Instruction Manual

HV TEST SET
T 26/1 A
T 26/1 B

Mess- und Ortungstechnik
Measuring and Locating Technologies

Elektrizitätsnetze
Power Networks

Kommunikationsnetze
Communication Networks

Rohrleitungsnetze
Water Networks

Leitungsortung
Line Locating

- Date of release: 2003/ 29-

CONSULTATION WITH SEBAKMT

The present system manual has been designed as an operating guide and for reference. It is meant to answer your questions and solve your problems in as fast and easy a way as possible. Please start with referring to this manual should any trouble occur.

In doing so, make use of the table of contents and read the relevant paragraph with great attention. Furthermore, check all terminals and connections of the instruments involved.

Should any question remain unanswered, please contact:

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

DIN	**D**eutsches **I**nstitut für **N**ormung German Standards Institute
HV	**H**igh **V**oltage
IEC	**I**nternational **E**lectrotechnical **C**ommission
UVV	**U**nfall**v**erhütungs**v**orschrift Accident prevention regulations applicable in Germany
VDE	**V**erband **D**eutscher **E**lektrotechniker Association of German Electrotechnical Engineers

ELECTROMAGNETIC COMPATIBILITY OF THE HIGH VOLTAGE TEST SETS T 26/1 A, T 26/1 B

The high voltage test sets T 26/1 A and T 26/1 B comply with the requirements of EN 55011 concerning conducted emission voltages on the mains supply.

The requirements concerning radiated electromagnetic fields in accordance with EN 55011 are fulfilled up to a voltage of 110 kV.

Voltages above 110 kV result in exceedings of the limits in the frequency range 30 ... 120 MHz. These disturbances are caused by principle of operation and cannot be prevented by any technical procedure.

During operation of the equipment an appropriate distance to any susceptible instrument or installation has to be kept.

CHAPTER 1

GENERAL

1. GENERAL

1.1. Safety instructions

All persons involved in the installation, operation, maintenance and repair of this system must have read this user manual carefully.

The instrument and all additional equipment are in accordance with the current state of safety technology at the time of delivery. Owing to the work processes involved, however, there may be parts of the instrument and its peripherals which cannot be given optimum protection without an unreasonable reduction in function and usability. Good personal safety practice is therefore indispensable in terms of the protection of staff and the instrument.

The following safety instructions must be complied with.

General instructions

Work on this instrument and its peripherals must only be performed by qualified and/or trained staff. Other persons must be kept away.

This user manual must be available for the supervisory, operating and maintenance staff to refer to.

Improper use may endanger life and limb, the system and connected equipment, as well as the efficient functioning of the system (accident prevention regulations). The instrument may only be used for the purpose for which it is intended by the manufacturer.

Always use correct tools in perfect condition for all work.

Regular checks must be made to ensure that the relevant safety regulations are being complied with during operation and maintenance.

The instrument may only be operated by authorised persons with the appropriate skills.

Only operate the system if it is in technically perfect condition.

No non-original parts may be used for the instrument and its peripherals, as the necessary safety will not otherwise be guaranteed. No mode of working which detracts from the safety of the instrument must be used.
The user is under an obligation to report any changes in the system to the supervisor responsible without delay.

The user is under an obligation to shut down the instrument immediately in the event of an instrument malfunction which detracts from the safety of staff. The instrument may only be put back into operation once the malfunction has been rectified.

Electrotechnical instructions

The instrument and all additional equipment must be connected properly. The relevant **DIN** and **VDE** regulations must be complied with.

Repair and maintenance work must only be carried out when the system is switched off (dead) and then only by a skilled electrician in accordance with current accident prevention regulations (APR). A skilled electrician in the sense of the accident prevention regulations is a person who can assess the work assigned to him/her and recognise possible dangers on the basis of his/her technical training, knowledge and experience, and of his/her knowledge of the relevant regulations.

1.1.1. General safety regulations

Fuses

The patching or bridging of fuses is forbidden, as is the use of patched fuses.

When replacing fuses, only use replacements with the same or a smaller rated current strength and action (slow, quick, super-quick). Fitted bolts must not be replaced with ones for fuses with a higher rated current strength.

Fuses must not be detached or pulled under load. Fuses must not be used for switching electric circuits.

Handling regulations for fixed and movable cables and lines

Mains cables and their mountings must not be used for securing, attaching or suspending equipment, items of clothing, etc.

When cables are disconnected, they must be protected against kinking. The penetration of cable ends by moisture must be prevented. Suitable moisture protection must be used were necessary.

Moveable supply leads must not be subjected to unacceptable stress while equipment is being operated or transported. In particular, care must be taken that instruments are not suspended by their leads and plugs are not pulled out of sockets by the lead.

Handling regulations for connectors

Movable electrical plant must only be connected using the connectors (plugs, sockets) provided.

The use of adapters and plugs which fit sockets of a different voltage is not permissible.

When replacing connectors, care must be taken that the terminals are connected in proper phase.

Handling regulations for cable accessories

Cable terminals must be secured against working loose by means of retainer washers and spring washers.

When reconnecting cables to equipment and plant, care must be taken that the cable shielding is earthed (earth cone) and the cable lead-in is tight (in accordance with the protection class of the equipment in question).

1.1.2. General rules for working with high voltages

Working with high-voltage devices and systems demands special care.

This is particularly true of mobile operation, i.e. if the accommodation in question and its equipment do not ensure safety with permanent safety devices from the outset.

VDE Regulation 0104 "Installation and operation of electrical test systems" and/or the equivalent IEC standard must be complied with to the letter.

This clearly instructs:

- that high-voltage installations must only be operated in properly secured rooms or behind corresponding barriers, and safety devices must not be circumvented or put out of operation.

- that at least two persons must be present during operation, with one person being able to activate the emergency-off circuit in the event of an emergency.

1.1.2.1. Supplementary instructions

The following supplementary instructions are not taken directly from the regulations.

- To avoid dangerous charges, all metal parts in the vicinity of a high-voltage system must be grounded. Special care is required in the case of mobile operation in this respect.

- Do not disconnect while live (risk of arcs).

- High-voltage test and burn equipment is short-circuit proof. This means that there is a danger that the voltage will run up when a short circuit is removed.

- Connect a discharger parallel to the measuring equipment in the case of short-circuit current measurements (e.g. 90 V corona discharger).

- Only ever touch component parts which have been live and read measuring/test devices if they are visibly grounded and short-circuited, even if they have been switched off and discharged properly.

1.1.2.2. Danger of recurring voltage from space charges

- Only remove grounding and short-circuit when the test object is to be put into operation again.

- Cables which are not in operation are capacitors.

Ground and short-circuit as a matter of principle.

1.1.3. Indications used in the description

Important instructions concerning personal protection, work safety and technical safety are indicated as follows:

WARNING: Warning indicates work and operating procedures which must be complied with in full to exclude the possibility of persons being put at risk. This includes instructions concerning particular dangers when handling the instrument.

ATTENTION: Attention indicates work and operating procedures which must be complied with in full to prevent the instrument/peripherals from being damaged or destroyed.

N.B.: N.B. indicates special technical requirements to which the user must pay particular attention when using the instrument.

1.2. Connection regulations

WARNING: Establish protective earth connection in accordance with regulations before inserting mains plug!

WARNING: **System earth connection to shielding of test object!**

The system earth of the measuring van/mobile pallet should be connected to the earthed cable shielding of the test object, or if that is not directly possible, to the connecting line to the earth connection as a matter of principle. The unused leads of the test object should if possible, and must in the case of unshielded cables, be earthed directly to the system earth connection.

WARNING: Establish potential equalization

If the test object and supply network are connected to different, unconnected earth systems, the potential equalization should be established by means of a connecting line with a cross-section of at least 16 mm² Cu during operation of the
measuring van/mobile pallet.

CHAPTER 2

TECHNICAL DESCRIPTION

2. TECHNICAL DESCRIPTION

2.1. Application

The T 26/1 A or T 26/1 B test set was developed for operating insulation testing of high-voltage systems and cables.

Two variants with different power outputs are available to cater for the different tasks and requirements:

T 26/1 A: 100 kV - 150 kV - 200 kV - 400 kV
T 26/1 B: 650 kV

If the set is used in conjunction with a surge capacitor with spark gap, the Teleflex fault location unit and a synchronisation device, it is possible to pre-locate high-impedance, low-impedance and intermittent cable faults with sufficient
accuracy and to pinpoint with precision in the pre-located area using a structure-borne sound measuring instrument.

Cable systems can be tested for electric strength with alternating current and direct current in accordance with the testing regulations of the "Association of German Electrotechnical Engineers" (VDE).

The T 26/1 A or T 26/1 B test set makes DC voltage testing possible.

2.2. Specifications

2.2.1. T 26/1 A HV test set

Output DC voltage	
Idling:	max. 400 kV
at load of 4.0 mA:	max. 350 kV
Short-circuit current:	200 mA ± 10% arithmetical mean 300 mA_{eff} ± 10%
Voltage display:	60 kV...480 kV
Current display:	in 5 ranges 0.1 mA, 1 mA, 10 mA, 100 mA, 300 mA automatic range switching up to 100 mA
Timer:	0 to 60 min.
Power supply	
Voltage:	220 V ... 240 V 50 Hz ... 60 Hz
Power consumption:	max. 4 kVA
Dimensions (H x W x D)	
T 26/100 basic unit:	280 x 480 x 520 mm (11" x 19" x 20½")
T 26/110-02 operation unit:	220 x 460 x 620 mm (8¾" x 18" x 24½")
Weight	
T 26/100 basic unit:	42 kg (approx. 93 lbs)
T 16/110-02 operation unit:	44 kg (approx. 97 lbs)
Discharge energy of liquid resistor	
T 26/190 A:	600 kWs at 400 kV

Subject to changes or alterations without further notice.

2.2.2. T 26/1 B HV test set

Output DC voltage	
Idling:	max. 650 kV
at load of 3.5 mA:	max. 600 kV
Short-circuit current:	200 mA ± 10% arithmetical mean 290 mA_{eff} ± 10%
Voltage display:	60 kV ... 720 kV
Current display	in 5 ranges 0.1 mA, 1 mA, 10 mA, 100 mA, 300 mA automatic range switching up to 100 mA
Timer:	0 to 60 min.
Power supply	
Voltage:	220 V ... 240 V 50 Hz...60 Hz
Power consumption:	max. 5.5 kVA
Automatic cut-out	20 A
Dimensions (H x W x D)	
T 26/100 B basic unit:	500 x 520 x 550 mm (19¾" x 20½" x 21¾")
T 26/110 B operation unit:	220 x 460 x 620 mm (8¾" x 18" x 24½")
Weight	
T 26/100 B basic unit:	55 kg (approx. 121 lbs)
T 16/110 B operation unit:	44 kg (approx. 97 lbs)
Discharge energy of liquid resistor	
T 26/195 B:	1600 kWs at 600 kV

Subject to changes or alterations without further notice.

2.2.3. Specifications of equipment parts

Description	Type	Dimensions mm (inches)	Weight kg (lbs)
Basic stage 50 kV	T 25/13	225 x 250 x 250 (8¾ x 9¾ x 9¾)	9 (20)
Normal stage 50 kV	T 25/15	225 x 250 x 250 (8¾ x 9¾ x 9¾)	9 (20)
Cascade 200 kV	T 26/141	750 x 300 ∅ (29½ x 1¾), bulge 400 (15¾) ∅	32 (71)
Cascade 200 kV	T 26/141 B	780 x 400 ∅ (30¾ x 15¾)	33 (73)
Cascade 200 kV	T 26/143 A	650 x 300 ∅ (25½ x 11¾)	33 (73)
Cascade 200 kV	T 26/143 B	780 x 300 ∅ (30¾ x 11¾)	33 (73)
Cascade 250 kV	T 26/144 B	910 x 410 ∅ (35¾ x 16¼)	37 (82)
Liquid resistor	T 26/190 A	1555 x 200 ∅ (61¼ x 7¾)	16 (35)
Liquid resistor	T 26/195 B	3120 x 370 ∅ (122¾ x 14½)	60 (132)
Discharge switch	T 26/161	600 x 200 (23½ x 7¾)	2 (4)
Discharge switch	T 26/162		8 (17)

Description	Type	Dimensions mm (inches)	Weight kg (lbs)
Bipod	T 26/191	150 x 1700 (6 x 67)	3 (7)
Bipod	T 26/196 B	2850 x 260 x130 (112¼ x 10¼ x 5)	14 (31)
Pallet	H 904	1550 x 550 x 380 (61 x 21¾ x 15)	36 (79)
Cross-arm	H 905	1600 x 300 x 150 (63 x 11¾ x 6)	12 (26)
Platform	H 906	2150 x 80 x 450 (84¾ x 3¼ x 17¾)	20 (44)
Ladder	H 908	500 x 2000 x 120 (19¾ x 78¾ x 4¾)	5 (11)
Connecting cable	K 202 S		20 (44)

Subject to changes or alterations without further notice.

2.3. Equipment parts / scope of supply

			T 26/1 A				B
Description	Type	Code no.	100 kV	150 kV	200 kV	400 kV	650 kV
Connection cable	K 007	893020678					1
Terminal	0406	893020642	3	3	3	3	3
Operation unit (up to 400 kV)	T 26/110-02	892495872	1	1	1	1	
Operation unit (650 kV)	T 26/110 B	892486970					1
Electrolyte for liquid resistor	H 915	892492725			1	1	1
Discharge switch (manual trigger)	T 26/162	892487055					1
Discharge switch (magnetic trigger)	T 26/161	893020666			1	1	
Grounding terminal (for cable sheath connection)	0403	892480646	1	1	1	1	1
Ground cable (15 m, 25 $mm^{2)}$	L 204	892487489					2
Ground cable (3 m, 25 $mm^{2)}$	0321	893020653	1	1	1	1	1
Ground cable (7 m, 25 $mm^{2)}$	L 201	893020656	2	2	2	2	
Filler (for SF_6 gas)	H 909	893020688			1	1	1
Basic unit (100 kV - 400 kV)	T 26/100	892480476	1	1	1	1	
Basic unit (650 kV)	T 26/100 B	892486954					1
HV connecting cable	K 701	892485508			1	1	
HV connecting cable	K 702	892485494			1	1	
HV connecting cable	K 712	893020675					1

			T 26/1 A				B
Description	Type	Code no.	100 kV	150 kV	200 kV	400 kV	650 kV
HV connector		892530880	1	1			
Cascade 200 kV, compl. (gas)	T 26/141	892480395			1	1	
Cascade 200 kV, compl. (gas)	T 26/141 B	893020668					1
Cascade 200 kV, compl. (gas)	T 26/143 A	892493403				1	
Cascade 200 kV, compl. (gas)	T 26/143 B	893020669					1
Cascade 250 kV, compl. (gas)	T 26/144 B	893020667					1
Basic stage 50 kV (Cascade, cast resin)	T 25/13	892480166	1	1			
Normal stage 50 kV (Cascade, cast resin)	T 25/15	892480301	1	2			
Ladder	H 908	892487179					2
Mains cable (4 m)	L 304	893020631	1	1	1	1	
Mains cable (4 m, 22 A)	L 304 S	893020674					1
Palett	H 904	892487144					1
Platform	H 906	893020687					1
Safety device		128309600	1	1	1	1	
Switch box for warning device	T 26/170 B	892487403					1
Protective resistor (cast resin)	T 26/151	892485575	1	1			
Corona shield	H 913	892491788					1
Cross-arm	H 905	893020686					2

Connecting cable (7 m, 19 pin)	K 202	893020655	1	1	1	1	
Connecting cable (15 m)	K 202 S	893020673					1
Liquid resistor	T 26/195 B	893020670					1
Liquid resistor for 400 kV (travelling wave protection)	T 26/190 A	892493608			1	1	
Corrugated hose (10 m, for corona shield)	H 907	893020662					1
Tension member I, compl.	T 26/192 A	892493780		4			
Tension member II, compl.	T 26/194	892485605	4				
Diagonal tie	H 914	893020682					4
Bipod 400 kV	T 26/191	893020651				1	
Bipod 650 kV	T 26/196 B	893020671					1

2.4. T 26/100 operation unit

The T 26/1 A and T 26/1 B HV test set consists of a T 26/110 operation unit, a T 26/100 basic unit and, depending on the voltage required, various combinations of high-voltage cascades and accessories.

2.4.1. Structure of T 26/110 operation unit

The T 26/110-02 or T 26/110 B operation unit largely consists of a short-circuit-proof thyristor frequency changer with a DC inter-mediate stage. The necessary operating frequency is produced from the mains frequency in this stage.
The output voltage is set via phase control in the 50 Hz branch.

The measuring instruments for voltage and current measurement are located on the front panel.
Current is measured via automatic measuring range switching.
The front panel also houses devices for excess current and excess voltage shutdown and a timer.

2.4.2. Working method of T 26/110 operation unit

The AC voltage of 230 V / 50 Hz supplied by the mains is converted into an adjustable DC voltage by a partially controlled bridge in phase control with subsequent filtering.
The DC voltage supplies a thyristor inverter which produces the operating frequency of 3 kHz (7 kHz in the case of the T 26/110 B). The inverter contains a balanced resonant circuit which is trigger with a constant clocking frequency (operating frequency).
The output voltage therefore consists of sine half waves of alternating polarity.

The thyristor inverter is protected by an input choke and automatic cut-out in such a way that the permitted surger currents will not be exceeded even if both thyristors are ignited simultaneously by noise pulses.

Automatic current measuring range switching has four measuring ranges of 0.1 mA, 1 mA, 10 mA and 100 mA. If one measuring range is exceeded, the system switches to the next, i.e. the pointer deflection goes back to 10%.
The measuring range selected is indicated by the corresponding button lighting up.

Excess current shutdown is preselected by pressing a button. It is only effective in the 0.1 mA, 1 mA and 10 mA ranges. The high voltage is switched off if excess current shutdown is triggered. The unit can only be restarted by turning both voltage adjusters to 0 and pressing the  button again.

The unit can also be shut down by the timer. The 300 mA measuring range is selected for *surge and burn* mode. Automatic range switching does not operate in this position  .

The voltage measuring range can be adjusted using two controls. Adjustment, which depends on the cascade set-up in question and the equipment variant used, should be carried out using the matrix shown on the front panel. See the following tables:

T 26/1 A	Measuring ranges			
100 kV [1]	36 kV [2]	60 kV	120 kV	
150 kV [1]	60 kV	120 kV	180 kV	
200 kV	60 kV	120 kV	180 kV	240 kV
400 kV	120 kV	240 kV	360 kV	480 kV

1 = cast-resin cascades
2 = divide reading by 10

T 26/1 B	Measuring ranges			
650 kV	240 kV	480 kV	720 kV	720 kV

At approx. 107% of the rated voltage excess voltage shutdown takes effect and the high voltage is switched off; e.g. in the case of a 400 kV set-up shutdown takes place at 428 kV.
The surge capacitors are included in the excess voltage protection for measuring van operation.

2.5. T 26/100 high-voltage basic unit

2.5.1. Structure

The T 26/100 high-voltage basic unit contains a high-voltage transformer, the first cascade capacitor and devices to protect against excess voltage peaks.

The high-voltage unit is made up of the T 26/100 or T 26/100 B basic unit and various cascade combinations with accessories, depending on the voltage required. The appropriate cascades with accessories are mounted on the basic unit.

The 100 kV and 150 kV versions are made up of cast-resin cascades (T 25/13, T 25/15). From 200 kV upwards only gas cascades are used. A detailed picture is given in the illustrations for configuration and test set-up (fig. 1 to 5) and the scope of delivery table in the appendix.

2.5.2. Working method of high-voltage unit

The T 26/100 basic unit contains the high-voltage transformer, the first surge capacitor, devices to protect against high-voltage peaks and a fan to prevent the transformer from overheating. This task is also performed by a temperature sensor, which switches the system off in the event of overheating.

Various components such as cast-resin or gas cascades can be mounted on the basic unit. See section 2.3. for possible combinations.

A gas cascade contains the elements required for voltage generation, including rectifiers and capacitors, protective resistors for the rectifiers and measuring resistors for measuring the high voltage. These elements are built into insulating tubes filled with SF_6 gas. The liquid resistor makes it possible to discharge the test object using the discharge switch and protects the unit against travelling waves in the event of flashovers in the cable.

The T 26/190 A resistor can be used for testing up to 400 kV. The resistor can be used vertically via a bayonet socket or horizontally, supported by the T 26/191 bipod.

The T 26/161 or T 26/162 discharge switch is screwed onto the basic unit as and when required. The T 26/162 discharge switch is actuated by means of a release cord. In this case a switch interrupts the operation unit, with the release cord acting as an EMERGENCY OFF. The T 26/161 discharge switch is closed automatically as soon as the mains switch on the operation unit is switch off or if the emergency-off function of the warning system is triggered.

2.6. Safety and warning device

The safety and warning device denotes the danger area of high-voltage test systems, cable measuring vans and test equipment as described in VDE 0104. In addition, emergency-off switches make it possible to shut down the connected test equipment immediately in the event of danger.

The safety device is connected between the general power supply and the mains input of the T 26/1 A (see fig. 1 to 4). Green indicator lamps signal readiness for operation. If the test equipment is activated using the key-operated switch, red indicator lamps mark the danger area.

2.7. Configuration and test set-up

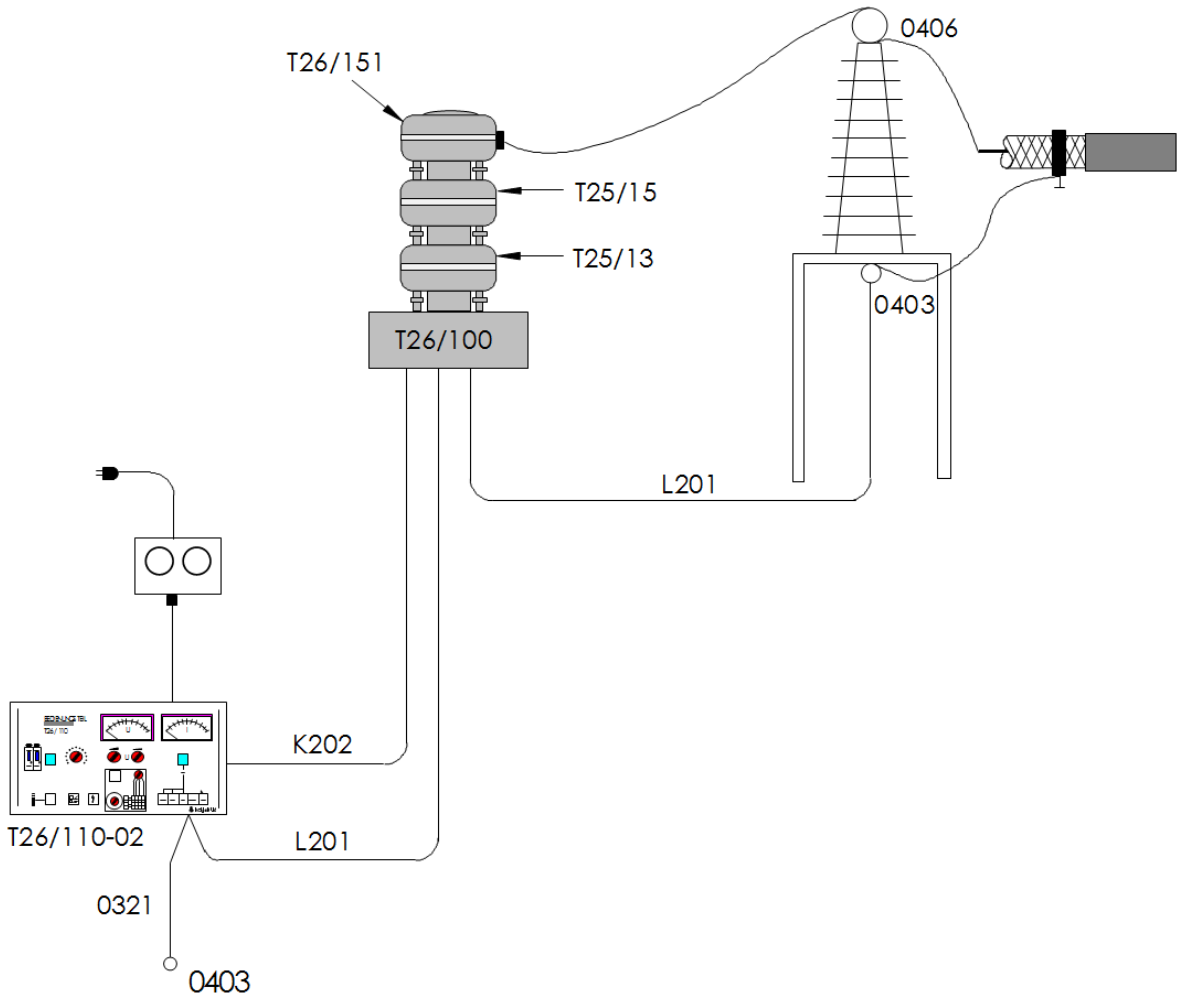

Fig. 1 T 26/1 A configuration and test set-up, 100 kV

N.B.: This configuration is mainly intended as a fixed installation in the measuring van. An additional discharge device is necessary if this configuration is set up
separately, e.g. discharge resistor 0531
(up to 80 kV only).

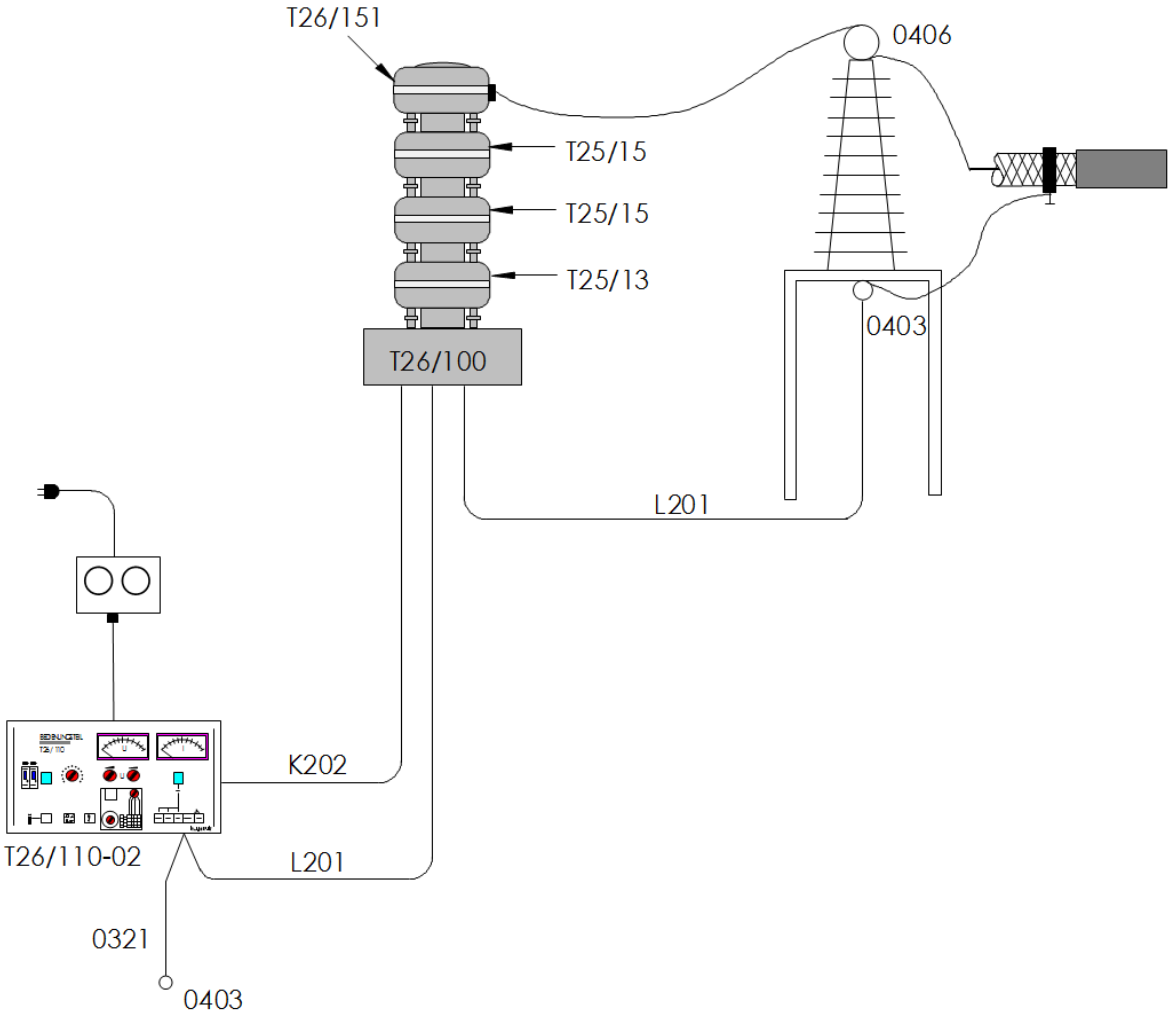

Fig. 2 T 26/1 A configuration and test set-up, 150 kV

N.B.: This configuration is mainly intended as a fixed installation in the measuring van. An additional discharge device is necessary if this configuration is set up
separately, e.g. discharge resistor 0531
(up to 80 kV only).

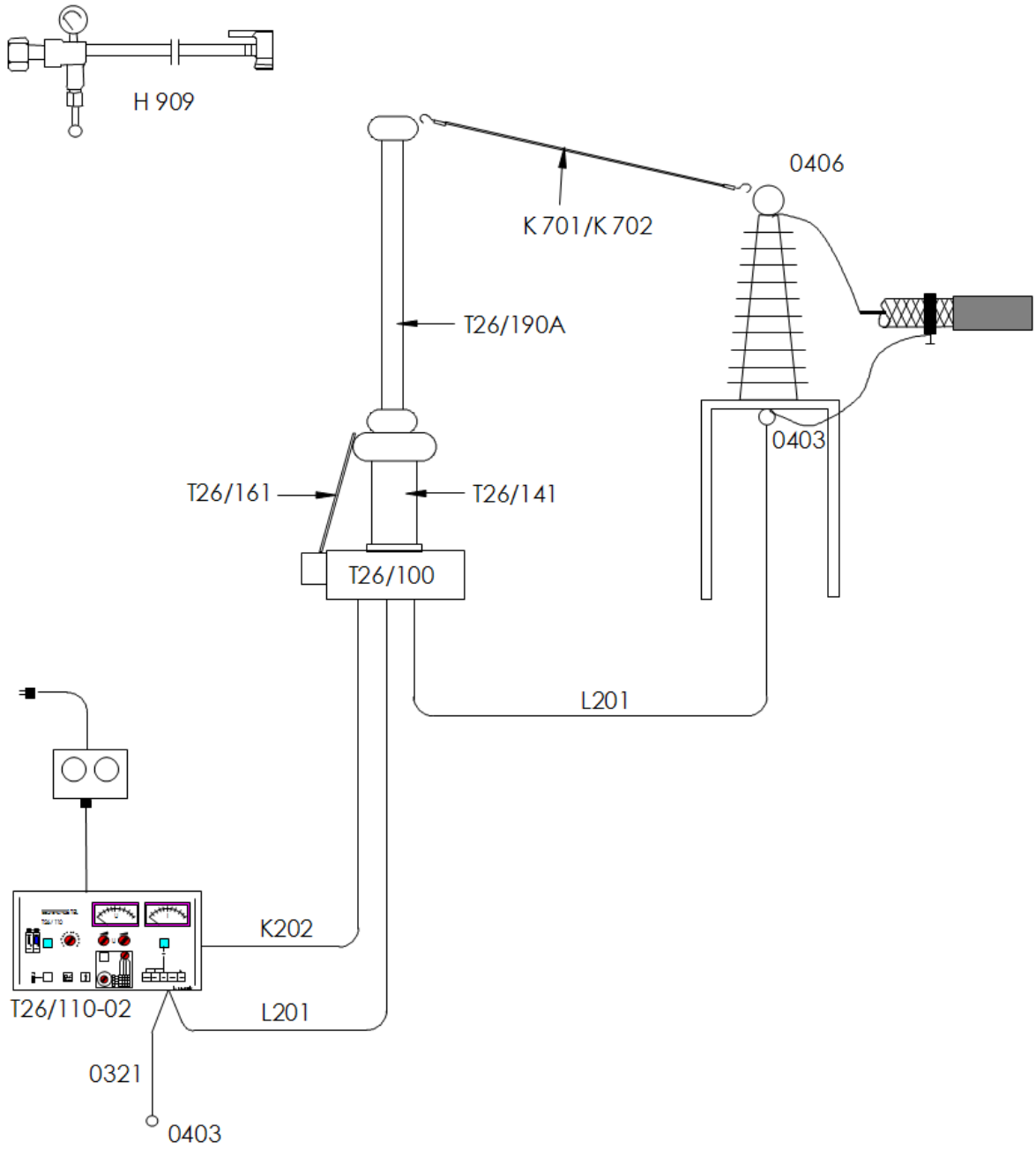

Fig. 3 T 26/1 A configuration and test set-up, 200 kV

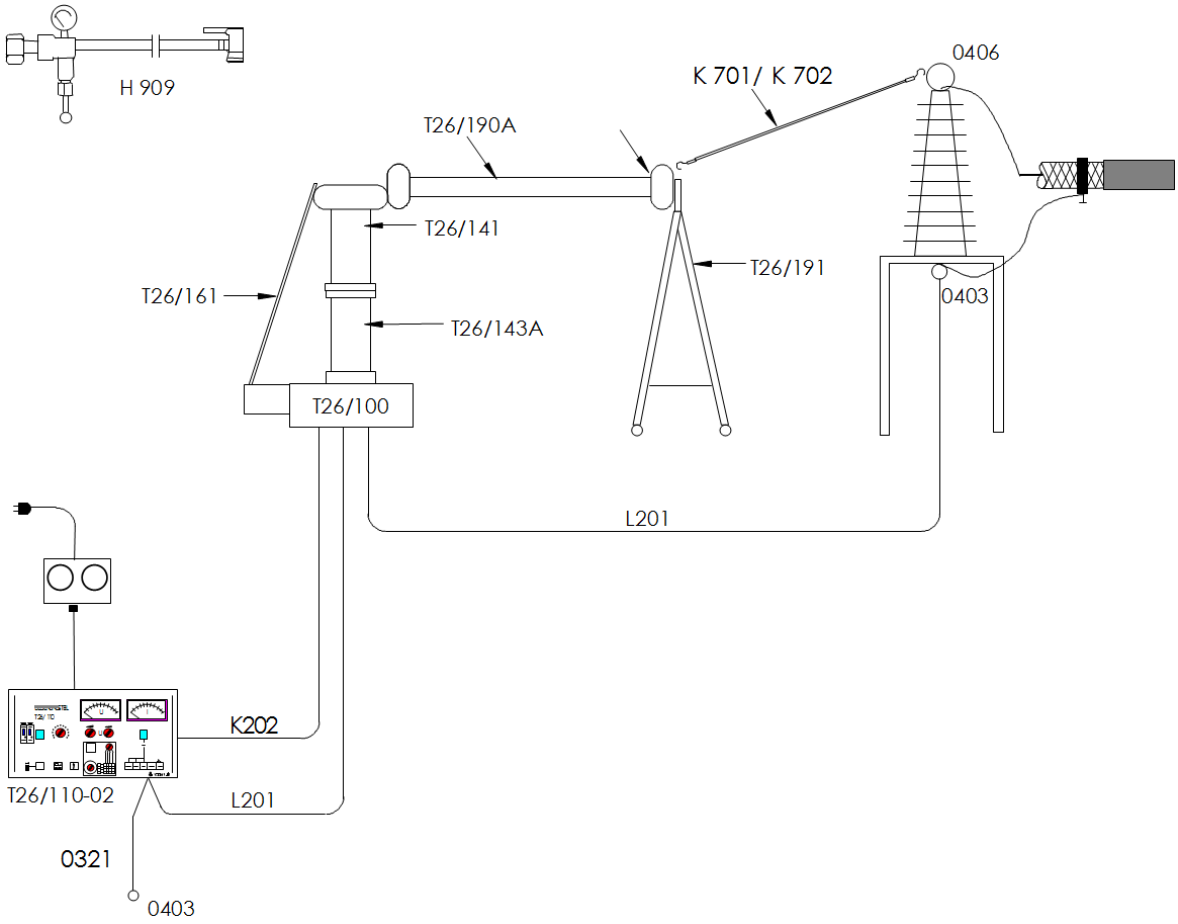

Fig. 4 T 26/1 A configuration and test set-up, 400 kV

N.B.: T 26/191 B bipod without measuring resistors.

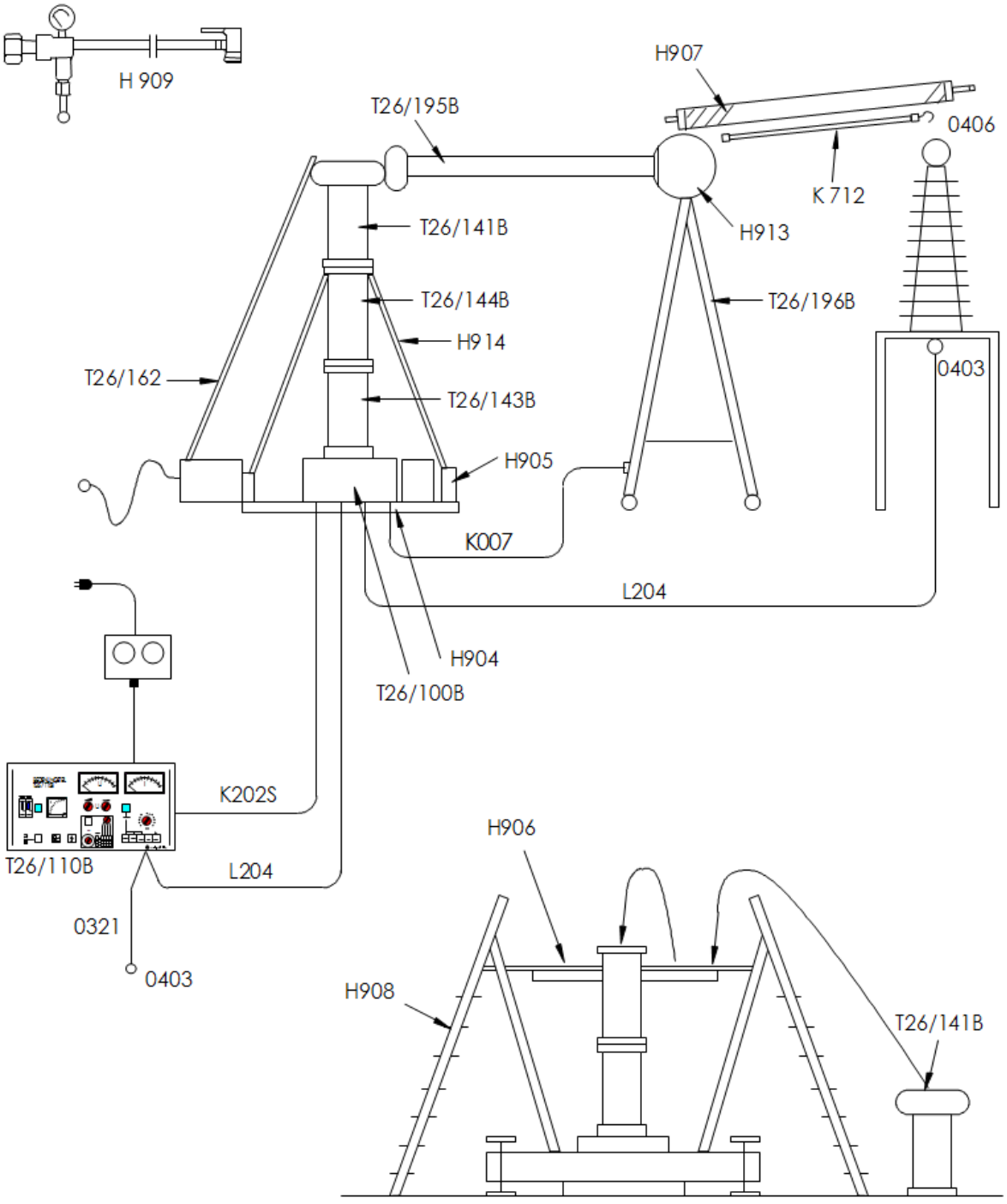

Fig. 5 T 26/1 B configuration and test set-up, 650 kV

CHAPTER 3

OPERATION

3. OPERATION

3.1. Start-Up

Before the equipment is put into operation, the usual safety regulations governing the operation of high-voltage equipment must be complied with. The equipment carries high voltage and its operation demands detailed knowledge of the information contained in the user manual.

All equipment components should be moved without hoists. The cascades are best assembled by two people from an H 906 platform. The platform can be mounted on two ladders.

3.1.1. Test preparations

The interconnection of the equipment shown in fig. 6 is not dependent on the version used. Combination of the cascades is shown in section 2.7.

The high-voltage unit should be set up in such a way that the cable from the protective resistor can be connected to the test object or surge capacitor at a large enough distance from grounded parts.

No set-up which exceeds 150 kV in any combination must be operated without a liquid resistor. In the case of set-ups of up to 150 kV the travelling wave protective resistor is integrated in the HV head.

The *operating ground* ⏚ terminal should be connected directly to the cable sheath. The *protective ground* ⏚ terminal should be laid to the ground potential where the operator is (frame ground) for safety reasons. The operation unit and high-voltage unit should be connected with the cable provided. Care must be taken that there is a large enough safety gap between the two units.

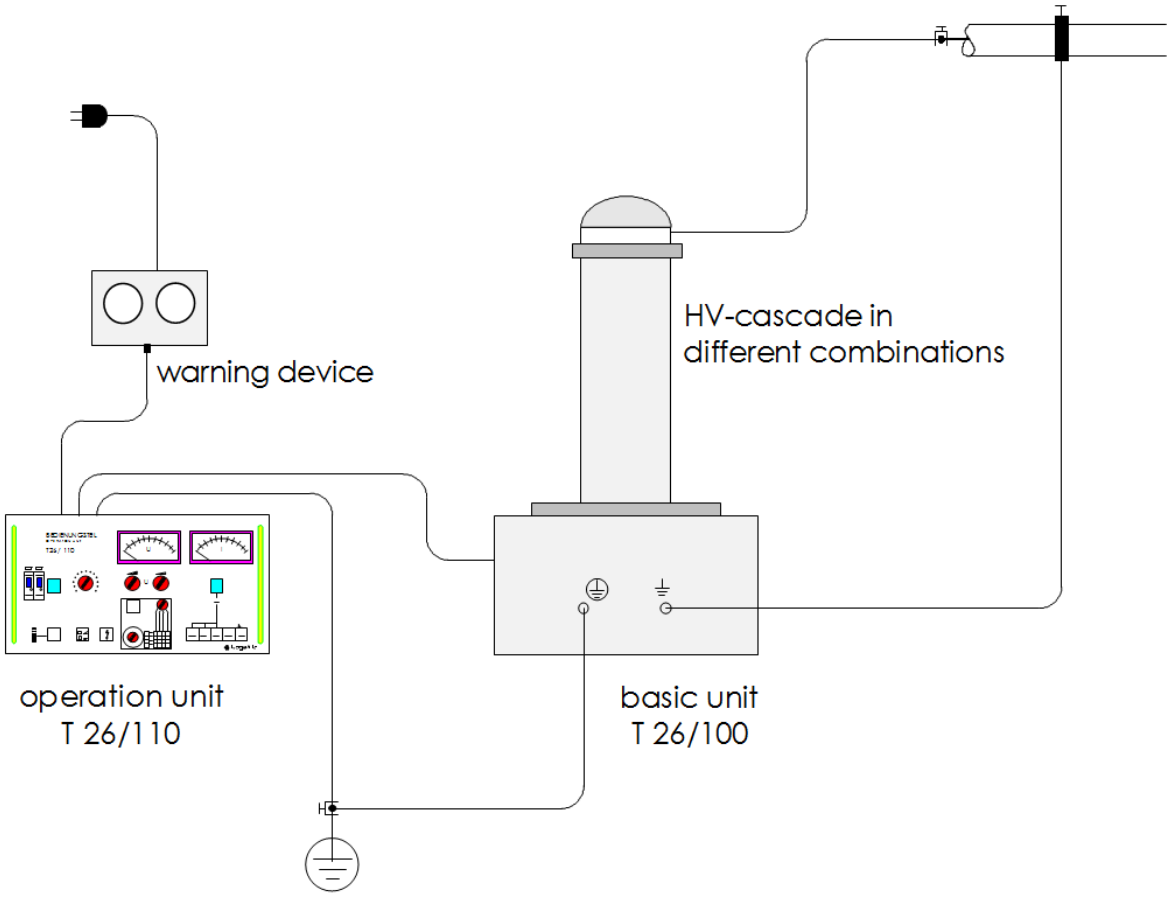

Fig. 6 Connection diagram

The operation unit should also be connected to protective ground. The mains connection can be to any mains socket fused with at least 16 A.

The equipment must not be switched on without a warning device.

3.1.2. Minimum distances when setting up equipment

N.B.: The distances in brackets apply exclusively to the T 26/1 A set.

When setting up the equipment, care must be taken that there is a gap of at least 1.2 m (1 m) between the live parts.
In the case of liquid resistors as shown in fig. 7 and fig. 8, the gap must not be less than 1.4 m (1.2 m).

The sealing end at the far end of the cable should be freed from all connections and have an empty protective space with a radius of r ≥1.2 m (≥1 m).

A flashover at the far end can load the liquid resistor with double voltage and cause a flashover at the output of the T 26/141 cascade, damaging the equipment.
It is therefore essential that the air gap of ≥1.4 m (≥1.2 m) is complied with.

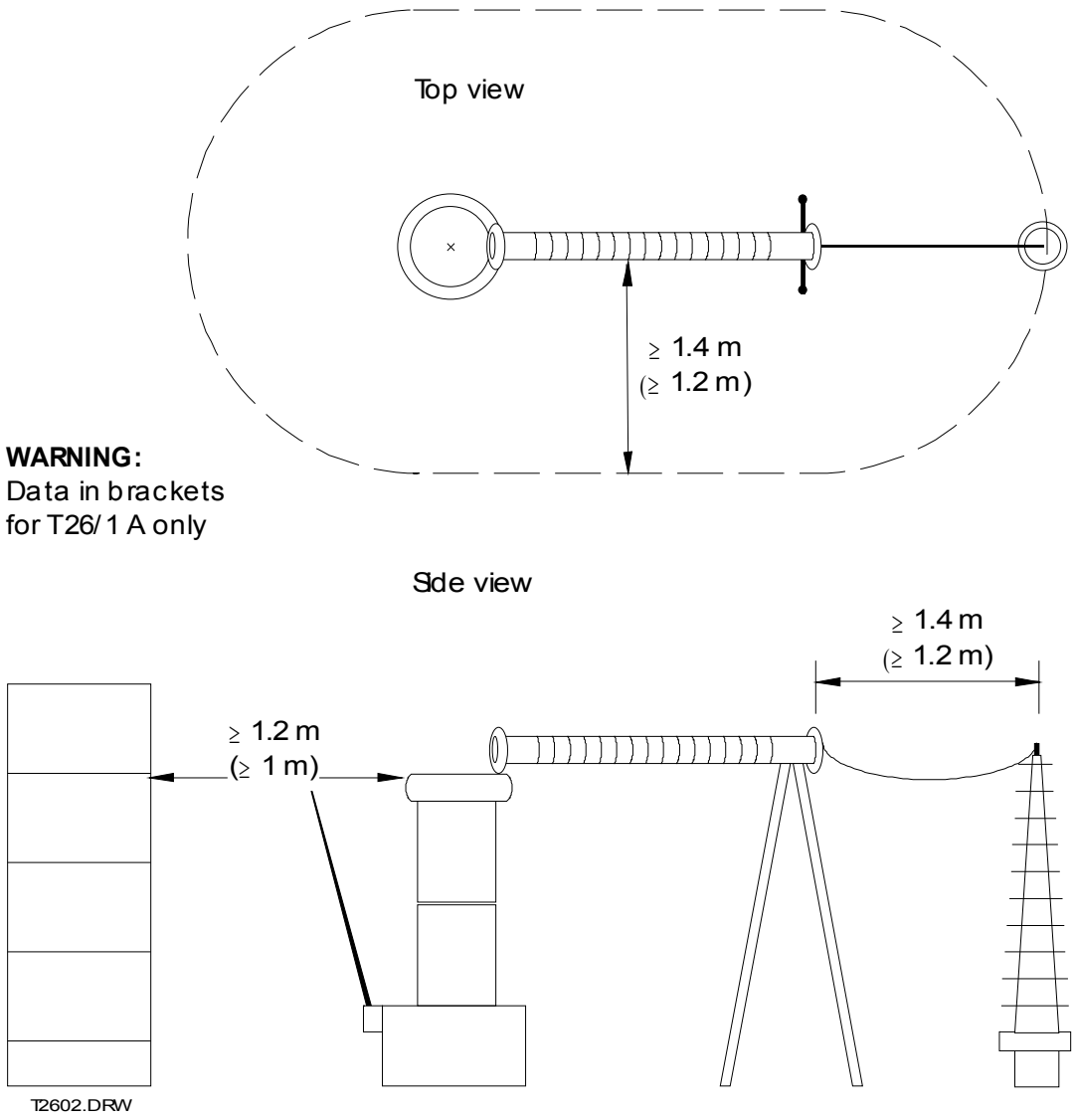

Fig. 7 Horizontal liquid resistor set-up

N.B.: The liquid resistor itself is longer than the minimum distance. The distances quoted are therefore only of importance if the equipment has to be set up in such a way that the HV head moves correspondingly closer to the sealing end (see fig. 7).

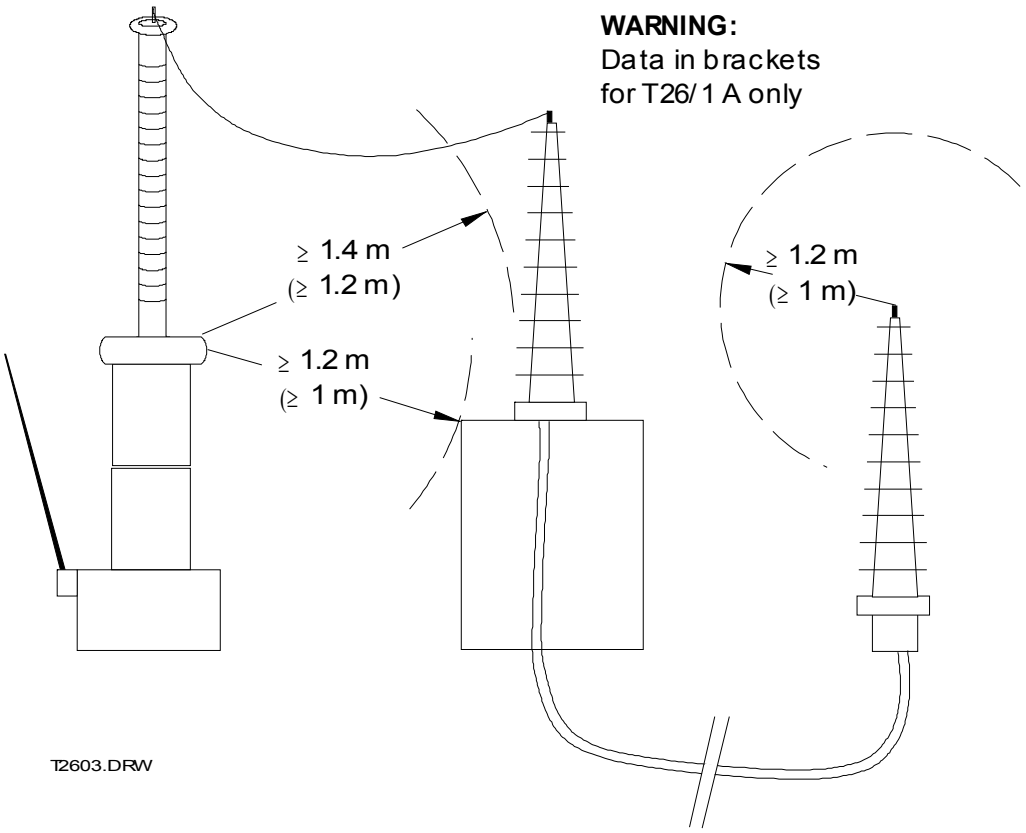

Fig. 8 Vertical liquid resistor set-up

3.1.3. Fitting the cascades

When fitting the cascades, reach into the foot recess with one hand and make sure that the red arrows are one above the other.

3.1.4. Connecting the liquid resistor

Vertical set-up

Connect the HV connecting cable to the liquid resistor.

Position the liquid resistor with the three openings of the bayonet socket on the three bolts of the cascade and lock by turning clockwise.

Horizontal set-up

Hook one end of the liquid resistor into the slot of the corona cover with the bolt and place the other end on the bipod.

The liquid resistor must be checked for gas bubbles before the equipment is put into operation. If gas bubbles have formed, turn the liquid resistor upright and allow the bubbles to rise. If the liquid level is less than 50 mm above the electrode, vent the liquid resistor by putting a screwdriver in the hole in the cover. If necessary, top up with electrolyte.
(1000 ml distilled water, 400 ml ethylene glycol,
60 g ammonium sulphate.)

In set-ups over 400 kV the H 913 corona shield must be used.

3.1.5. Installing the discharge switch

Push the discharge switch over the knurled screws from above and screw in position. Plug in the control plug on the basic unit. The switch is adjusted to the height of the cascade by pulling out the telescopic rod.

In the case of the T 26/162 discharge switch, pay out the release cord and tension the switch by pressing down the whip.

ATTENTION: Before the equipment is switched on, care must be taken that the whip is pulled out to the right length (EMERGENCY OFF).
If the whip is not pulled out, the test object will have to be discharged/grounded by grounding the cover with a grounding rod.

3.2. Controls

The controls of the T 26/110-02 operation unit are illustrated in fig. A-1 in the appendix and those of the T 26/110 B in fig. A-2. Numbers in [ ] refer to the controls in those figures.

[1] Connection for warning device in accordance with VDE 0104, with key-operated switch and connection for indicator lamps (T 26/110 B only)

[2] Si 4 fuse for indicator lamps (T 26/110 B only)

[3] Mains connection

[4] P 70 connection for stand-by circuit for installation in measuring van (e.g. surge capacitor control)

[5] P 71 connection for connecting cable to T 26/100 or T 26/100 B basic unit

[6] Protective ground

[7] Si 2 fuse for internal control circuit

[8] Si 1 automatic cut-out for mains input
T 26/1 A: 16 A B16
T 26/1 B: 20 A B16

[9] Si 3 automatic cut-out (10 A B10) for thyristor inverter

N.B.: If this is triggered during operation, the unit must be switched off before the automatic cut-out is switched back on [3].

[10] Control lamp for overheating of high-voltage transformer (T 26/1 A) or thyristor (T 26/1 B).

[11] Timer, adjustable up to 60 minutes
a) set the high voltage to the required value
b) set the timer to the right test time
The high voltage is switched off when the timer runs out.

[12] Rough voltage setting
This adjuster must be turned as far anticlockwise as it will go before the high voltage is switched on, otherwise start-up will not be possible.

[13] Voltmeter

[14] Fine voltage setting
(see comment for [12])

[15] Control lamp for excess current
After excess current triggering this lamp will remain lit until the unit is switched off or the high voltage is restarted from zero.

[16] Ammeter
The arithmetical mean is displayed.
e.g. short-circuit indication = 200 mA; effective current = 290 mA

[17] Button switch with indicator lamp for measuring range selection.
One of the measuring ranges must be selected before the high voltage is switched on [20].

a) Automatic measuring range switching for the 0.1 mA, 1 mA, 10 mA and 100 mA ranges.
The active measuring range is indicated by the button lamp lighting up.

b) Excess current shutdown is active after the 0.1 mA, 1 mA or 10 mA button has been pressed. Once the current specified on the button has been reached, the high voltage is switched off.

c) The (300 mA) button does not have automatic measuring range switching and is used for *surge and burn* mode.

[18] Measuring range switch for voltage measurement
It can be switched over during operation.

[19] Cascade selection switch with 4 positions
ATTENTION:
The switch must be turned to the appropriate position before start-up, depending on the cascade set-up.

N.B.:
When the HV test set is installed in a cable measuring van, the switch is locked in one position and must not be moved.

[20] Button for switching on high voltage with control lamp

[21] Mode switch

T 26/1 A:

a) Button out ⎍:
Surge, burn and test with reduced power mode
In this mode the unit is short-circuit proof and works until overheating shutdown.

b) Button in ⎍ :
Test with rated power mode
The maximum power at rated voltage can be taken from the unit (300 kV / 5 A). In this mode the unit is not short-circuit proof, so the automatic cut-out will be triggered in the event of a short circuit. Equipment not in danger.

N.B.: In the measuring van up to 110 kV test voltage this button is not effective and only mode a) applies.

T 26/1 B:

a) Button out ⎍ :
Surge, burn and *test with reduced power* mode

b) Button in ⎍ :
Test with rated power mode

Operation is described in section 3.4.2.

[22] Mains ammeter (T 26/110 B only)

[23] Mains control lamp
Lights up if unit is switched on and mains voltage is present

[24] Mains switch
ON = On or |, OFF = Off or O

3.3. Performing measurements with the T 26/1 A

3.3.1. Cable testing

N.B.: If *surge* or *burn* mode is to be used repeatedly, compact installation in a measuring van or on a measuring pallet is recommended. This would include all the safety devices such as excess voltage protection, etc. Setting the equipment up separately on site is time consuming and costly.

3.3.1.1. Directions in brief

Connect safety device.

Connect protective grounds, connecting cables and mains lead to safety device.

Set cascade selector switch [19] in accordance with cascade set-up.

Put the safety and warning device into operation; the red indicator lamp flashes. Tension the discharge switch.
Turn the mains switch [24] to On position; the control lamp [23] lights up.

Turn voltage adjusters [12] and [14] as far anticlockwise as they will go.

Set measuring range switch for voltage [18] using matrix and position of cascade selector switch [19].

Select current measuring range with button [17].

If the test power is not sufficient after cable charging, press the mode switch [21] and turn to *test* = mode (see 3.2. [21]).

Preset timer [11] to required time.

Press [ϟ] button [20] and set voltage to required value with the voltage adjusters [12] and [14].

Set timer [11] to required time.

3.3.1.2. Directions

With the mode switch [21] in *surge and burn* ⩘ position cables of normal length can be run up in short-circuit operation, i.e. the voltage setting is turned right up and turned back down accordingly once the required voltage has been reached.
In the case of extremely long cables with capacities in excess of 15 µF the energy to be supplied may lead to a mains overload, causing the automatic cut-out [8] to be triggered.

Once the equipment has been switched on again by pressing the [ϟ] button [20], it can be run back up again by turning the voltage adjusters [12] and [14] more slowly.

After the equipment has been shut down, the high voltage cannot be switched on again until both voltage adjusters [12] and [14] have been turned as far anticlockwise as they will go. It does not matter whether the equipment was shut down manually, by an automatic cut-out, by excess current or excess voltage triggering or by the timer [11].

If the test voltage cannot be reached with the mode switch [21] in ⩘ position, the voltage should be turned back to 0.
Then switch [21] must be turned to = position. A charging current of 10 mA must not be exceeded, however, as otherwise the automatic cut-outs will be triggered again.
The equipment is not in danger.

The charging current during running up and the test discharge current are very different. However, automatic current measuring range switching ensures that the right current measuring range is always selected. The operator can concentrate fully on the voltage setting.

The required test time can be preset using the timer [11]. See section 3.2. [11]. When this time expires, the equipment shuts down automatically.
To make it possible to ascertain later whether the equipment was shut down earlier by excess current triggering, the control lamp [15] will remain on in this eventuality until the equipment is restarted or switched off.

Once testing has been completed, the equipment must be switched off and the cable discharged.

Do not touch connections or dismantle equipment until all cable wires are fully grounded.
The closed discharge switch does not provide full grounding in accordance with VDE 0104.

3.3.2. Surging

Surge operation is possible with a spark gap or shock switch and surge capacitors. Cascades up to 150 kV in cast resin, T 25/..., are used for this.

For connection of the system and protective grounds see section 3.1.1.

Connect the operating ground ⏚ and the protective ground ⏚ separately to the surge capacitor.

Surge mode is selected with switch [21]. Turn the switch to ⎍ position (button out).

Press the (300 mA) button on the measuring range switch [17]. There will be no automatic measuring range switching.

Surge and burn operation is only possible with cast-resin travelling wave protection. A liquid resistor is not suitable.

A capacitor unit with working and protective spark gaps is connected to the high-voltage output of the T 26/1 A.
The protective spark gap must be parallel to the capacitor and the working spark gap must be between capacitor and cable (see fig. 9).

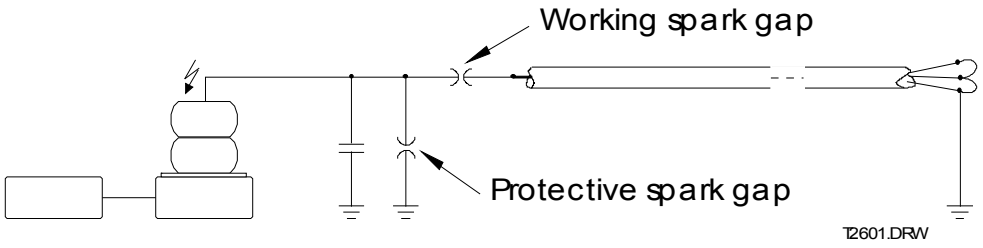

Fig. 9 Connection of protective and working spark gaps for surging

The protective spark gap must be set to the maximum permitted voltage for the cable or surge capacitor. The faultless functioning of the protective spark gap must be tested beforehand with the working spark gap well apart.

The necessary flashover voltage, i.e. surge voltage, is set with the working spark gap, while the voltage setting on the operation unit determines the surge rate.

When the equipment is used in a measuring van, the appropriate voltage limitation for the surge capacitor automatically becomes effective when it is switched on. This means that a protective spark gap is not required.

3.3.3. Burning

For connection of the unit to the test object see section 3.1.1. Cascades gas, T 26/... may be used. The liquid resistor is not suitable for burn operation.

Burn mode is selected with switch [21]. Turn the switch to ⎍ position (button out).

Press the (300 mA) button on the measuring range switch [17]. There will be no automatic measuring range switching.

The reduction in the fault resistance/the burning process can be monitored on the voltmeter and ammeter.

3.4. Performing measurements with the T 26/1 B

3.4.1. Cable testing

3.4.1.1. Directions in brief

Connect switch box for T 26/170 B warning device to connection [1].

A corona shield must be fitted for equipment configurations of 400 kV and above.

Connect protective grounds, connecting cables and mains lead.

Set cascade selector switch [19] according to cascade set-up.

Turn mains switch [24] to | position. The control lamp [23] and the green indicator lamp of the warning system will light up.

Tension discharge switch and actuate key-operated switch. The red indicator lamp of the warning system will light up.

Turn voltage adjusters [12] and [14] as far anticlockwise as they will go.

Set measuring range switch for voltage [18] using matrix and position of cascade selector switch [19].

Select current measuring range with button [17].

Do not press mode switch [21], thereby switching to *charge* = mode.
Press ϟ switch [20], run up high voltage and charge cable.

Switch to test mode (press button [21]). For a more detailed description see section 3.4.1.2.

Preset timer [11] to required time.

Set voltage to required test value with the voltage adjusters [12] and [14].

3.4.1.2. Directions

N.B.: The H 913 corona shield must be fitted before start-up, as otherwise there will be a risk of flashovers.

Depending on the connection conditions the automatic cut-out [8] may respond. The equipment can be run up again by turning the voltage adjusters [12] and [14] after switching back on by pressing the  button [20].

After the equipment has been shut down, the high voltage cannot be switched on again until both voltage adjusters [12] and [14] have been turned as far anticlockwise as they will go. It does not matter whether the equipment was shut down manually, by an automatic cut-out, by excess current or excess voltage triggering or by the timer [11].

The charging current during running up and the test discharge current are very different. However, automatic current measuring range switching ensures that the right current measuring range is always selected. The operator can concentrate fully on the voltage setting.

The required test time can be preset using the timer [11]. See section 3.2. [11]. When this time expires, the equipment shuts down automatically. To make it possible to ascertain later whether the equipment was shut down earlier by excess current triggering, the control lamp [15] will remain on in this eventuality until the equipment is restarted or switched off.

Once testing has been completed, the equipment must be switched off and the cable discharged.

Do not touch connections or dismantle equipment until all cable wires are fully grounded.
The closed discharge switch does not provide full grounding in accordance with VDE 0104.

3.4.2. Measurement up to 650 kV

The T 26/1 B test set should be set up as shown in fig. 5.

Care must be taken that live parts of the equipment, including the connecting hose, have a large enough **safety gap of at least 2 m** to grounded parts.

Test mode was provided so that the equipment would not be overloaded during cable charging.

After removing short circuit and grounding, tension discharge switch and turn equipment on. Turn the voltage adjusters [12] and [14] as far anticlockwise as they will go.
Put button in ⟋ position (button out ⊓).
Press the ↯ button [20] and turn the voltage adjusters slowly up to a voltage of 200...250 kV. The cable is charged.
The mains current during charging should not exceed 25 A.
If the charging current drops perceptibly, turn the voltage adjusters back as far anticlockwise as they will go.
Then switch over to *test* mode.

Put the button in = position (button in ⊔).
Once the cable has been charged (*charge*), increase the voltage again slowly until the test voltage is reached.

After the test period, switch the equipment off and discharge the test object by pulling the release cord of the discharge switch.

The cable can then be grounded and short-circuited in accordance with VDE 0104.

CHAPTER 4

CARE, MAINTENANCE AND REPAIR

4. CARE, MAINTENANCE AND REPAIR

4.1. Care and maintenance

The HV test set requires no maintenance.

The housing surfaces and controls should be cleaned with a mild cleaning agent. Naphtha, acetone, lyes or similar agents must not be used under any circumstances, as they attack the housing surfaces and possible equipment failure cannot be ruled out.

4.2. Repair

In the event of repair becoming necessary, authorized technical staff must always be notified.

APPENDIX

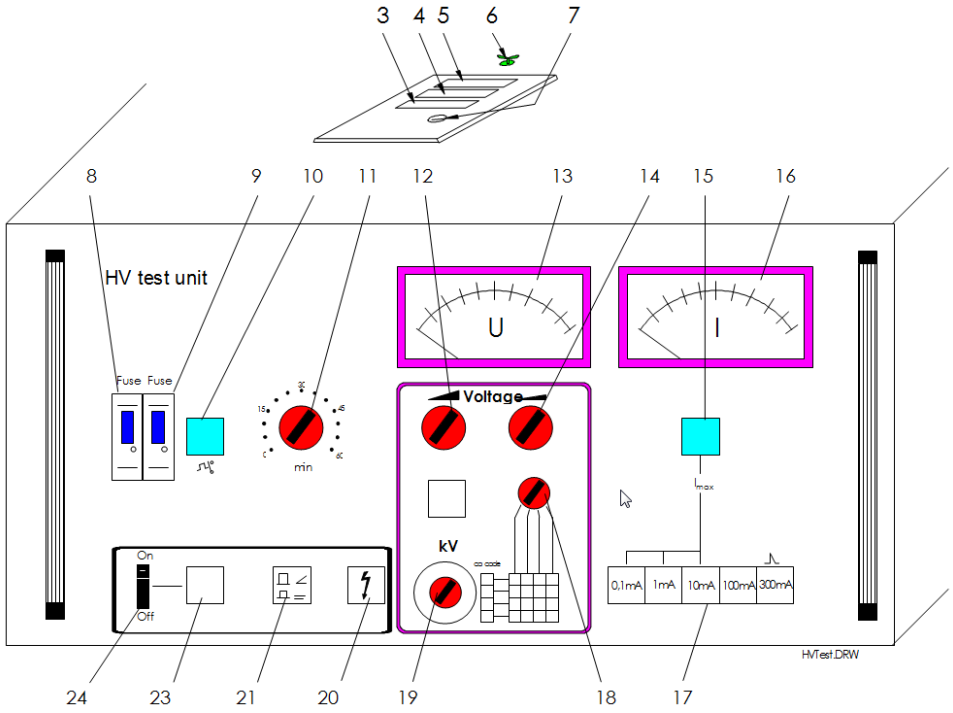

Fig. A-1 T 26/110-02 controls

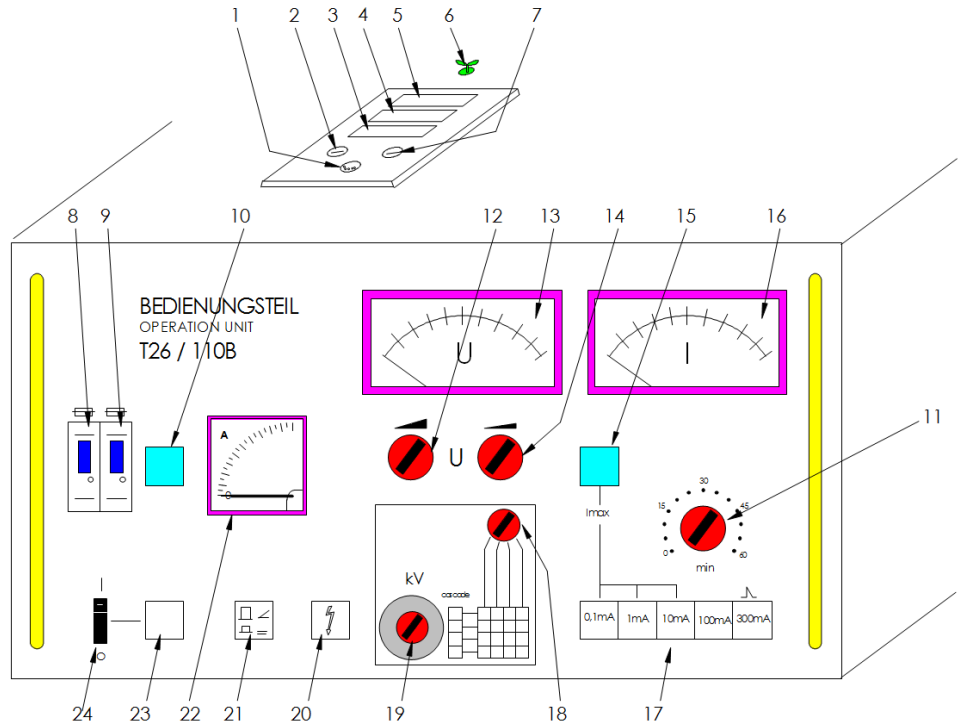

Fig. A-2 T 26/110 B controls