114
Type B	664	169	Singapore, Dubai	598 739
Type B	670	235	Helsinki, Finland	597 303
Type B	723	200	Milan, Italy	597 693
Type B	726	220	Rotem, Korea	597 457
Type B	783	240	Bangkok, Thailand	597 450
Type B	818	135	Berlin, Germany	598 651
Type B	725	148	Bangalore, India	597 701

Each device is designed and manufactured to meet customers' specific requirements !

SHORT CIRCUITER FOR UNDERGROUND RAILWAYS

QUESTIONNAIRE

In order to respond to your enquiry, information is required concerning the related rail track.
Please fill in all data, incomplete questionnaires will not be dealt with !

Project data

Name of rail track: _____ Location: _____

Nominal voltage: _____

Rated current/ time: _____

Profile of current rail: _____ ☐ drawing enclosed

Profile of running rail: _____ ☐ drawing enclosed

Current rail with cover: ☐ no ☐ yes ☐ drawing enclosed

Horizontal rail distance **B** (mm): _____

Vertical rail distance **C** (mm): _____

Contact on current rail: ☐ Type A ☐ Type B

Size of design limited: _____ ☐ no ☐ yes ☐ drawing enclosed

Others: _____

_____

_____

_____

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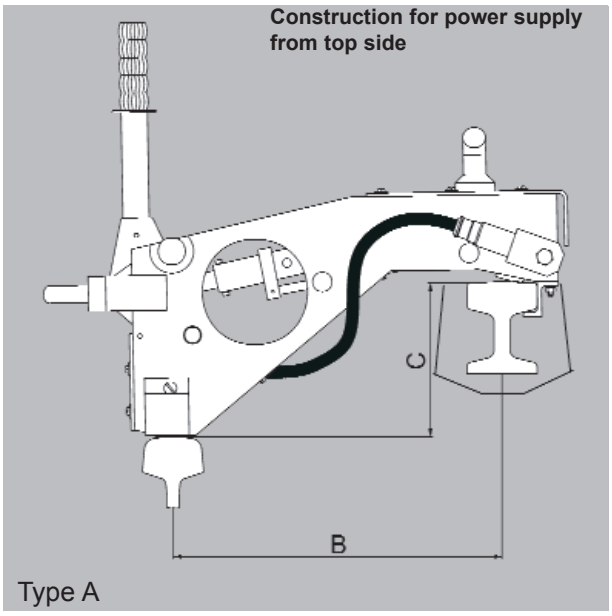
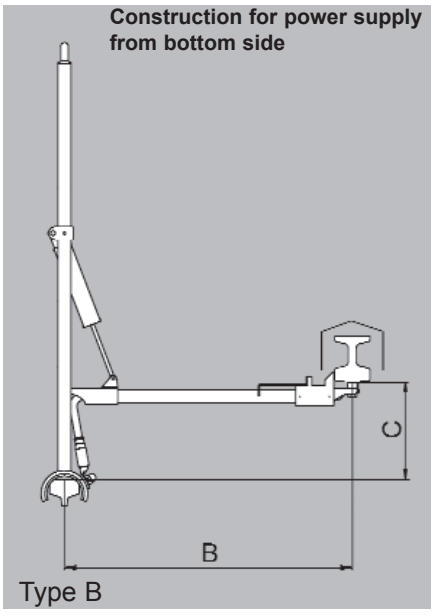
_____

_____





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