Instructions
for Maintenance and Overhaul

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Notice 1
Based on our own experience, you will obtain the best possible operational reliability from our equipment by following to the recommendations given in these instructions.

Notice 2
Within the scope of these instructions, it is impossible to take into account every possible eventuality which may arise with technical equipment in service. Please consult our local agents in the event of any irregularities, especially if not referred to herein.

Notice 3
We expressly decline any liability for all damages, whether direct or indirect, resulting from any incorrect operation or wrong handling of our equipment, even if those instructions contain no specific indication in this respect. Our liability for any indirect damages resulting from any cause is expressly excluded.

Notice 4
Without our written authority it is strictly forbidden to disclose, reprint, copy or reproduce any part of these instructions.
# Instructions for maintenance and overhaul

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E-3
1. Definitions

The following definitions for servicing and inspections are based on IEC Document No. 13-74 (WG 06) 04.

1.1 Inspection

Visual, periodical observation of the unit's main characteristics during operation. Dismantling is not required.

In general the following characteristics have to be checked:
- Operating pressure
- Tightness of equipment
- Settings, e.g. of relays, valves, etc.
- Degree of pollution of insulating media, etc.

Observations made in the course of this inspection may necessitate servicing.

1.2 Servicing

Operations to which a unit is subjected with a view to checking and/or replacing individual components, with the unit in a disconnected state. These jobs are listed in the operating instructions. Here a distinction is made between maintenance and overhauls.

1.2.1 Maintenance

Work carried out according to operating conditions and including, for instance:
- replacement of exchangeable parts
- checking the operation of controls
- measuring the characteristic values of insulating and arc extinguishing media
- tightening up screwed connections
- readjustment of settings to ensure reliable operation
- lubrication
- cleaning and washing
- measuring such operational characteristics as
  - minimum pressure limit
  - switching times
  - insulation values of secondary circuits, etc.

1.2.2 Overhaul

Here we distinguish between scheduled and non-scheduled overhauls.

The work to be performed corresponds to that required for maintenance. Wearing parts and, where necessary, spare parts, are to be replaced in accordance with pertinent instructions.

1.2.2.1 Scheduled overhauls

Work carried out after a prolonged period of service, a definite number of switching operations.

1.2.2.2 Non-scheduled overhauls

These have to be performed following the occurrence of a fault or defect, as well as after exposure to undue stresses.
2. General

Maintenance and overhaul operations must not be carried out unless:
- the breaker is de-energized
- the h.c. and l.v. connections are correctly disconnected and earthed
- the spring operating mechanism is blocked

2.1 Spring operating mechanism

In order to prevent damage to the circuit-breaker neither the operating mechanism nor the contacts should be manipulated while the spring assembly is fully or only partially charged.

2.1.1 Discharging the spiral spring assembly

In order to perform the work it has been found convenient to switch the breaker to its «ON» position. In this state secure the auxiliary crosspiece 3621 by means of two blocks of wood measuring roughly 120 x 50 x 25 mm, so that it cannot move unexpectedly.
- Release and remove the chain drive 3430
  - Release the hex. nut 3436 and run it up towards the head on the threads of the screw of hex. screw 3439
    Tool required: 13 mm open-ended spanner
  - Turn the hex. screw into the mounting bracket of the motor 3410 until the roller chain 3435 can be removed from the sprocket 3431
  - Lift off the chain
  - Separate the driver 3203 from the spring drum by removing the hex. screw 3551.
    Tool required: 13 mm open-ended spanner
  - Mark the eye gap used on the spring drum and the direction of rotation of the spring drum, which is charged up to Mmax, for reassembly.

- Place the crank 3490 on the square end of the worm shaft
- Hold the locking lever 3941 firmly
- Turn the crank anti-clockwise. When the rotary motion is blocked by the shutter 3471, press the latter to the right against the force of the pressure spring 3475 and, while turning the crank, release the shutter again. At the same time hold the latch in the unlatched position.
  - Repeat this sequence of operation until, after about 2 1/2 revolutions of the drum, the spiral springs no longer exert any torque on the drive shaft 3310. The spring drum can then be moved by hand.

To prevent the slide nut from jamming, it should be held near the spring drum while the spring is being discharged.

2.1.2 Charging the spiral spring assembly

Having completed the overhaul or maintenance work, the spring assembly has to be recharged as described below.

Initial position: circuit-breaker «ON»
- Push the crank 3490 over the square end of the worm shaft 3451
- Turn the crank clockwise until the spring drum has performed 1 to 1 1/4 revolutions
- Make sure that the slide nut does not jam when doing so
- Remove the two wooden blocks
- Remove the crank
- Switch the breaker «OFF»
- Discharge the spring assembly again
  - Put the crank back on the square end of the worm shaft
  - Hold the locking lever 3941 tight
  - Turn the handle anti-clockwise. When the rotary motion is blocked by the shutter 3471, press the latter to the right against the force of the pressure spring 3475 and, while turning the crank, release the shutter again.
  - Repeat this sequence of operation until the spiral springs no longer exert any torque on the drive shaft 3310. The spring drum can then be moved by hand.
- Turn the handle clockwise until the spring drum has completed about 2 1/2 to 2 3/4 revolutions
- Advance the slide nut 3202 to within 1/4 - 1/2 turn of the thread from the spring drum
- Fit the driver 3203 with a screw 3208 at the marked point on the spring drum
  Tool required: 13 mm open-ended spanner
  Force applied: screw up tight
- Recharge the spring assembly with the handle. On reaching the marked position, the indicator has to be re-adjusted to Mmax.

- Refit the chain drive 3430 and tension the chain
  - Lift the mounting bracket of the motor
  - Lay the roller chain 3435 over the sprocket of the motor. Ensure the closed side of the spring clip is pointing in the direction of travel.
  - Lay the roller chain over the second sprocket 3455.
  - Unscrew the screw 3439 towards the drive housing and tension to such an extent that the two sides of the chain can be pressed together in the middle to a distance of 10 - 20 mm.
  Tool required: 13 mm open-ended spanner
- Finally screw the hex. nut 3436 with spring washer 3437 against the mounting bracket, until the screw is secured.
  Tool required: 13 mm open-ended spanner
2.2 Sealed and marked settings

Certain connections and settings, which are necessary to ensure that the unit will function reliably, are sealed with lead seals in the factory or secured with marking paint.

If such connections or settings have to be opened or changed in the course of maintenance or overhaul, this should only be done by the manufacturer’s own personnel or by special service personnel trained for this task in the manufacturer’s works. They reseal the new connections or determine the new settings and mark them, to ensure that the unit operates reliably.

2.3 Gas leakage

The pressure in the gas compartment is noted at each routine check of the circuit-breaker. From these entries it is possible to determine the extent of any gas leakage.

If, during an overhaul, new parts are correctly installed, the necessary gas tightness should be re-established after assembly. This can be determined by noting the readings on the manometer over a period of several weeks.

An exhaustive check for gas leakage should be arranged with the service station of the manufacturer or his agency.

3. Inspection and servicing schedule

Fig. E2, page E-33 – Tables I and II, pages E-2 and E-3

3.1 Inspections

The breaker should be inspected as a rule every 12 months.

3.2 Servicing

Servicing will depend on the length of duty and the operational frequency. Table I, page E-2, refers.

3.2.1 Electrical load

Fig. E2, page E-33, shows the relationship between the number of switching cycles and the magnitude of the working current. This summation current limiting curve clearly shows higher values for the circuit-breaker type HC. As a result, SF6 circuit-breakers in distribution networks under normal operating conditions need overhauling only once in 20 years.

3.2.2 Mechanical load

The mechanical load depends only on the number of switching cycles, which can be read off the counter.

3.2.3 Combined load

For establishing the overhaul interval in this case both the electrical and the mechanical loads must be taken into account.
4. Handling the extinction medium

Sulphur hexafluoride (SF₆) has proved to be particularly suitable for use as an insulating and quenching medium, being incombustible, non-toxic, odourless and colourless. Chemically it is extremely stable and is inert up to about 500°C.

For deliveries of SF₆ gas the supplier must provide a certificate verifying the chemical purity of the delivered gas. Care must be taken to ensure that the permissible amount of manufacturing impurities is not exceeded.

With a small gas volume of only few litres in this SF₆ medium-voltage breaker the gas can be discharged direct or via a filter into the outside air when servicing. The gaseous secondary products arising during opening operations are absorbed to a great extent by the large-sized adsorbers installed in the breaker.

These works can be carried out in accordance with the service instructions without hesitation if the following preventive measures are observed:

- Gas discharge, dismantling and cleaning are to be carried out with the room well ventilated.

- Where dust caused by switching operations is apparent persons working on the installation should wear gloves of plastic or rubber (eye protectors and dust mask if necessary) to prevent irritation.

- Any dust deposits on the inside surface of the switchgear are to be drawn off with a vacuum cleaner through filter paper or to be wiped off with a dry non-fraying cellulose cloth.

- After use the filter paper strips, cellulose cloths and the used active lumina are to be collected in a plastic sack and disposed of in accordance with local regulations.

4.1 Checking the pressure in the gas compartment

The gas pressure in the gas compartment can be read off the pressure gauge 5051.

4.2 Filling with SF₆ gas

Fig. E3, page E-35

The rated filling pressure at a gas temperature of 20°C is 3.0 bar absolute (i.e. 2.0 bar overpressure). If the gas temperature deviates from 20°C the secondary pressure must be corrected on the pressure reduction valve.

Table B1 and Fig. B3, page B-19 of the operating instructions.

Fill with SF₆ gas as follows:

- screw off the valve cap of the gas filling valve 5042 by hand
- open the gate valve of the cylinder
- open the pressure reduction valve
- flush the hose connection between the gas tank, the pressure reduction valve and the lever plug connection

- connect the lever plug connection to the gas filling valve
- set the pressure reduction valve so that the secondary pressure corresponds to the rated filling pressure of the circuit breaker
- regularly check the gas pressure on the gauge 5051. If this shows that the breaker has been overfilled, the surplus can be discharged by lightly pressing the knob in the valve
- shut off the gas supply and disconnect
- replace the cap on the valve and screw tight

Extinction medium: Sulphur hexafluoride (SF₆)

For specification refer to para. 11.1, page E-26

Equipment: See para. 10.1, 1c, page E-25

4.3 Discharging the SF₆ gas

Fig. E3, page E-35

As a preparatory measure unscrew the cap of the gas filler valve 5042 by hand.

4.3.1 To the atmosphere

The simplest method is to screw the valve insert out of the gas filling valve using the back of the valve cap, permitting the SF₆ gas to flow out freely. If it is not possible to permit the SF₆ gas to be discharged into the work room in consideration of the safety measures recommended the gas should be discharged into the open air using a plastic hose (inside diameter 8 mm) fitted with a snap-on nipple.

In order to remove as far as possible the used SF₆ gas still in the gas compartment flush the extinguishing unit twice with pure SF₆ gas, with air or pure nitrogen.

For this purpose the extinguishing unit is filled up to the nominal filling pressure and then, as described above, again discharged.

After the second flushing operation service work can begin.

4.3.2 Drawing off SF₆ gas with a compressor

If facilities for regenerating SF₆ gas, such as a service truck, for instance, are available, the SF₆ gas in the gas compartment can also be drawn off and compressed. In the service truck the drawn off gas is cleaned and dried and then compressed in a storage tank.

The pressure in the gas compartment is reduced during this operation to a value lower than 5 mbar, the gas compartment is then filled with air and flooded. The extinguishing unit is then ready for maintenance.
4.4 Filling with SF₆ gas after servicing
Fig. E3, page E-35

4.4.1 Evacuating the gas compartment
Before re-commissioning the installation after maintenance or overhaul, the gas compartment of the circuit-breaker must be evacuated until the pressure is less than 5 mbar and this should be continued for approximately one hour. This period is necessary to allow the gas compartment and the installed compartments to dry out well. Evacuation is then to be terminated without removing the lever plug connection (the built-in non-return valve does not operate under vacuum in the gas compartment).

4.4.2 Filling with SF₆ gas
As described under 4.2, page E-7, the gas compartment can now be filled with SF₆ gas.

4.4.3 Checking for gas leakage (under operating pressure)
After operation of the circuit-breaker has been resumed it should be checked for gas tightness over a period of several weeks by observing the reading on the pressure gauge.

5. Working description—inspection

5.1 Extinguishing unit

5.1.1 Pressure in gas compartment
The pressure in the gas compartment should be checked once every two years. The manometer indicator should be in the green zone. For readings, however, the effective room temperature should be taken into account. More detailed information is given in Fig. B3 on page B-19 of the operating instructions.

If the indicator is in the red zone SF₆ gas must be added as described in para. 4.2, page E-7.

5.2 Spring operating mechanism
Fig. E3, page E-35

5.2.1 Screwed and pinned joints
- Ensure that all screwed and pinned joints of the spring operating mechanism are still tight.
- Examine all removed connecting elements, including lock washers and packing discs, for damage and replace if necessary.
- Retighten all screwed and pinned joints.

5.2.2 Silentbloc damper
- The brake cleat 3372 surrounds the Silentbloc 3371
- Both the brake cleat and the Silentbloc are marked. Check whether these two marks are exactly aligned. Should the cleat have become displaced, readjust it in accordance with section 6.3.5, page E-14.

5.2.3 Carbon brushes of the drive motor
- Inspect the contact surfaces of the carbon brushes in the drive motor.
  If necessary, clean and polish.
  Tool required:
  Accessories: see section 9, page E-23
- Examine the state of the commutator ring surface. If necessary, clean and polish. Use a mirror if required.
  Tool required:
  Accessories:
6. Working description—servicing

The SF₆ circuit-breaker type HC requires remarkably little servicing.

The servicing required, however, must not be carried out unless
- the breaker is switched off
- the h.v. and l.v. terminals are correctly disconnected and earthed
- the spring operating mechanism is blocked in accordance with para. 4.2.9, page A-22 of the operating instructions. For additional blocking a wooden block approx. 120 × 50 × 25 mm can be inserted in each of the recesses for the auxiliary crosspiece 3621 in the drive housing.

6.1 Maintenance

6.1.1 Spring operating mechanism

6.1.1.1 Screwed Joints

Fig. E3, page E-35

The following screwed joints are to be checked for tightness in accordance with the schedule, Table II, page E-3:
- the four hexagon screws 3099 for securing the drive 3010 to the base 5010
  Tool required:  torque wrench with 24 mm Allen key insert
  Force applied:  110 Nm
- the two cheese-head screws 3094 for securing the drive to the base
  Tool required:  torque wrench with 10 mm Allen key insert
  Force applied:  45 Nm
- the three cheese-head screws 3379 for securing the brake cleat 3372 to the Silentbloc 3371
  Tool required:  torque wrench with 6 mm Allen key insert
  Force applied:  13 Nm

6.1.1.2 Lubrication

to be carried out in accordance with the schedule Table II, page E-3, and lubrication chart, section 8.4, page E-22.

Lubricant: See section 8.1, page E-20

6.2 Overhauling the switching unit/dismantling

When servicing the switching unit ensure that:
- the relative humidity in the work room does not exceed 70 %

- all those components which must be packed dry as specified in the following description must be packed immediately after cleaning in order to reduce the absorption of moisture to a minimum. The parts can be packed singly in plastic bags together with bags of absorbents or together in a well-sealed container with bags of absorbent.

See para. 11.2, page E-27 for specification of the absorbent.

- When transporting the circuit-breaker should be so secured that it cannot tip.

Instructions for handling the extinguishing medium are compiled under section 4 on page E-7.

The necessary maintenance tasks are listed in Table II, page E-3.

6.2.1 Preliminary work

Fig. E1, pages E-29 and E-31.

6.2.1.1 Disconnecting the circuit-breaker

- Interrupt the h.v. contacts by switching off the circuit-breaker.
- Fully recharge the spring assembly with the motor drive.

Applicable only for permanently installed breakers

- Open the corresponding isolators.
- Earth the h.v. leads on both sides in accordance with pertinent regulations.

Interrupt the low-voltage control circuits

- Earth the l.v. leads in accordance with pertinent regulations.
- Ensure that no remote control command is able to reach the breaker.
- Disconnect the h.v. connections to the breaker.
  Tool required:  30 mm open-ended spanner
- Disconnect the earth wire from the breaker.
  Tool required:  17 mm open-ended spanner
- Disconnect the breaker 1000 from its bed.
  Tool required:  17 mm open-ended spanner
- Remove the breaker and take it to the workshop for overhaul.

Applicable only for truck-mounted breakers

- Withdraw the breaker truck form the cubicle (see relevant operating instructions).
- Earth the h.v. feeders in accordance with pertinent regulations.
- Earth the l.v. leads in accordance with pertinent regulations.
- After removal of the truck, cover the cubicle in accordance with pertinent regulations.
- Take the breaker on the breaker truck into the workshop for overhaul.
6.2.1.2 Preparations for overhauling the extinguition unit

- Press button 1012 to bring the breaker into the «ON» position.
- Block the auxiliary crosspiece 3621 in this position with two wooden blocks measuring approx. 120 x 50 x 25 mm to prevent their being moved accidentally. Fig. E1 b, page E-29 refers.

6.2.1.3 Draining the SF₆ gas

For the necessary procedure refer to para. 4.3, page E-7.

Tool required: See para. 10.1, page E-25

6.2.2 Fixed contact

Fig. E4 a, page E-37

- Unscrew the six cheese-head screws 5329 and remove them together with the washers 5328.
  Tool required: 8 mm Allen key
- Pull off the fixed contact 5300 with the aid of the dismantling device 0053/1 from the extinguition chamber.
  Tool required: Dismantling device 0053/1
    See para. 10, page E-25
- Replace cord ring 5314.

6.2.2.1 Dismantling the contact fingers

Fig. E4 b, page E-37

- Grip the fixed contact 5300 in a vice with the cage 5340 pointing upwards.
  Tool required: vice
    See para. 10, page E-25
- Using the special tool 0053/2 provided, pull the contact fingers 5345 together with the springs 5349 out of the rated current cylinder of the cover 5311. The procedure is illustrated schematically in Fig. E4 b, page E-37.
  Tool required: special tool 0053/2
    See para. 10, page E-25
    Flatnose pliers 120 mm
- Replace all contact fingers and springs
- Pull out the cage 5341 by hand and clean it with a duster inside and outside.
  Aids required: See para. 9.3, page E-24

6.2.2.2 Dismantling the guide washer

Fig. E4 b, page E-37

- Remove the circlip 5327
  Tool required: Screwdriver 00 or 0
- Remove the light-alloy washer 5317 and the guide washers 5315/5316.
- Clean these parts with a duster, check and if necessary replace.

6.2.2.3 Dismantling the cooling plate

Fig. E4 a, page E-37

- Lift the cooling plate 5321 of the rated current cylinder of the cover 5311 by hand.
- Clean the cooling plate with a duster
  Aids required: vacuum cleaner
    See para. 10, page E-25

6.2.2.4 Dismantling the contact stud

Fig. E4 a, page E-37

- Remove the contact stud 5330.
  Tool required: special tool 0053/3
    See para. 10, page E-25
- Clean the contact stud with a duster, check and if necessary replace.

6.2.2.5 Assembling the contact stud

Fig. E4 a, page E-37

- Install the contact stud 5330
  Tool required: special tool 0053/3
    See para. 10, page E-25
    Torque wrench with 27 mm
    Allen key Insert
    Force applied: 110 Nm

6.2.2.6 Assembling the cooling plate

Fig. E4 a, page E-37

- Push the cooling plate 5321 onto the rated current cylinder of the cover 5311. The side with the short soldering lugs must rest on the mating surface of the cover.

6.2.2.7 Assembling the guide washer

Fig. E4 b, page E-37

- Insert the plastic guide washer 5315/5316 into the rated current cylinder of the cover. Then insert the light-metal disc 5317. Finally insert the circlip 5327 by hand.
- Check whether the plastic guide washer can easily be moved by hand in radial direction.

6.2.2.8 Assembling the contact fingers

Fig. E4 b, page E-37

- Push the cage 5314 onto the load current cylinder of the cover.
- In each sector of the cage push in five contact fingers 5345 with spring 5349 by hand. For the correct position see Fig. E4 b, page E-37.
  The assembly sequence shown in Fig. E4 b/4 should be strictly adhered to, in order to ensure that the cage remains centered and the amount of force applied is uniform.
- Lightly grease the contact ring formed by the mounted contact fingers. See lubrication schedule, para. 8.4, page E-22.
6.2.2.9 Storing the fixed contact
- After completion of assembly the fixed contact should be packed dry.

6.2.3 Tubular switching chamber
Fig. E4 c, page E-39
- Keep the circuit-breaker in the «CLOSED» position.
- Unscrew hex. screw 5229 and remove it together with washers 5228.
  Tool required: 17 mm open-ended spanner
- Pull the tubular switching chamber 5210 upwards by hand, overcoming the resistance offered by a guide ring and the multicontacts.
- Replace the cord ring 5214
- Take out the multicontacts 5220
- Remove the guide ring 5225 by hand
- Clean any dirty components, check all parts for damage and replace, if necessary.

6.2.4 Moving contact
Fig. E4 d, page E-39
6.2.4.1 Dismantling the contact tube
- Unscrew the cheese-head screws 5439 and remove together with the washers.
  Tool required: 4 mm Allen key long type
- Lift off the contact tube 5430 together with the nozzle 5432/5433 by hand, overcoming the resistance of a number of guide rings.
- Unscrew the nozzle from the contact tube by hand and replace.

6.2.4.2 Dismantling the breaking contact
- Unscrew set-screw 5429 visible in the opening in the guide tube 5230 directly beneath the piston plate 5421.
  Tool required: 2.5 mm Allen key long version
- Dismantle the breaking contact 5410
  Tool required: belt spanner
Caution: The auxiliary nozzle 5416/5417 may become detached from the rest of the breaking contact assembly. In this case the flow tube 5424 can be released with the aid of a pipe wrench.

6.2.4.3 Dismantling the piston
- Remove special screws 5249.
  Tool required: Screwdriver No. 5
- Remove diaphragm 5248
- Remove piston plate 5241
- Remove ring 5245 and the spiral pressure element 5246 by hand.

6.2.4.4 Dismantling the guide tube
- Undo and remove screws 5239
  Tool required: 5 mm Allen key
- Lift off the guide tube 5230 by hand, in the course of which the resistance of a number of guide rings has to be overcome.
- Remove the guide ring 5235 and the corrugated ring 5236.

6.2.4.5 Dismantling the guide elements of the switching rod
- Lift the disc 5146 and sealing ring 5144 together with the cylindrical compression spring 5145.
- Bend guide ring 5143 upwards and lift off.

6.2.4.6 Cleaning and examining the parts
- Examine the dismantled parts or sub-assemblies for wear and damage and replace, where necessary.
- Clean any parts or sub-assemblies that are dirty.
  See para. 9.4, page E-24.

6.2.5 Transmission system
Fig. E5 a, page E-43
6.2.5.1 Dismantling the cover
- Undo screws 5039 and remove together with the washers 5038 and spring washers 5037.
  Tool required: 13 mm open-ended spanner
- Dismantle the cover 5020
- Replace the cord ring 5029

6.2.5.2 Replacing the activated alumina
- Remove and replace split pins 5026
  Tool required: flat-nose pliers 120 mm
- Remove both covers 5022 and 5023 and filter 5024 by hand.
- Empty the activated alumina 5025 out of the cover into a refuse container.
  Due to the composition of the adsorbed decomposing matter local regulations on disposal should be taken into consideration.

6.2.5.3 Dismantling the crossbar
Provided the spacer tubes and straps have not been deformed by impact:
- Unscrew the hex. screw 5139 at both ends and dismantle together with spring washers 5137 and corrugated washers 5136.
  Tool required: 19 mm spanner
- On both sides remove the switchrod subassembly 5140 consisting of the switchrod 5141, the two straps 5131, special hex. screw 5149 and hex. nut 5148 by hand thereby releasing the spacer tubes 5133.
- On both sides dismantle the spacer tube 5134 and the damper tube 5135.
- Pull the crossbar 5130 out of the drive lever, thus releasing the two spacer tubes 5132 and the third switchrod subassembly 5140.

If the spacer tubes and the straps have been damaged by impact, only one of the hex. screws can be unscrewed.
- Remove this hex. screw 5139 together with spring washer 5137 and corrugated washer 5136.
  Tool required: 19 mm spanner
- Remove the first switchrod subassembly 5140 - consisting of switchrod 5151, the two straps 5131, special hex. screw 5149 and the hex. nut 5148 by hand, thus releasing on spacer tube 5133.
- Dismantle the spacer tube 5134 and the damper tube 5135.
- Dismantle the second and third switchrods subassembly 5140 by unscrewing the special hex. screw and the hex. nut.
  Tool required: 19 mm spanner
- Remove the released strap 5131 by hand.
- Pull out the crossbar 5130 together with the remaining parts from the drive lever, thus releasing the two spacer tubes 5132.
- Replace the crossbar 5130, the six straps 5131, the pairs of spacer tubes 5132, 5133 and 5134, the two damper tubes 5135 and the three special hex. screws 5149 with hex. nuts 5148.

6.3 Overhauling the operating mechanism

6.3.1 Discharging the spring assembly
  Fig. E1, pages E-29 and E-31
- Detach the driver 3203 by removing the hex. screw 3209 from the spring drum 3351.
  Tool required: 13 mm spanner
- Mark the eye clearance on the spring drum and the direction of rotation of the spring drum charged up to to facilitate reassembly.
  - Push the hand crank 3490 onto the square end of the worm shaft 3451.
  - Turn the crank counter-clockwise. Every time the rotation is blocked by the shutter 3471, press the latter to the right. Against the force of the pressure spring 3475 and, while turning the crank, release the shutter again. At the same time hold the latch in the spring charging indicator 3215 in the disengaged position.
  - Repeat this sequence of operations until, after about 2½ revolutions of the drum the spiral springs no longer exert any torque on the drive shaft 3310. The spring drum can then be moved by hand.
  To prevent jamming, the slide nut must remain near the spring drum while the spring is being discharged.

6.3.2 Dismantling the rewind motor
  Fig. E6 a - d, pages E-47 to E-51
- Unscrew the cheese-head screws 3634 and remove together with washers 3633 and spring washer 3632.
  Tool required: 4 mm Allen key
- Unscrew the cheese-head screw 3639 and remove together with washer 3638, washer 3638 and spring washer 3637.
  Tool required: 4 mm Allen key
- Remove both auxiliary springs 3605/3606.
- Remove both washers 3631 from the crossbar 3621 and the two washers 3635 from the bolt 3601/3602.
- Unscrew the two setscrews 3629.
  Tool required: 5 mm Allen screw
- Remove the two guide rings 3628 together with washer 3625.
- Unscrew both setscrews 3619.
  Tool required: 5 mm Allen key
- Remove crank bolts 3615 and 3616 together with washers 3618.
  The two straps 3611 can then be detached. Apply adhesive tape to the guide bush 3612 in each strap to hold it in position.
  The two sleeves 3613 can also be detached.
- Remove the two setscrews 3624.
  Tool required: 6 mm Allen key
- Push out crossbar 3621. This will release the two guide rings 3623.
- Remove the front plate 1010 by unscrewing the hex. screws 1018 and 1019 and remove these together with washers 1017 and spring washers 1016.
  Tool required: 13 mm spanner
- Remove the valve extension 5043 from the mounting plate 5041:
  - Screw off valve cap of gas filler valve 5042 by hand, then remove the two nuts.
    Tool required: 11 mm spanner
  - Pull the gas filler valve out of the mounting plate, then screw on the two nuts and the valve cap again.
- Dismantle the pressure gauge 5051:
  - Unscrew the countersunk screws 5048 and remove together with the two hex. nuts 5046 and the spring washers 5047.
    Tool required: screwdriver size 5
    10 mm spanner
  - Remove the pressure gauge with the damper ring 5055—fitted to the pressure gauge extension 5052—from the mounting plate.
- Detach the valve extension 5043 and the pressure gauge extension 5052 from the drive plate 3011:
  - Unscrew the cheese-head screws 1059 and remove together with the washers 1058.
    Tool required: screwdriver size 4
  - The clips 1052/1053 remain on the hoses.
- Remove the cable hose 5064 of the pressure switch 5060 (electrical pressure monitor) from the drive plate 3011:
  - Unscrew the cheese head screws 1059 and remove together with washers 1058.
    Tool required: screwdriver size 4
  - The clips 1051 remain on the hose.
- Unscrew the two cheese head screws 3094 and remove together with washers 3093 and spring washers 3092 (see Fig. E3 b, page E-35).
  Tool required: 10 mm Allen key
- Unscrew the four hex. screws 3099 and remove together with washers 3098 and spring washers 3097 (see Fig. E3 a, page E-35).
  Tool required: ratchet with 24 mm Allen key insert and extension
- Remove the spring operating mechanism from the extinction unit.
  Tool required: hoist with bar and sling rope

**6.3.3 Dismantling the drive shaft**
Fig. E7 a and Fig. E7 a/1 – 8, pages E-53 to E-61

- Cut the safety wire 3339, remove and replace.
  Tool required: wire cutter.
- Drive out the spiral dowel pin 3336 and replace.
  Tool required: pin punch dia 5 mm hammer 200 g
- Remove the washer 3338 by hand.
- Pull off the cam crank 3332 together with the bearing 3335.
  Tool required: pulley pliers
- Cut the safety wire 3349, remove and replace.
  Tool required: wire cutter
- Drive out the spiral dowel pins 3344 and 3347 and replace.
  Tool required: pin punch dia 5 mm hammer 200 g
- Drive out the two spiral dowel pins 3343 and 3346 and replace.
  Tool required: pin punch dia 9 mm hammer 200 g
- Pull off the crank 3341 together with the bearing 3345.
  Tool required: extractor pliers
- Dismantle the drive unit 3020:
  - Swivel the auxiliary switch plate 3801 to the side after removing the two hex. screws 3809 together with washers 3808 and hex. nuts 3806, releasing the damping discs 3805.
    Tool required: screwdriver size 4
    10 mm spanner
  - Unscrew the four special nuts 3015.
    Tool required: ratchet with Allen key
    Insert 19 mm and extension
  - Unscrew the two cheese-head screws 3024 and remove them together with the washers 3023 and spring washers 3022.
    Tool required: ratchet with 6 mm Allen key insert and extension
  - Lift out the drive unit.
  - Remove the adjusting bolts 3019 and 3029 by unscrewing the locknuts 3016/3026 and remove together with the washers 3018/3028.
    Tool required: 19 mm spanner
  - Replace the complete adjusting bolt assembly.
  - Remove the corrugated washer 3328 and then break the connection between strap 3221 and crank 3325.
    Tool required: screwdriver size 4
  - Cut the safety wire 3369, remove and replace.
    Tool required: wire cutter
  - Drive out the two spiral dowels 3363 and 3364 and replace.
    Tool required: pin punch dia 5 mm (for 3364)
    pin punch dia 9 mm (for 3363)
    hammer 200 g
  - Pull the cam 3361 of the drive shaft 3310 together with strap 3221 and locking ring 3224.
    Tool required: pulley pliers, if necessary
  - Remove the locking ring 3319.
    Tool required: straight-circclip A 19

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- Remove the axial bearing assembly, comprising disc 3315, two axial discs 3317, axial cage 3316 and disc 3318, by hand.
- Unscrew the three hex. screws 3329 and remove together with spring washers 3327.
  Tool required: 7 mm spanner
- Remove the flange 3330, bronze bearing and washer 3322 by hand.
- Pull out the drive shaft 3310 by hand from the spring operating mechanism. This releases the cam subassembly consisting of the cam, right, 3702, the cam, left, 3703 and the stop disc 3705, and also the spring drum assembly 3350, the slide nut 3202 and the driver 3203.
- Remove the bronze bearing from the drive housing 3021 by hand and replace, if necessary.
- Remove the bronze bearing ring 3356 by hand from the spring drum 3351 and replace, if necessary.
- Remove the cover 3353 by hand.
- The spring drum 3351, the two coil springs 3352 and the washer 3354 are then exposed.
  Replace the coil springs and the washer.
- Dismantle the torsion spring shaft:
  - Unscrew the hex. screw 3739 and remove together with spring washer 3737 and lockwasher 3736.
    Tool required: ratchet with 7 mm Allen key insert
  - Withdraw grooved pin 3731 by hand from the drive housing.
  - The two torsion springs 3732 and 3733 are now exposed. Check the springs and replace, if necessary.
- Dismantle the half shaft:
  - Drive out the spiral dowels 3749 and then 3747 and replace.
    Tool required: pin punch dia 4 mm hammer
  - Remove the spiral spring 3746 by hand. Check the spring and, if necessary, replace.
  - Pull out the bush 3743 by hand out of the drive housing, check and replace, if necessary.
  - After lifting the rocker plate 3721, pull the half shaft 3741 out of the drive housing. This exposes the spiral spring 3745 and lever 3748 - the latter still connected to the trip releasing latch 3902.
  - Remove the rocker plate
    - Release the support shaft on which the rocker plate is mounted by driving out the spiral dowel.
      Tool required: pin driver dia 2,5 mm hammer
  - Using a screw as an aid (hex. screw M6) pull the support shaft out of the drive housing, exposing the rocker plate subassembly, and the two discs 3728.
  - Replace the lever subassembly 3720 and the discs.

6.3.4 Replacing the carbon brushes of the drive motor
Fig. E7 b, page E-63

After approx. 10000 switching operations the carbon brushes of the drive motor should be replaced.

- Detach the electrical connections of the drive motor from the terminal board.
  Tool required: screwdriver size 4
- Unscrew hex. screws 3439.
  Tool required: 13 mm spanner
- Remove the chain drive 3430 by hand.
- Remove the split pin 3424 and replace.
  Tool required: flat nose pliers 120 mm
- Push out the shaft 3421 to the front by hand.
- Remove the motor drive 3410 together with the bearing 3420.
- Screw off the carbon brush covers.
  Tool required: screwdriver size 4
- Replace the two carbon brushes 3414.

Assemble in reverse order.

Tension the chain drive such, that the roller chain at top and bottom can be squeezed together by hand up to 10 – 20 mm.

6.3.5 Adjusting the brake fitting
Fig. E7 c, page E-63

- Unscrew four hex. screws 3389 and remove together with the washers 3388 and spring rings 3387. Now remove plate 3380.
  Tool required: 17 mm spanner
- Unscrew the cheese-head screws 3379 and remove together with the three spring rings 3377.
  Tool required: 6 mm Allen key
- Detach the brake cleat 3372 by hand from the Silentbloc 3371.
- Clean the outside surface of the Silentbloc and the inner surface of the brake cleat.
  Aid: See para. 9, page E-23
- Coat the lateral surfaces all round with Loctite as instructed.
  Aid: See para. 10.4, page E-25
- Restore the cleat to its correct position, ensuring that the two marks are exactly aligned.
- Secure the brake cleat with the cheese head screws and the spring rings.
  Tool required: torque wrench with 6 mm Allen key insert
  Force applied: 13 Nm
- Re-install the machined plate and secure with hex. screws, washers and spring rings. Coat the hex. screws with Loctite.
  Aid: See para. 10.4 page E-25
  Tool required: torque wrench with 17 mm Allen key insert
  Force applied: 27 Nm
Replacing the shunt releases and the no-voltage release for the blocking system
Fig. E7 d, page E-65

The shunt releases for opening for 3832 and 3833 and for closing 3831 are mounted on the ends of the relevant half shafts 3931 and 3921 such, that their shaft butts drive the half shafts when the trip is actuated.

The first trip release is mounted on the left end and the second one on the right end of the half shaft 3931, while the close release is fitted to the left end of the half shaft 3921.

The releases are located externally on the side walls of the drive bearing block and engage with two pins in the holes provided in the block to prevent them turning. Bolted plates prevent axial movement.

The no-voltage release for blocking and the blocking lever form a unit which, like the shunt releases 3831 and 3832, is mounted on the left side wall of the drive bearing block.

Description of dismantling work:
- Bend back the lock washer 3842.
  Tool required: screwdriver No. 0
- Unscrew the hex. bolt 3849 and remove by hand together with the lock washer 3842, cup springs 3847 and plate 3841.
  Tool required: 10 mm spanner
- Pull off the tripping device by hand in axial direction.
- Disconnect the line connection.
- Replace the trip.
- Restore the line connection.
Assemble in reverse order.

Replacing the operations counter
Fig. E7 e, page E-67

- Detach the helical tension spring 3033 from the crank 3035.
- Unscrew the two cheese head screws 3039 and remove together with the spring rings 3037.
  Tool required: screwdriver size 3
- Remove the operations counter 3036.
- Remove and replace the split pin 3034.
  Tool required: flat nose pliers 120 mm
- Take down the crank 3035 and push it onto the shaft butt of the new operations counter.
  Secure with the split pin.
  Tool required: flat nose pliers 120 mm
- Mount the operations counter and secure with cheese-head screws and spring washers.
  Tool required: screwdriver size 3
  Force applied: tighten well
- Re-insert the helical tension spring.
7. Working description—servicing/reassembly

7.1 General
When reassembling the extinction unit note that:
- the relative humidity in the work room does not exceed 70%.
- the part coming into contact with SF₆ gas must be free of dust and must only be touched with clean rags or plastic gloves.
- all current transmission points must be coated only with a thin film of grease.
- all rubber sealing elements must be lightly greased just before installation.
- all points to be lubricated during reassembly are listed in para. 8.4, page E-22.
- the procedure for filling the SF₆ gas is described in para. 4.4, page E-8.

7.2 Reassembly of the extinction unit

7.2.1 Reassembling the transmission system
Fig. E5, pages E-43 and E-45

7.2.1.1 Assembling the operating lever
- In accordance with 8.4.1, page E-22, place the lip of the gasket 5123 by hand in the groove of the cover 5121a of lever 5121.

On no account use a tool here as the gasket is easily damaged.
- Press the seal guide 5124 into the gasket until it meets the stop.
- Place the protective tube 5125 over the cover 5121a and fasten with circlip 5129.
- Push bolt 5103 with the spring cotter 5106 into the bearing bore of lever 5121.
- Push the gasket holding ring 5122 into the gasket. Fasten by engaging the lip in the groove of the ring.
- Fit two studs M 10 × 100 mm into the tapped holes in the base 5010.
- Grease the two cord rings 5105 and 5128 in accordance with 8.4.1, page E-22, and place them on the bearing.
- Push the pre-assembled lever assembly into the hole in the base, making sure that the bolt 5103 with the spring cotter 5106 is situated in the correct position relative to the hole in bearing 5101.
- Now push the lever assembly up onto the two studs. Push two 20 mm thick spacers between the bearing and the gasket holding ring.
- Place one nut M 10 on each of the threaded studs.
- By tightening the nuts, press the entire assembly into the opening in the base until the gasket holding ring is flush with the face of the base.

Tool required: 17 mm spanner

This method of assembly must on all account be employed in order to prevent the lever twisting when being inserted. Subsequent alignment would distort the gasket.
- Remove the spacers and press the assembly right home by tightening up the nuts further.
- Having pressed the assembly up to the flange in the base, replace the two studs by the hex. screws 5109 and the spring washer 5107.

Tool required: torque wrench with 17 mm Allen key insert
Force applied: 21 Nm

7.2.1.2 Assembling the crossbar
- Push the crossbar 5130 through the hole in the lever 5121, at the same time assembling the two spacer tubes 5132 and straps 5131 together with the switchrod 5140.
- Push the damper tube 5135 and spacer tube 5134 on to both ends of the crossbar.
- Fit the straps 5131 together with the switchrod 5140 at both ends, pushing the spacer tube 5133 between the two straps on the crossbar.
- Fit screws 5139 at both ends, together with the spring washers 5137 and the corrugated washers 5136.

Tool required: torque wrench with 19 mm Allen key insert
Force applied: 30 Nm

7.2.2 Reassembling the moving contact
Fig. E4, pages E-37 to E-41

7.2.2.1 Assembling the guide elements of the switchrod
- Push the guide ring 5143 over the switchrod 5141, bend up and fit between the two discs of the switchrod. Check that the guide ring can move easily.
- Place the sealing ring 5144 with the cylindrical compression spring 5145 inserted, together with the washer 5146 on the upper disc of the switchrod.

7.2.2.2 Assembling the guide tube
- Mount the guide tube 5230 above the switchrod 5141 on the base 5010. When pushing the tube over the rod, make sure that the sealing ring 5144 and guide ring 5143 are correctly pushed into the guide tube and lie against the wall.
- Insert screws 5239 and tighten up.

Tool required: torque wrench with 5 mm Allen key insert
Force applied: 4 Nm
- Insert the corrugated washer 5236 and then fit the guide ring 5235 by hand.
7.2.2.3 Assembling the piston
- Fit the piston plate 5241 together with the diaphragm 5248 on the guide tube 5230 and fasten with special screws 5249.
   Tool required: torque wrench with leaf insert No. 5
   Force applied: 2.5 Nm

When assembling ensure that the diaphragm is not squashed. It should be possible to lift it.
- The spiral pressure element 5246 and the ring 5245 should now be inserted in the groove in the piston plate by hand.

For correct position see enlarged sketch Fig. E4 d, page E-39.

7.2.2.4 Assembling the breaking contact
- Mount the breaking contact 5410 on the switchrod 5141.
   Tool required: torque wrench with belt sling
   Force applied: 50 Nm

- Fit the setting screw with cup tip 5429 and tighten up firmly. Secure with Loctite.
   Tool required: 2.5 mm Allen key, long version flat-nose pliers

The tapped hole is visible in the opening in the guide tube, directly beneath the piston plate.

7.2.2.5 Assembling the contact tube
- Screw the nozzle 5432/5433 by hand into the contact tube 5430.
- Now push the contact tube over the piston 5240. Make sure that the ring 5245 in the piston plate is correctly pushed into the contact tube and lies flat against the wall.
- Turn the contact tube so that the through holes and the tapped holes in the auxiliary nozzle of the breaking contact 5410 are in line with one another.
- Fit the screws 5439 together with the washers 5438.
   Tool required: torque wrench with 4 mm Allen key insert, long version
   Force applied: 2.5 Nm

7.2.3 Assembling the extinction chamber tube
- Grease the extinction chamber tube according to para. 8.4.1, page E-22.
- Assemble the guide ring 5225 and the MC contact segments 5220 by hand, by inserting them into the extinction chamber tube.
- Lightly grease the cord ring 5214 according to 8.4.1.
- Now push the extinction chamber tube 5210 on over the contact tube, making sure that the MC control segments and the guide ring fit properly round the contact tube.
- Place the extinction chamber tube 5210 on the base and turn into the correct position. Do not damage the cord ring.

- Screw in the hex. screws 5219 with their washers 5218 by hand but DO NOT tighten them up.

7.2.4 Assembling the fixed contact
- Lightly grease the cord ring 5314 and its groove in the fixed contact according to 8.4.1, page E-22. Place the cord ring in the groove.
- Insert the fixed contact in the correct position in the extinction chamber tube. The guide washer 5315 must slide easily over the nozzle 5432/5433.
- Fasten the fixed contact with the cheese-head screws 5329 and the washers 5328.
   Tool required: torque wrench with 8 mm Allen key insert
   Force applied: 20 Nm

- Now centre the extinction chamber tube 5210 and tighten the hex. screws 5219.
   Tool required: torque wrench with 17 mm Allen key insert
   Force applied: 27 Nm

- Mount the other two fixed contacts onto the remaining extinction chamber tubes in the same way.

7.3 Reassembling the operating mechanism

7.3.1 Reassembling the drive shaft
   Fig. E7 a and Fig. E7 a/1-8, pages E-53 to E-61

- Installing the rocker plate:
  With the aid of a screw (hex. screw M6 x 25) guide the shaft of the rocker plate subassembly 3720 through its bearing in the drive housing, then push it through the first disc 3728, the rocker plate and the second disc 3728 and into the counter-bearing.

- Installing the half-shaft:
  Push the bush 3744 onto the cylindrical part of the half-shaft 3741, with only one hole, so that the flange of the bush points outwards, then push the helical torsion spring 3745 in front of the bush onto the half-shaft.

  Drive one of the spiral dowels 3747 into the half-shaft so that it juts out the same amount at either end.

  Grease the outside of the bush 3743 with Loctite and insert it into the housing according to Fig. E7 a/5.

  Guide the half-shaft through the left hole in the drive housing, through the rocker plate 3748 and the bush 3743.

  Push the helical torsion spring 3746 onto the half-shaft and drive in the second spiral dowel 3747. This should also protrude the same amount at either end.

  Hook the two torsion springs into the spiral dowels. When the springs are relieved the half-shaft should allow the latch of the rocker plate 3721 to drop through. Now secure the rocker plate 3748 to the half-shaft with the spiral dowel 3749.

   Tool required: pin punch 5 mm dia hammer
Installing the torsion spring shaft:

Insert the grooved pin 3731 into the drive housing. Hook in both torsion springs 3732 and 3733 as shown in Fig. E7 a/s and push the grooved pin through them. Place the locking plate 3736 in the groove of the pin and secure with hex. screw 3739 and spring washer 3737.

Tool: torque wrench with 7 mm Allen key insert
Force applied: 2.5 Nm

Installing the spiral springs in the spring drum:
For lubrication of the spiral springs see 8.4.3.2, page E.22. Position the spring drum with the opening uppermost. Place the first spiral spring 3352 in the spring drum so that the spiral runs clockwise from inside to outside and the upright lugs on the periphery engage in the groove in the inner surface. Then place the disc 3354 into the spring drum.

Installing the drive shaft:

Insert the bronze bearing 3365 from inside into the bearing bore.

Insert the drive shaft 3310 with the two-hole end first, and with the milled slot uppermost, into the drive housing.

Push the cam assembly—comprising the cam left 3703, cam right 3702 and the stop disc 3705—onto the drive shaft so that the slot is positioned on the left above the hex. shaft.

Screw the slide nut 3202 onto the slide piece 3201 so that the distance between the beginning of the thread on the slide piece and flange of the slide nut is 41 mm. Then push the slide nut with the driver opening over the hex. shaft onto the drive shaft.

Place the driver 3203 on the slide piece.

Insert the bronze bearing ring 3356 into the hole in the spiral drum.

Push the fitted spring drum onto the drive shaft and hook the spiral springs into the milled slot.

Fit the bronze bearing 3321 and, if necessary, the disc 3322, and then the flange 3320. Secure the flange with three hex. screws 3329 and spring washers 3327.

Tool required: torque wrench with 7 mm Allen key insert
Force applied: 2.5 Nm

Fit the axial bearing—comprising the disc 3315, two axial discs 3317 and the axial cage 3316. Fill in the space between the axial bearing and the locking ring 3319 with packing discs 3318.

Tool required: circlip pliers A 19, straight version

By varying the thickness of the discs 3322 and 3318 move the toothing of the spring drum to the centre under the worm gear 3451. The overall axial play in the drive shaft should be as small as possible.

Setting the rocker plate:
The rocker plate must be positioned in the centre between the cam discs. Adjust the rocker plate by varying the thickness of the discs 3728.

Turn the rocker plate until the spiral dowel 3729 can be inserted into the bearing hole provided and the through-hole in the shaft. Drive in the spiral dowel and remove the screw used as an aid.

Tool required: pin punch 5 mm dia hammer 10 mm spanner

Reassembling the cam:
Fit the strap 3221 onto the cam 3361 and secure with locking ring 3224.

Tool required: circlip pliers A 19 straight version

Fit the cam with the mark opposite the milled slot in the drive shaft 3310.

Fasten the cam with the spiral dowel 3363 and 3364 and secure with wire 3369.

Tool required: pin punch 12 mm dia pin punch 6 mm dia hammer flat nose pliers

Restore the connection between the strap 3221 and rocker plate 3225 and secure with the shaft lock 3229

Tool required: screwdriver size 4

Installing the drive unit into the plate:

Screw the new adjusting bolts—four 3019 and two 3029—into the plate so that the drive shaft 3310 of the drive unit 3020 is exactly aligned with the two bearing holes in the drive plate. Then screw up the 4 special nuts 3015 or the two cheese-head screws 3022 together with washers 3023 and spring rings 3022. Seal each of these screw connections with a drop of Loctite.

Tool required: 3015 torque wrench with 19 mm Allen key insert 3024 torque wrench with 6 mm Allen key insert
Force applied: 3015 37 Nm 3024 13 Nm

Aid: Loctite

Reverse the plate with the built-in drive unit and screw on the locknuts 3016/3026 together with washers 3018/3028.

Tool required: torque wrench with 19 mm Allen key insert
Force applied: 37 Nm

Assembling the crank plate and the crank cam:
Mount bearing 3345/335 on crank plate 3341 or crank cam 3332

Tool required: copper tube 50/58 dia. hammer

Push the crank plate with the bearing onto the drive shaft, then place the disc 3338 on the drive shaft, secure with spiral dowel 3336 and fasten with locking wire 3339.

Tools required: pin punch 12 dia. pin punch 8 dia. hammer flat nose pliers
- Assembling the auxiliary switch plate: Swivel back the auxiliary switch plate 3801 and secure with the two hex. screws 3809, damper disc 3805, washer 3808 and hex. nuts 3806.

Tools required: screwdriver size 4
10 mm spanner

7.3.2 Reassembling the operating mechanism
Fig. E6 a-d, pages E-47 to E-51

Screw the spring operating mechanism back onto the extinction unit:
- With the aid of a hoist position the spring operating mechanism in front of the base 5108.

Tool required: hoist with bar and sling
- Screw in the four hex. screws 3099 together with the washers 3098 and the spring washers 3097 (see Fig. E3 a, page E-35).

Tool required: torque wrench with
24 mm Allen key insert
and 100 mm extension
Force applied: 110 Nm
- Screw in the two cheese-head screws 3094 with washers 3093 and spring washers 3092 (see Fig. E3 b, page E-35).

Tool required: torque wrench with 10 mm Allen key insert
Force applied: 45 Nm

Couple the extinction unit to the operating mechanism:
- Carry out the tasks detailed in 6.3.2, page E-12, but in reverse sequence.

7.3.3 Filling up with active alumina
Fig. E5 a, page E-43

- Fill the cover 5021 with approx. 300 g active alumina 5025.

Specification: see 11.3, page E-27
- Insert the filter 5024 and the two pressure covers 5022 and 5023 and secure with split pins 5026.

Tool required: flat-nose pliers 120 mm

The mechanism permissible period between opening a bag of active alumina and evacuating the extinction unit is one hour.
The contents of one of these bags should be used within one hour and the remainder disposed of. Once the extinction unit is evacuated the active alumina must only come into contact with SF₆ gas.

7.3.4 Assembling the cover
Fig. E5 a, page E-43

- Lightly grease the cord ring 5029, and its groove in the cover 5021 as per para. 8.4.1, page E-22.
- Push the cover assembly 5020 into the base and secure with the eight hex. screws 5039, the washers 5038 and the spring washers 5037.

Tool required: torque wrench with 15 mm Allen key insert
Force applied: 10 Nm

The maximum permissible period for a delivered cover assembly between removal from the bag and evacuating the extinction unit is two hours.

7.3.5 Filling with SF₆ gas

- Fill the gas compartment with SF₆ gas as per para. 4.4, page E-8.

7.3.6 Charging the spiral spring assembly
Fig. E1, pages E-29 and E-31

After performing the overhaul and maintenance work the spiral spring assembly must be recharged as described in 2.1.1, page E-5.

7.3.7 Functional check

After servicing the functional check is to be carried out in accordance with para. 2.2, page B-10 of the operating instructions.
8. Lubrication

8.1 Lubricants

The following lubricants should be employed:

- for the extinction unit:
  - lubricating oil spec. 2 accord. to 8.2.1
  - lubricating oil L3 accord. to 8.2.2
  - Dow Corning MS 4 accord. to 8.2.5

- for the spring operating mechanism:
  - lubricating grease L3 accord. to 8.2.2
  - Isoflex NBU 15 accord. to 8.2.3
  - Molybdenum sulfide spray accord. to 8.2.4

8.2 Lubricant specifications

8.2.1. Lubricating oil spec. 2

<table>
<thead>
<tr>
<th>Definition</th>
<th>Lubricant spec. 2 is a mixture of 5 vol % lubricating oil 4 and 95 vol % lubricating oil spec. 6*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity</td>
<td>at 20 °C: 665 to 870 kg/m³</td>
</tr>
<tr>
<td>Solidification point</td>
<td>&lt; -40 °C</td>
</tr>
<tr>
<td>Flashpoint</td>
<td>&gt; +150 °C</td>
</tr>
<tr>
<td>(acc. to Pensky-Martens)</td>
<td></td>
</tr>
<tr>
<td>Kin. viscosity</td>
<td>at +40 °C accord. ISO: approx. 10 mm²/s</td>
</tr>
<tr>
<td>BBC part. No.</td>
<td>NBT 402604 Pl</td>
</tr>
<tr>
<td>Packaging</td>
<td>in 200 g tin cans</td>
</tr>
</tbody>
</table>

* Lubricant spec. 4 is a dispersion of 10% colloidal graphite in oil. The flaky particles of colloidal graphite are smaller than 1 μm.
Lubricant spec. 6 is a pure mineral oil without any other admixture.

8.2.2 Lubricating grease L3

<table>
<thead>
<tr>
<th>Definition</th>
<th>L3 is a mineral grease with high mechanical stability and shearing resistance based on lithium stearate or lithium olestearate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>Lithium soap and mineral oil</td>
</tr>
<tr>
<td>Appearance</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>Colour</td>
<td>Not characteristic</td>
</tr>
<tr>
<td>Drop point</td>
<td>≥ 150 °C</td>
</tr>
<tr>
<td>Pour point</td>
<td>≥ 150 °C</td>
</tr>
<tr>
<td>Permissible working temp.</td>
<td>-30 to +100 °C</td>
</tr>
<tr>
<td>Penetration unworked</td>
<td>265 to 295 × 0.1 mm</td>
</tr>
<tr>
<td>Special characteristics</td>
<td>High water resistance, free from abrasive components, No uncombined water</td>
</tr>
<tr>
<td>BBC part. No.</td>
<td>HAGT 556 460 R1</td>
</tr>
<tr>
<td>Packaging</td>
<td>in 250 g tubes</td>
</tr>
<tr>
<td>Only permissible brands</td>
<td>Alvania Grease R2 (Shell Code No. 65725)</td>
</tr>
<tr>
<td>Supplier</td>
<td>Shell</td>
</tr>
</tbody>
</table>

Attention: In the light of long-time tests over a period of years the manufacturers can guarantee faultless operation of their breakers only if they are lubricated with the above grease. It is absolutely essential for the code No. to be stated in orders so as to ensure that the above tried and tested lubricants be supplied.
### 8.2.3 Isoflex NBU 15

<table>
<thead>
<tr>
<th>Definition</th>
<th>This lubricant is a synthetic grease based on a special thickener</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>Thickener and synthetic oil</td>
</tr>
<tr>
<td>Appearance</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>Colour</td>
<td>Light brown</td>
</tr>
<tr>
<td>Drop point</td>
<td>&gt; 200 °C</td>
</tr>
<tr>
<td>Permissible working temp.</td>
<td>-60 to +130 °C</td>
</tr>
<tr>
<td>Penetration unworked</td>
<td>265 to 295 × 0.1 mm</td>
</tr>
<tr>
<td>Special characteristics</td>
<td>Resistant to boiling water and steam</td>
</tr>
<tr>
<td>Packing</td>
<td>In 1 kg tins</td>
</tr>
<tr>
<td>Only permissible brands</td>
<td>PRO AA2</td>
</tr>
<tr>
<td>Supplier</td>
<td>Klöber Lubrication</td>
</tr>
</tbody>
</table>

### 8.2.4 Molybdenum disulphide spray

<table>
<thead>
<tr>
<th>Definition</th>
<th>Molybdenum disulphide spray consists of a highly effective, solid lubricant, e.p. additive and active adhesive components and molybdenum disulphide powder in a solvent, which evaporated completely after application.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>Bitumen, mineraloil and additives</td>
</tr>
<tr>
<td>Appearance</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>Colour</td>
<td>Black</td>
</tr>
<tr>
<td>Drop point</td>
<td>Approx. 150 °C</td>
</tr>
<tr>
<td>Specific weight</td>
<td></td>
</tr>
<tr>
<td>Permissible working temp.</td>
<td>-30 to +130 °C</td>
</tr>
<tr>
<td>Penetration, worked</td>
<td>Approx. 300 × 0.1 mm</td>
</tr>
<tr>
<td>Special characteristics</td>
<td>max. water resistance</td>
</tr>
<tr>
<td>Packing</td>
<td>In approx. 500 g (10 g) spray cans</td>
</tr>
<tr>
<td>Only permissible brands</td>
<td>Molybute spray 3694</td>
</tr>
<tr>
<td>Supplier</td>
<td>Molybute</td>
</tr>
</tbody>
</table>

### 8.2.5 Dow Corning MS 4 silicone compound

<table>
<thead>
<tr>
<th>Definition</th>
<th>An inert, vaseline type paste on a silicone base with water resistance and dielectric characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>Thickener and silicone oil</td>
</tr>
<tr>
<td>Appearance</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>Colour</td>
<td>Light gray, translucent</td>
</tr>
<tr>
<td>Drop point</td>
<td>Without</td>
</tr>
<tr>
<td>Pour point</td>
<td>Without</td>
</tr>
<tr>
<td>Permissible working temp.</td>
<td>-50 to +200 °C</td>
</tr>
<tr>
<td>Penetration, unworked</td>
<td>205 × 0.1 mm</td>
</tr>
<tr>
<td>Penetration, worked</td>
<td>250 × 0.1 mm</td>
</tr>
<tr>
<td>Special characteristics</td>
<td>High water resistance; non melting; good electrical insulating properties</td>
</tr>
<tr>
<td>Packaging</td>
<td>In approx. 50 and 200 g tubes</td>
</tr>
<tr>
<td>Application</td>
<td>Direct from the tube, with grease gun, with brush or cloth</td>
</tr>
<tr>
<td>Only permissible brand</td>
<td>Dow Corning MS 4 silicone compound</td>
</tr>
<tr>
<td>Supplier</td>
<td>Dow Corning</td>
</tr>
</tbody>
</table>
8.3 Acceptable brands and suppliers

<table>
<thead>
<tr>
<th>Lubricating oil spec. 2</th>
<th>BBC</th>
<th>BBC part. No. NBT 402604 PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lubricating oil spec. 4</td>
<td>Acheson Colloids Ltd., Prince Rock/Plymouth G.B.</td>
<td>Oildag colloidal graphite in oil</td>
</tr>
<tr>
<td>Lubricating oil spec. 6</td>
<td>Shell Esso BP</td>
<td>Carneia 19 (ISO) – (ex 21) Coray 22 (ISO) Energol EM 22 (ISO)</td>
</tr>
<tr>
<td>Lubricating grease L3</td>
<td>Shell</td>
<td>Alvania Grease R2 Shell Code No. 65725</td>
</tr>
<tr>
<td>Isoflex NBU 15</td>
<td>Klüber Lubricant</td>
<td>Isoflex NBU 15</td>
</tr>
<tr>
<td>Dow Corning MS 4</td>
<td>Dow Corning</td>
<td>Dow Corning MS 4 Silicone Comp.</td>
</tr>
<tr>
<td>MoS2 spray</td>
<td>Molykote</td>
<td>Molykote 3694</td>
</tr>
</tbody>
</table>

Where lubricants are obtained from other suppliers, the details contained in the individual lubricant specifications apply in accordance with Section 8.2, page E-20, and not the equivalent product lists of the lubricant suppliers.

8.4 Lubrication schedule

8.4.1 Greasing seal and contact surfaces

The surfaces of the parts mentioned below must be coated with a thin film of grease on reassembly and the grease well rubbed in. Superfluous grease must be wiped off with a rag, so that only a thin film of grease remains.

Lubricant: Lubricating grease L3 see para. 8.2.3, page E-21
Lubricating aids: see para. 8.3, page E-24

8.4.1.1 Cord rings

All cord rings just before their assembly.

8.4.1.2 Base
- The bearing surface for the extinction chamber tube 5210.
- The bearing surface for the cover 5021.

8.4.1.3 Extinction chamber tube
- The groove for the cord ring 5214.
- The bearing surface towards the base 5010.
- An approx. 30 mm wide strip on the inner surface on the fixed contact side.

8.4.1.4 Fixed contact
- The groove for the cord ring 5314.

8.4.2 Extinction unit

The lubricants to be used are specified in 8.2, page E-20.
- Just before assembly treat the bulge of the seal 5123 as follows:
  - Coat the inner surface with a 0.5 mm uniform layer of grease.
  - Lightly grease the outside of the two bulges.

Lubricant: Dow Corning MS 4 compound see 8.2.5, page E-21

Also lightly grease the following:
- The contact ring formed by the mounted contact fingers.
- The contact tube. Rub grease into the contact surfaces and then carefully wipe off the latter with a rag so that only a thin film of grease remains.
- All other bearing points in the SF6 atmosphere.

Lubricant: lubricating grease L3, see 8.2.2, page E-20

Also oil:
- All bearing points in the air atmosphere.

Lubricant: lubricating oil spec. 2, see 8.2.1, page E-20

8.4.3 Spring assembly

8.4.3.1 During maintenance

- The following parts contained in the spring assembly should be sprayed:
  - Latches
  - Support shafts
  - Slide surfaces
  - Pivot bearing points
  - Worm gear
  - Chain drive

Lubricant: Molykote spray see 8.2.4, page E-21

8.4.3.2 During overhaul

- The following parts contained in the spring operating mechanism should be lightly greased:
  - Latches
  - Support shafts
  - Slide surfaces
  - Pivot bearing points

Lubricant: Lubricating grease L3 see 8.2.2, page E-20

- Coat the worm gear and the chain drive with grease. Remove superfluous grease to prevent the drive from being soiled.

Lubricant: Isoflex NBU 15 see 8.2.3, page E-21
9. Cleaning

9.1 Cleaning aids

The following cleaning aids are recommended for cleaning the components of the circuit-breaker during servicing:

- Trichlorethene according to specification para. 9.2.1, page E-23
- Ethanol F25M according to specification para. 9.2.2, page E-23
- Scouring powder in accordance with specification para. 9.2.3, page E-23

A conventional industrial soap is recommended for washing the outer plastic surfaces.

9.2 Specifications of cleaning agents

9.2.1 Trichlorethene

| Definition | 1.1.1-Trichlorethene (CCl₃-CH₂) is a non-combustible, chlorinated hydrocarbon with a relatively high maximum admissible concentration value |
| Density at 20 °C | 1.320 g/cm³ |
| Appearance | Colourless, clear liquid |
| Boiling point °C/1 bar | 74 |
| Boiling range °C/1 bar | 74 to 75 |
| Freezing point °C | approx. -31 |
| Odour threshold | < 100 ppm |
| Max. adm. concentration | 200 ppm (cm³/m³) or 1080 mg/m³ |
| Toxicity class | 5 (DL₅₀ 5000 to 15000 mg/kg) |
| BBC part. No. | NBT 402547 P.. |
| Note | Use in accordance with the maker’s instructions. |

9.2.2 Ethanol F25M

| Definition | Ethanol F25M is a 96 vol % ethyl-alcohol denatured by the addition of 5% methanol |
| Density at 20 °C | 0.812 g/cm³ |
| Appearance | Colourless, clear liquid |
| Boiling point °C/1 bar | 78 |
| Boiling range °C/1 bar | — — |
| Freezing point °C | -114 |
| Flashpoint °C | +18 |
| Odour threshold | 350 ppm |
| Max. adm. concentration | 1000 ppm |
| Toxicity class | 5 (DL₅₀ 5000 to 15000 mg/kg) |
| BBC part. No. | NBT 402777 P1 |
| Note | Use in accordance with the maker’s instructions. |

9.2.3 Scouring powder

The scouring powder must be a sand-free cleaning agent containing quartz powder.

| Composition | Quartz flour 75 |
| Phosphate 13 |
| Pure soap 2 |
| Soda 5 |
| Tenside 5 |
| Special requirements | Only components ground to extreme fineness (< 1 µm) |
| BBC part. No. | WMN 400397 P2 |
| Packaging | 500 g perforated box |
9.3 Cleaning cloths

<table>
<thead>
<tr>
<th>Definition</th>
<th>Materials of textile, woven or nonwoven, or of tanned chamois leather for cleaning, drying or greasing components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Natural and synthetic fibres or chamois leather</td>
</tr>
<tr>
<td>Requirements</td>
<td>These materials must:</td>
</tr>
<tr>
<td></td>
<td>- be non-fluffing</td>
</tr>
<tr>
<td></td>
<td>- contain no aggressive chemical compounds</td>
</tr>
<tr>
<td></td>
<td>Woven cloths must exhibit a continuous selvedge all round.</td>
</tr>
<tr>
<td>BBC part. No.</td>
<td>Linen cloths WMN 400399 P1 or P11</td>
</tr>
<tr>
<td></td>
<td>Nonwoven textile (Polltex 333) WMN 400399 P9</td>
</tr>
<tr>
<td></td>
<td>Chamois leather NBT 400395 P1</td>
</tr>
<tr>
<td>Note</td>
<td>Soiled cloths must not be used again.</td>
</tr>
</tbody>
</table>

9.4. Cleaning procedure

The specifications of the cleaning aids for performing the cleaning work are entered under para. 9.2, page E-23.

9.4.1 Parts outside the gas compartment

- Metal parts
  
  Place the parts to be cleaned in a bath with a cleaning agent and, after approx. 5 to 10 min brush them thoroughly, removing all residue.
  
  After this cleaning operation dry the parts with a clean rag and place them on a clean surface (cloth or paper) to protect against dust.

- Non-metal parts
  
  Thoroughly rub these parts clean with a clean rag moistened with cleaning fluid until all dirt is completely removed.
  
  Keep in a clean place as described above.

9.4.2 Parts inside the gas compartment

Certain demands are made on the SF₆ gas and on the insulating and switching rod components with regard to insulating strength.

Care should be taken when performing work on the open, dismantled circuit-breaker to ensure that all parts coming into contact with SF₆ gas are kept dry and clean (use clean gloves).

Between the successive dismantling phases the switching dust should be removed using a vacuum cleaner with a paper filter. As soon as switching dust is visible, it is advisable to wear a dust mask.

- Metal parts
  
  Cleaning is to be performed in accordance with para. 9.4.1.

- Non-metal parts
  
  These parts, unless they are to be replaced, must be cleaned immediately after dismantling with a brush and domestic cleaning powder under running water. They must not be immersed in water. After washing, dry the parts and store them in a dry place until they are reinstalled.
List of tools and materials

10.1 Devices for replenishing the gas in the SF₆ compartment (as required):

1a SF₆ service truck in accordance with publication CH-A 424 336 E  Type ELK ZD

1b SF₆ maintenance truck in accordance with publication CH-A195286 E  Type SK-304

1c Gas tank containing approx. 5 kg gas
  with Pressure reducing valve, filling hose and lever plus connection  B.V. No. 5095
  B.V. No. 5096

1d Transportable vacuum pump with vacuum pressure gauge, connecting hose and lever plus connection  B.V. No. 5091

1e Plastic hose, inside diameter 8 mm, length as required
  with Lever plus connection  B.V. No. 5093
  B.V. No. 5094

10.2 Special tools

1 Puller for fixed contact  0053/1
  see Fig. E10 a

2 Lifting device for contact fingers  0053/2
  see Fig. E10 b

3 Special pipe spanner for contact studs  0053/3
  see Fig. E10 c

10.3 Tools

1 Set of torque wrench comprising:
  Torque wrenches  range 0–150 Nm
  Ratchet  range 0–10 Nm
  Torque screw drivers  50–250 mm
  Extensions
  Universal joint
  Allen key inserts  4–19 mm
  Hexagon inserts  5–32 mm
  Screwdriver inserts  size 3–5
  Allen key insert  27
  Allen key inserts, long version  2.5–4
  Set Allen keys  4–19
  Set open-end ring spanners  5–32
  Allen key, long version  2.5–4
  Box spanner  27 × 175 mm
  Torque wrench with belt sling
  Belt spanner
  Set screwdrivers  size 00–5
  Set pin punches  dia. 2.5–12
  Hammer  200 g
  Flat-nose pliers with side cutter  size 120 mm
  Circlip pliers, straight  A 19
  Extractor pliers

10.4 Auxiliary materials (recommended)

Absorption agent in bags or sacks
See 11.2, page E-27

Gas burner with liquid gas tank, small model
Hand brush
Plastic or rubber gloves
 for 500 kg approx. dia. 45 × 1000 mm
Holst with bar and rope
Copper tube approx. dia. 56/50 × 150 mm
Loctite 0241
Cleaning cloths
Sacks or hose of plastic
with sealing device
Vice with jaw chucks of soft metal
Safety glasses, if necessary
Dust mask, if necessary
Vacuum cleaner with paper bags of filter material

jaw width approx. 250 mm

E-25
### Additional specifications

#### 11.1 Sulphur hexafluoride (SF₆)

<table>
<thead>
<tr>
<th>Definition</th>
<th>Sulphur hexafluoride is a colourless, non-combustible, non-toxic, low-reactive insulating and quenching gas</th>
</tr>
</thead>
</table>
| Composition | - SF₆: 99 Mass %  
- O₂: 500 ppm (mg/kg)  
- CF: 500 ppm (mg/kg)  
- S₂F₁₀: 0.02 ppm (mg/kg)  
- SO₂: 1 ppm (mg/kg)  
- H₂O: 15 ppm (mg/kg)  
- uncombined H₂F₂ and fluorides suitable for hydrolysing: 1.3 ppm (mg/kg) |

| Specific thermal capacity Cₜ (acc. to ISO) | 669 J/kg °C  
0.160 kcal/kg °C |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sublimation temperature at 760 torr</td>
<td>- 63.8 °C</td>
</tr>
<tr>
<td>Critical temperature</td>
<td>45.55 °C</td>
</tr>
<tr>
<td>Freezing point (2.29 bar)</td>
<td>- 50.8 °C</td>
</tr>
<tr>
<td>Steam pressure</td>
<td></td>
</tr>
</tbody>
</table>
- at 0 °C: 12.54 bar  
- at 20 °C: 21.02 bar  
- at 40 °C: 33.09 bar |
| BBC part. No. |  
- Steel tank containing 40 kg gas: B.V. No. 5097  
- Steel tank containing 5 kg gas: B.V. No. 5096  
- Pressure reducing valve for SF₆: B.V. No. 5096  
- Filling hose and lever plug connection: B.V. No. 5096 |
| Gas manufacturer |  
- Montecatini S.p.A.: Milan/Italy  
- Allied-Chemical & Dye Corp.: New York/USA  
- Prodelec S.A.: Coursbevoie/France |
| Precaution | Sulphur hexafluoride is non-toxic but by displacing the air it can lead to a shortage of oxygen. Use only well-ventilated rooms. Avoid inhaling gas which has been decomposed by electrical discharge or thermally. |

Sulphur hexafluoride is supplied in liquid form in steel cylinders of 5, 10, 20, 40, 80, and 450 kg capacity.

The size of the valve screw connector is W 21.80 x 1/14" and is therefore the same size as the connectors for carbon dioxide, for which the same fittings can be used.

A steel cylinder with about 40 kg of SF₆ gas should always be held in reserve.
### 11.2 Absorbents

#### 11.2.1 Blue gel 1

| Definition | Blue gel 1 is a nearly anhydrous colloidal silicic acid with a relatively loose pore structure and containing a cobalt compound by way of moisture indicator in the form of a blue, granular substance with a high absorption capacity for gases, vapours and liquids. Following absorption of moisture the colour changes from blue to pink. It is neither combustible nor aggressive. |
| Absorption capacity at 20 °C and 1 bar | at 20% relative humidity approx. 8 mass% | at 40% relative humidity approx. 16 mass% |
| | at 60% relative humidity approx. 27 mass% | at 80% relative humidity approx. 39 mass% |
| Grain size | 2-5 mm |
| Hardness according to Mohs | approx. 4.5 |
| Regeneration | Steam saturated blue gel 1 can be fully regenerated by heating to about 120 °C-180 °C. The drying process is indicated by a colour change from pink to blue. At 500 °C the porous structure is destroyed and the substance becomes non-absorbent. |
| BBC part. No. | B.V. No. 5291 |

#### 11.2.2 Silica gel

| Definition | Silica gel is a nearly anhydrous colloidal silicic acid with a relatively loose pore structure. It is a white, granular substance with a high absorption capacity for gases, vapours and liquids. It has the same features as blue gel 1 but does not change its colour as a result of moisture absorption. |
| BBC part. No. | B.V. No. 5292 |

### 11.3 Activated alumina

#### Definition:
Activated alumina is partly dehydrated aluminium hydroxide in the form of pellets (2-5 mm diameter), whose general composition is given by the formula Al₂O₃·0.2 - 0.6 H₂O.

#### Application:
Drying the SF₆ gas and removing acid products of the decomposition of SF₆, by absorption.

<table>
<thead>
<tr>
<th>Term</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition when dried at 300° C</td>
<td>% by weight</td>
<td>≥ 92</td>
</tr>
<tr>
<td>- Al₂O₃</td>
<td>ppm</td>
<td>≤ 120</td>
</tr>
<tr>
<td>- Si</td>
<td>% by weight</td>
<td>≤ 0.5</td>
</tr>
<tr>
<td>- Soluble Na₂O</td>
<td>% by weight</td>
<td>≤ 0.7</td>
</tr>
<tr>
<td>Bulk density</td>
<td>kg/l</td>
<td>0.7-0.85</td>
</tr>
<tr>
<td>Special characteristics</td>
<td>- - -</td>
<td>The activated alumina must be free from foreign substance, such as sand, paper and wood chips, metal filings, etc.</td>
</tr>
<tr>
<td>Internal surface</td>
<td>m²/g</td>
<td>320 to 350</td>
</tr>
<tr>
<td>Resistance to wear (abrasion) in state as delivered</td>
<td>% by weight</td>
<td>≤ 0.3</td>
</tr>
<tr>
<td>Residue on heating to 1000° C based on the product dried at 300° C</td>
<td>% by weight</td>
<td>≥ 95</td>
</tr>
<tr>
<td>Purity of the product dried at 300° C</td>
<td>% by weight</td>
<td>≥ 92</td>
</tr>
<tr>
<td>Moisture absorption per 100 g alumina at 25° C</td>
<td>g</td>
<td>≥ 21</td>
</tr>
<tr>
<td>Packaging</td>
<td>- - -</td>
<td>P1: in metal drums holding 60 or 56 litres, containing 50 kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P2: in 200 litres metal drums containing 150 kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P3: in metal cans containing 6 kg</td>
</tr>
<tr>
<td>BBC part. No.</td>
<td>B.V. No. 5025</td>
<td></td>
</tr>
</tbody>
</table>
Fig. E1 a
Demontieren des Kettentriebes
Dismantling the chain drive
Démontage de la transmission par chaîne

Fig. E1 b
Demontieren des Kettentriebes
[Einsatz - Einlegen vom Holzstück in der Schaltstellung EIN]
Dismantling the chain drive
[showing the insertion of the wooden block in the closed position of the breaker]
Demontage de la transmission par chaîne
[mise en place d’une cale en bois le disjoncteur étant «FERMÉ»]
Summenstromgrenzkurven für die Bestimmung des Service-Intervalls, dargestellt im Verhältnis zu der Höhe des Ausschaltstromes und der Anzahl Schaltspiele. Die im Diagramm erwähnten Werte sind Richtwerte.
Cumulative limit current curve for determining the required servicing frequency, in terms of breaking current and number of switching cycles. All graph values are approximate.
Courbe de détermination des échéances de révision, en fonction de la somme des courants coupés, résultant de la valeur du courant et du nombre de manoeuvres. Valeurs approximatives.

Zeitplan für die Durchführung von Service-Arbeiten
Servicing schedule
Périodicité des contrôles, des entretiens et des révisions

Fig. E2
### Fig. E4 a

Fig. E4 a
Demontage des Festkontaktes
Dismantling the fixed contact
Démontage du contact fixe

### Fig. E4 b/4

Fig. E4 b/4
Anordnung der Kontaktfinger
Arrangement of the contact fingers
Disposition des doigts de contact

### Fig. E4 b/1...3

Fig. E4 b/1...3
Demontage der Kontaktfinger
Dismantling the contact fingers
Démontage des doigts de contact

---

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<tr>
<th>Pos.</th>
<th>Bezeichnung</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5300</td>
<td>Festkontakt</td>
<td>Contact fixe</td>
</tr>
<tr>
<td>5311</td>
<td>Deckel</td>
<td>Couver</td>
</tr>
<tr>
<td>5314</td>
<td>Rundschlitzring</td>
<td>Joint torique</td>
</tr>
<tr>
<td>5315</td>
<td>Führungsscheibe</td>
<td>Disque de guidage</td>
</tr>
<tr>
<td>5317</td>
<td>Führungsscheibe</td>
<td>Disque en métal léger</td>
</tr>
<tr>
<td>5321</td>
<td>Kahlblech</td>
<td>Allètes de refroidissement</td>
</tr>
<tr>
<td>5327</td>
<td>Sprungring</td>
<td>Jonc</td>
</tr>
<tr>
<td>5328</td>
<td>Unterlegscheibe</td>
<td>Rondelle</td>
</tr>
<tr>
<td>5329</td>
<td>Zylinderschraube</td>
<td>Vis à tête cylindrique</td>
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<tr>
<td>5330</td>
<td>Kontaktbolzen</td>
<td>Contact</td>
</tr>
<tr>
<td>5340</td>
<td>Unterbaugruppe Fingerkorb</td>
<td>Ensemble de la cage des doigts</td>
</tr>
<tr>
<td>5341</td>
<td>Fingerkorb</td>
<td>Cage des doigts</td>
</tr>
<tr>
<td>5345</td>
<td>Kontaktfinger</td>
<td>Doigt de contact</td>
</tr>
</tbody>
</table>
**Fig. E4 c**

Demontage des Löschkammerrohres
Dismantling the extinction chamber tube
Démontage du tube pôle

**Fig. E4 d**

Demontage des beweglichen Kontakts
Dismantling the moving contact
Démontage du contact mobile

**Fig. E4 c/1**

Unterbaugruppe Kolben
Piston subassembly
Ensemble du piston

**Fig. E4 d/1**

Führungsröhren-Dichtung
Guide tube gasket
Joint du tube de guidage

**Fig. E4**

Arbeitsbeschreibung des Service
Démonstraion der Löscheinheit
Working description of servicing
Dismantling the extinction unit
Travaux d'entretien
Démontage du groupe de coupure
Fig. E4 e
Anordnung der SF₆-Gas-Anfüllrichtung
Layout of the SF₆ filler device
Disposition des dispositifs de remplissage pour le gaz SF₆

Fig. E4 f
Anordnung der SF₆-Gas-Drucküberwachungseinrichtung
Layout of the SF₆ pressure monitor
Disposition des organes de contrôle de la pression du gaz SF₆

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Bezeichnung</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5040</td>
<td>Ventilbau</td>
<td>Valve assembly</td>
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<td>5041</td>
<td>Befestigungsblick</td>
<td>Mounting plate</td>
</tr>
<tr>
<td>5042</td>
<td>Gasinfüllventil</td>
<td>Gas filter valve</td>
</tr>
<tr>
<td>5043</td>
<td>Ventilverlängerung</td>
<td>Valve extension</td>
</tr>
<tr>
<td>5044</td>
<td>Abdeck scheibe</td>
<td>Cover plate</td>
</tr>
<tr>
<td>5046</td>
<td>Sechskantschraube</td>
<td>Hex. nut</td>
</tr>
<tr>
<td>5047</td>
<td>Federdichtung</td>
<td>Spring washer</td>
</tr>
<tr>
<td>5048</td>
<td>Senkschraube</td>
<td>Countersunk screw</td>
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<tr>
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<td>Manometer</td>
<td>Pressure gauge</td>
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<td>5052</td>
<td>Manometerverlängerung</td>
<td>Pressure gauge extension</td>
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<td>Manometervermessung</td>
<td>Pressure gauge union</td>
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<td>Dichtung</td>
<td>Gasket</td>
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<tr>
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<td>Dichtung</td>
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<td>5066</td>
<td>Verbindungsstück</td>
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<tr>
<td>5069</td>
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<td>Tapped tube</td>
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</table>

Arbeitsbeschaffung des Service
Demontage des Antriebs
Working description of servicing
Dismantling the drive
Travaux d'entretien
Démontage de la commande
<table>
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<tr>
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<th>Designation</th>
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<td>5010</td>
<td>Base</td>
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<td>Unterbaugruppe Deckel</td>
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<td>Cover subassembly</td>
</tr>
<tr>
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<td>Deckel</td>
<td>5021</td>
<td>Cover</td>
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<td>Aktive Tonerde</td>
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<td>Active alumina</td>
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**Fig. E5 a**

Demontage der Übertragung  
Démontage de la transmission
Fig. E5 b
Demontage des Antriebshebels
Démontage de l'opérateur
Démontage du levier

Fig. E5
Arbeitbeschreibung des Service
Démontage der LÖSCHeinheit
Working description of servicing
Dismantling the extinction unit
Travaux d'entretien
Démontage du groupe de coupure
Fig. E6 b/1...3
Springs and snap lock
Fixation des ressorts et des bielles

Fig. E6 a
Demontage der Hilfs traverse
Dismantling the auxiliary crossbar
Demontage de la traverse auxiliaire

Fig. E6
Arbeitsbeschreibung des Service
Demontage des Antriebs
Working description of servicing
Dismantling the operating mechanism
Travaux d'entretien
Demontage de la commande
Fig. E6 c/1
Anordnung der SF₆-Gas-Antifalleinrichtung
Layout of SF₆ filter device
Disposition des dispositifs de remplissage pour le gaz SF₆

Fig. E6 c/2
Anordnung der SF₆-Gas-Drucküberwachungseinrichtung
Layout of SF₆ pressure monitor
Disposition des organes de contrôle de la pression du gaz SF₆

Fig. E6 c/3
Anbau des elektrischen Druckwächters
Electrical pressure monitor
Montage du pressostat électrique

Arbeitsbeschreibung des Service
Demontage des Antriebs
Working description of servicing
Dismantling the operating mechanism
Travaux d'entretien
Démontage de la commande
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**Fig. E6 d/1...4**

Befestigung der Schläuche für Anfüllen und für Druckmessung des SF6-Gases sowie der elektrischen Verbindungsleitungen des elektrischen Druckwächters

Securing the hoses for filling and for pressure metering of the SF6 gas and the electric leads to the electrical pressure monitor

Fixation des conduites pour le remplissage en gaz SF6 tout comme celle des câbles électriques du pressostat

Arbeitsbeschreibung des Service
Demontage des Antriebs
Working description of servicing
Dismantling the operating mechanism
Travaux d'entretien
Démontage de la commande
Fig. E7 a
Dismantling the drive shaft
Démontage de l'arbre d'entraînement

Arbeitsbeschreibung des Service
Working description of servicing
Dismantling the operating mechanism
Travaux d'entretien
Démontage de la commande

Fig. E7
**Fig. E7 a/1 + 2**  
Dismantling the drive unit  
Démontage de l'entraînement

**Fig. E7 a/3**  
Dismantling the axial bearing on the drive shaft  
Démontage de la butée de l'arbre d'entraînement

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Arbeitsbeschreibung des Service  
Démontage des Antriebs  
Working description of servicing  
Dismantling the operating mechanism  
Travaux d'entretien  
Démontage de la commande

Fig. E7

E-55
Fig. E7 a/4
Demontage der Federtrommel
Dismantling the spring drum
Démontage du tambour à ressorts

Arbeitsbeschreibung des Service
Demontage des Antriebs
Working description of servicing
Dismantling the operating mechanism
Travaux d'entretien
Démontage de la commande
Fig. E7 a/5 + 6
Demontage der Stützkurbel
Dismantling the rocker plate
Démontage du levier d'appui
Fig. E7 a/7
Démontage des Hilfschalterplatten
Dismantling the auxiliary switch plate

Fig. E7 a/8
Detail Zylinderschraube
Détail de la vis à tête cylindrique
Fig. E7 b
Auswechseln der Kohlenbürsten des Antriebsmotors
Replacing the carbon brushes of the drive motor
Remplacement des balais de charbon du moteur

Fig. E7 c/2
Brems Scheibe – Frontansicht
Brake cleat – front view
Collier de freinage – vue frontale

Fig. E7 c
Justieren der Brems scheibe
Adjusting the brake cleat
Réglage du collier de freinage

Fig. E7 c/1
Brems scheibe – Seitenansicht
Brake cleat – side view
Collier de freinage – vue latérale
Fig. E7 d/1
Antrieb – Lagerblock – Frontansicht
Operating mechanism – bearing block – front view
Commande – paliers – vue frontale

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Fig. E7 d/2
Antrieb – Lagerblock – Seitenansicht
Operating mechanism – bearing block – side
Commande – paliers – vue latérale

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Fig. E7 d
Auswechseln der Arbeitsstromauslöser und des
Ruhestromauslöser für das Sperren
Replacing the operating current trips and the quiescent
current trip for the blocking system
Remplacement de la bobine de déclenchement
à émission de courant et de la bobine de déclenchement
à manque de tension de verrouillage

Arbeitsbeschreibung des Service
Demontage des Antriebs
Working description of servicing
Dismantling the operating mechanism
Travaux d’entretien
Démontage de la commande

Fig. E7
Fig. E10 a
Abziehvorrähtung für Festkontakt
Puller for fixed contact
Dispositif de démontage pour le contact fixe

Fig. E10 b
Abhebevorrichtung für Kontaktfinger
Lifting device for contact fingers
Dispositif de soulèvement pour doigts de contact

Fig. E10 c
Spezialrohrschlüssel für Kontaktbolzen
Special box spanner for contact studs
Clef à tube spéciale pour contact
## Contents

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### Definitions

**Wearing components:**

Wearing components are parts which require replacement at regular intervals depending on the mechanical and electrical loads to which they are subjected.

**Replacement parts:**

Replacement parts require changing at scheduled routine servicing intervals to ensure reliable operation of the equipment until the next overhaul.

**Spare parts:**

Spare parts are not required for scheduled routine servicing but should be held in stock.

### Order data

To facilitate execution of your order please furnish the following particulars:

- Object for which the parts are required: SF₆ circuit-breaker
- Type designation: e.g. HC 24,25,25
- Works serial number: e.g. 1-307 537
- Quantity required: e.g. 3
- Part designation: e.g. Contact tube
- Identification No.: HAMT 401 915 R1
- Item No.: 5420
- Number of overhaul manual: CH-A 269 276
## Spring operating mechanism KHC
### Wearing parts

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2. Item as per overhaul instructions
## Spring operating mechanism KHC
### Spare parts

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### Extinction unit

#### Wearing parts

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1 Quantity per breaker  
2 Item as per overhaul instructions
# Extinction unit

## Wearing parts

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1. Quantity per breaker
2. Item as per overhaul instructions
## Circuit-breaker Replacement parts

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1. Quantity per breaker
2. Item as per overhaul instructions
## Extinction unit
### Replacement parts

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1. Quantity per breaker
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### Extinction unit
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