



4.2015

Operating Instruction
for the dry cleaning set for live line maintenance
from 0.4 to 36 kV

N° 01/2015 HUBIX



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11. HANDLING AND STORAGE

Keep all components of the system in the original case, in dry premises. Protect the system against corrosive gases/vapours and direct sunlight. Carry the system in the original case to protect it against mechanical damage.

1. PURPOSE

The system is intended for dry vacuum cleaning of live electric equipment (voltage ranging from 0.4 kV to 36).

2. REQUIREMENTS

The system conforms to the following standards:

- EN 50101-1:2004 *Operation of electrical installations*
- EN 61235:1995 *Live working. Insulating hollow tubes for electrical purposes.*
- EN 61481:2001 *Live working. Portable phase comparators for use on voltages from 1 kV to 36 kV a.c., part concerning requirements for pipe attachments: protection against bridging (short circuit).*
- EN 60900:2004 *Live working. Hand tools for use up to 1000 V a.c. and 1500 V d.c.*

Each component of dedicated equipment has to be marked as fit for live working.

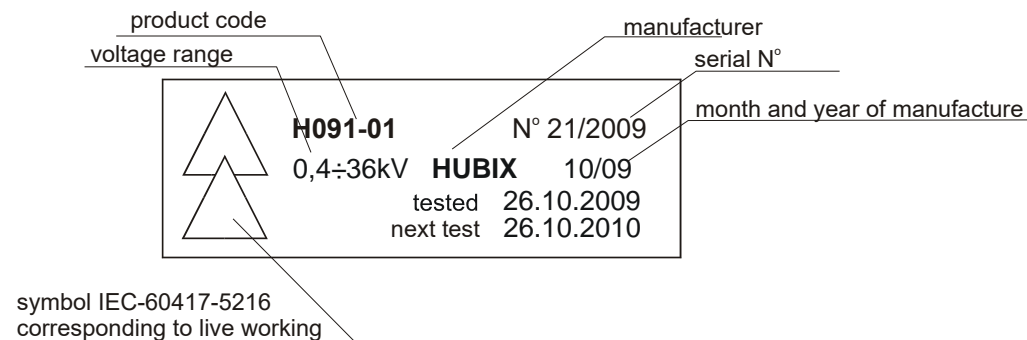


Fig. 1: Label explanation

Equipment components unfit for live working have to be clearly marked as such.

DO NOT USE FOR LIVE WORKING !

Fig. 2: Label identifying components unfit for live working.

3. REQUIREMENT FOR SAFE USE OF THE SYSTEM

Only personnel authorised by the Owner/User of the cleaned equipment may operate the system. Please follow the detailed instruction for live working approved by the Owner/User.

4. SELECTION OF SYSTEM COMPONENTS

The main components of the system include the vacuum tube made from insulating material and cleaning attachments, such as suction nozzles and brushes with insulating extension and angle fittings for easy cleaning of electric apparatus and devices from the safe distance. KÄRCHER NT 65/2 Eco vacuum cleaner with vacuum hose is an optional component.

4.1 Suction tube

The main suction tube contains a reach limiter (protective disc) and a limit mark (Fig. 3). The part of the tube between the reach limiter and the limit mark is insulating. The operator may touch the holder, below limiter part only. The minimum length of the insulating part is 600 mm. The suction tube, optionally with extension tubes, elbows, nozzles or brushes may have contact with the live parts to limit mark only.

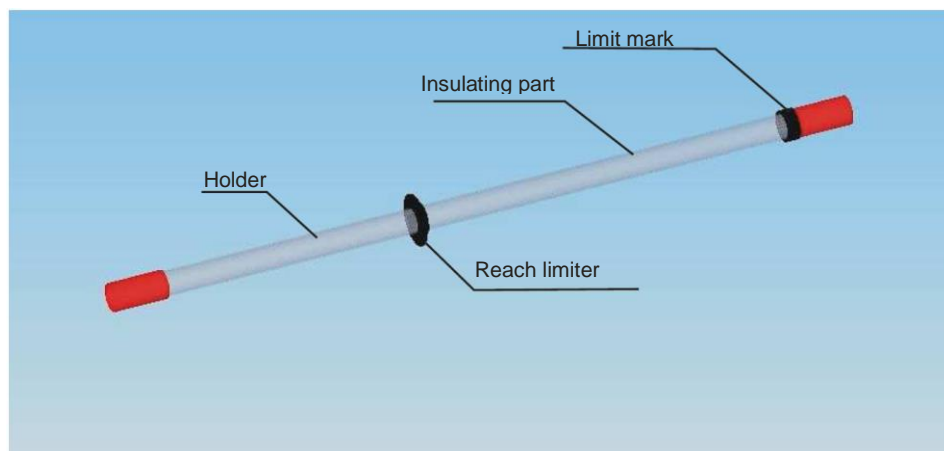


Fig. 3: Main suction tube

Press the tube onto the vacuum cleaner hose (Fig. 4). Attach the selected cleaning component to the other end of the tube using the insulated threaded connector (Fig. 5).

A test is considered as passed when the following requirements are met:

- No damaged or excessively worn system components;
- Each system component has a legible label;
- Leakage current during the last 30 seconds of the test: ≤ 0.2 mA;
- No spark-over on the inner and outer surfaces of the suction tube;
- No discharges or damage on the surface of the suction tube;
- No spark-over or breakdown observed during the 3-stages test.

Remarks and limitations:

Based on a review of the results of the test, the system meets/fails to meet* the safety requirements for live working from 0.4 to 36 kV and is fit/unfit* for use.

/* - Delete as appropriate

/** - Enter "positive" or "negative".

Next check date:

Check performed by:

**Report N° (Template)
on acceptance/periodical* test of the dry cleaning set
for live working from 0.4 to 36 kV**

Manufacturer: "HUBIX" Sp. z o.o.
Huta Żabiowska ul. Główna 43
96-321 Żabia Wola

Test type: Routine check/Validation check

Date of test:

temperature: °C
relative humidity: %
atmospheric pressure: kPa

Testing and measuring devices:

Testing procedure: Acc. to Operating Instruction for the dry cleaning set for live line maintenance from 0.4 to 36 kV N° 01/2009 HUBIX

Measurement Results

#	item	symbol	serial N°	kind of test		
				visual inspection	leakage current.30s 43,2kV-1min.	dielectric test 84kV/1min.
1	Suction tube with reach limiter L=1,200mm	H091-01		positiv e/negativ e**	µA	positiv e/negativ e**

#	item	symbol	serial N°	visual inspection	kind of test		
					protection against bridging		
					first stage	second stage	third stage
2	Tube extension L= 800mm	H091-02		positive/negative**	positive/negative**	positive/negative**	---
3	Tube extension L= 400mm	H091-03		positive/negative**	positive/negative**	positive/negative**	---
4	Tube extension L= 200mm	H091-04		positive/negative**	positive/negative**	positive/negative**	---
5	90° elbow	H091-05		positive/negative**	positive/negative**	positive/negative**	---
6	90° swivel elbow	H091-05-S		positive/negative**	positive/negative**	positive/negative**	positive/negative**
7	135° elbow	H091-06		positive/negative**	positive/negative**	positive/negative**	---
8	Plain brush, Φ 120 mm	H091-07		positive/negative**	positive/negative**	positive/negative**	positive/negative**
9	Forked brush, 2 x Φ 100 mm	H091-08		positive/negative**	positive/negative**	positive/negative**	positive/negative**
10	Right-angle small brush, 60 x 40 mm	H091-09		positive/negative**	positive/negative**	positive/negative**	---
11	Long brush, 50 x 130 mm	H091-10		positive/negative**	positive/negative**	positive/negative**	---
12	Narrow suction nozzle, 30 mm	H091-11		positive/negative**	positive/negative**	positive/negative**	---
13	Suction nozzle, 40 mm	H091-12		positive/negative**	positive/negative**	positive/negative**	---
14	Wide-angle suction nozzle, 95 mm	H091-13		positive/negative**	positive/negative**	positive/negative**	positive/negative**
15	TURBO Special brush	H091-14		positive/negative**	positive/negative**	positive/negative**	positive/negative**
16	Wide suction brush, L = 360 mm	H091-15		positive/negative**	positive/negative**	positive/negative**	positive/negative**
17	Brush for cleaning the system	H091-16	---	positive/negative**	---	---	---
18	Turbo standard brush	H091-18		positive/negative**	positive/negative**	positive/negative**	positive/negative**
19	Conical connector	H091-20	---	positive/negative**	---	---	---

#	item	symbol	serial N°	visual inspection	kind of test			
					protection against bridging			
					43.2kV		7.2kV	
					first stage	second stage	first stage	second stage
20	Insulating mirror	H091-30		positive/negative	positive/negative	positive/negative	positive/negative	positive/negative



Fig. 4: Connect the hose to the tube (press).



Fig. 5: Connect the suction nozzle to the tube (twist).

4.2 System assembly for required configuration

The standard components of the system can be set for any shape of the target space.

See the following examples of system component configurations.

4.2.1 Brushes: plain, forked and Turbo for cleaning of live equipment in any configuration using various angle fittings: elbows and extensions.



Fig. 6: Plain brush (H091-07) with 135° elbow (H091-06)



Fig. 7: Plain brush (H091-07) with 200 mm extension (H091-04) and 135° (H091-06) or 90° (H091-05) elbow



Fig. 8: Forked brush (H091-08) with special 2x90° swivel elbow (H091-05S)



Fig. 9: Forked brush (H091-08) with special 2x90° swivel elbow (H091-05S) and 135° elbow (H091-06) for rotating the brush around the insulator



Fig. 10: Turbo brush (H091-14) with 135° elbow (H091-06) for cleaning petticoat insulators

The test is considered as passed when no spark-over or electric discharges are observed.

10.4 Routine Check Frequency

The frequency of the checks depends on the system operation intensity. Checking the system at least once every 12 months is recommended. Do not subject the conical connector H091-20 or the system cleaning brush H091-16 to electrical tests. Make visual inspections only.

stage 3

This tests the components, where the largest diameter or the smallest outer dimension in vertical plane in relation to the main axis of the suction tube is larger than one half of the narrowing d_1 . Place the tested component connected to the main vacuum pipe between the bus bars at the narrowest point (d_1), so that the tip of the component touches the grounded bus bar. Then, rotate the component and move it down by manipulating the pipe until the limit mark touches the bar, while keeping the component in contact with the grounded bar (Fig. 31).

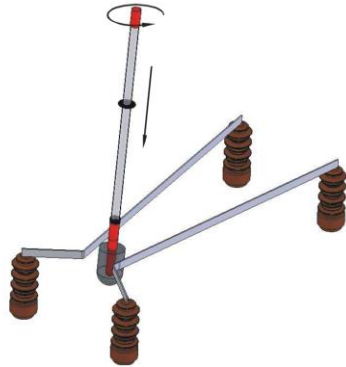


Fig. 31: Testing protection against bridging, stage 3

If the largest outer dimension of the component in the vertical plane in relation to the main axis of the suction pipe is larger than d_1 , place the component on the grounded bar at the narrowest point and move it towards the live bar until the contact loses contact with the bar (Fig. 32).

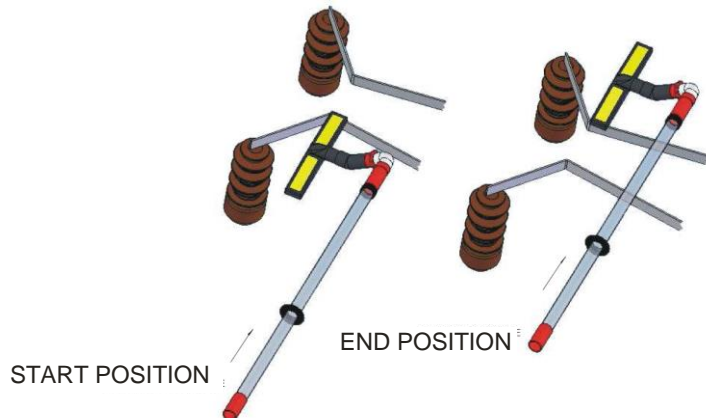


Fig. 32: Testing protection against bridging, stage 3

4.2.2 Brushes: for cleaning live structural equipment, walls and floors.



Fig. 11: Brushes (H091-10) and (H091-09) for walls and structural parts of equipment



Fig. 12: Brush (H091-15) for walls and floors

4.2.3 Suction nozzles for removing solid contaminants and spider webs



Fig. 13: Nozzle connection example (nozzles H091-12 and H091-13)

4.2.4 Insulating Mirror

The mirror is used for checking equipment parts for presence of contamination and loose items (wires, tools, or other conductors left after maintenance) invisible for the user and which could produce short circuit during live working.



Fig. 14: Insulated mirror (H091-30)

4.2.5 Conical Connector (for up to 1 kV)

You can use the conical connector (H091-20) instead of the main suction tube for cleaning live equipment (up to 1 kV). Press the connector onto the vacuum hose and attach the other components with the use of screw joint.



Fig. 15: Using the conical connector for attaching cleaning components directly to the vacuum cleaner hose (for cleaning equipment for live working up to 1 kV).

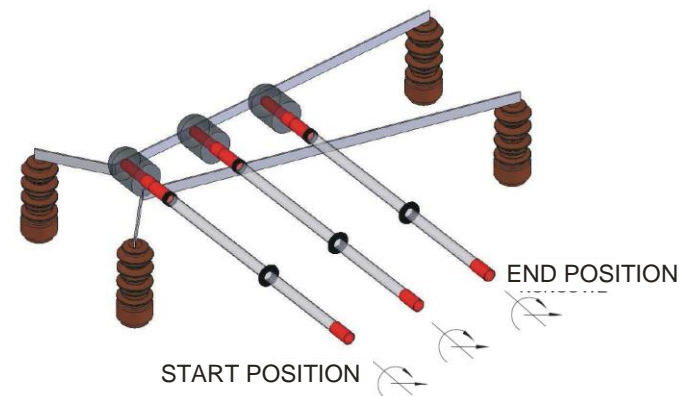


Fig. 29: Testing protection against bridging, stage 1

stage 2

Place the tested component connected to the main suction tube on the bus bars at the narrowest point (d1), so that the tip of the component touches the live bus bar. Then, rotate the component (without rolling it over) and move it towards the live bus bar until the limit mark touches the bar. Keep the component in contact with both bars during the test (Fig. 30).

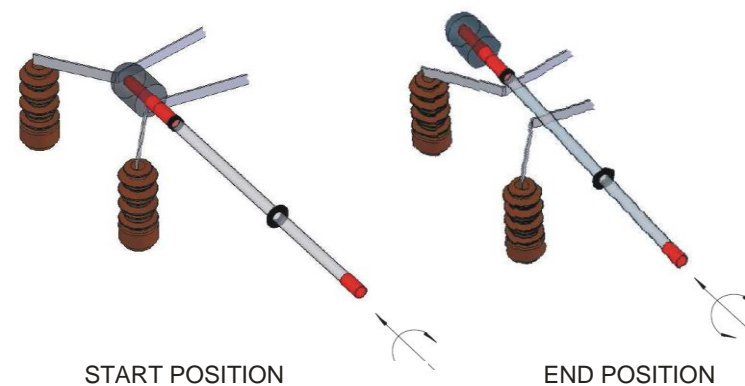


Fig. 30: Testing protection against bridging, stage 2

For the components of the system designed for 0.4-36 kV range, apply the effective test voltage of 43.2 kV / 50 Hz to buses set with the following spacing:

$$d_1 = 180 \text{ mm}$$

$$d_2 = A_1 + d_1 + 200 \text{ mm}$$

Where A_1 is the insertion depth (distance from the limit mark to the tip of the connected component).

For components with rated voltage other than 0.4-36 kV (for instance, the H091-30 mirror designed for 6-36 kV range) perform the test for both the highest and the lowest rated voltage.

For the lowest rated voltage (6 kV), apply the effective test voltage of 7.2 kV / 50 Hz to buses set with the following spacing:

$$d_1 = 50 \text{ mm}$$

$$d_2 = A_1 + d_1 + 200 \text{ mm}$$

Where A_1 is the insertion depth (distance from the limit mark to the tip of the connected fitting).

See Table 1 for distances (d_1) between the buses depending on the rated voltage.

Rated voltage U_n [kV]	Distance at the narrowest point d_1 [mm]
$U_n \leq 7.2$	50
$7.2 < U_n \leq 12$	60
$12 < U_n \leq 17.5$	85
$17.5 < U_n \leq 24$	115
$24 < U_n \leq 36$	180

Table 1: Bus bar spacing at the narrowest point

stage 1

Place the tested component connected to the main suction tube on the grounded bus bar at the narrowest point, where the distance between the electrodes is equal to d_1 , so that the tip of the component is pressed against the live bus bar. Then roll the tested component along the bus bar to the end position (where the limit mark touches the grounded bus bar), while keeping the component in contact with both bars (Fig. 29).

5. LIST OF COMPONENTS

• Basic Components

#	Item	Code
1	Main suction tube with reach limiter, L = 1.200 mm	H091-01
2	Tube extension, L = 800 mm	H091-02
3	Tube extension, L = 400 mm	H091-03
4	Tube extension, L = 200 mm	H091-04
5	90° elbow	H091-05
6	90° swivel elbow	H091-05S
7	135° elbow	H091-06
8	Circular brush, Φ 120 mm	H091-07
9	Forked brush, 2 x Φ 100 mm	H091-08
10	Right-angle small brush, 60 x 40 mm	H091-09
11	Long brush, 50 x 130 mm	H091-10
12	Narrow suction nozzle, 30 mm	H091-11
13	Suction nozzle, 40 mm	H091-12
14	Wide-angle suction nozzle, 95 mm	H091-13
15	TURBO Special brush	H091-14
16	Wide suction brush, L = 360 mm	H091-15
17	Brush for cleaning the system	H091-16
18	TURBO Standard brush	H091-18
19	Conical connector	H091-20
20	Insulating mirror	H091-30

• Technical characteristic

#	Item	Code
1	Vacuum cleaner with hose	NT 65/2 Tact ²
	Key specifications:	
	Power supply: 1/230/50	1Ph/V/Hz
	Rated power: 2 400	W
	Vacuum: 254	mbar
	Air flow: 2x74	l/s
	Container capacity: 65	l

You can use a different vacuum cleaner with similar vacuum and air flow values.

6. PREPARING TO WORK

Check the vacuum cleaner following the manufacturer's instructions. Clean and check the system before each use. Do not use any damaged (cracked), excessively worn (scratches, distortion) or contaminated components. Ensure that wet or humid components (e.g., condensate formed after moving equipment from a cold to a warm place) are dried before use.

7. APPLICATION EXAMPLES

See the following sections for examples of using components of the system for cleaning insulators, structural parts of equipment, walls, floors and other items. Always keep the safe distance from cleaned live equipment (see the detailed instruction for live working).



Fig. 16: Main suction tube H091-01 with extensions H091-02 and H091-04

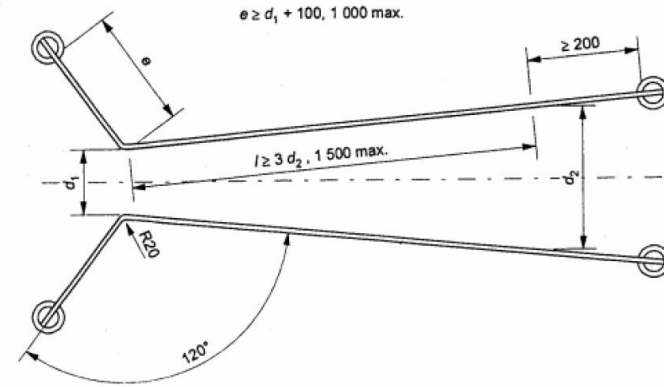


Fig. 17: 90° swivel elbow H091-05S



Fig. 18 and 18a: Circular brush H091-07

maximum rated voltage of the components). See Fig. 28 and Fig. 28a for the meter circuit setup.



Dimensions in millimeters

Fig. 28: Circuit for the testing of protection against bridging and spark discharge resistance

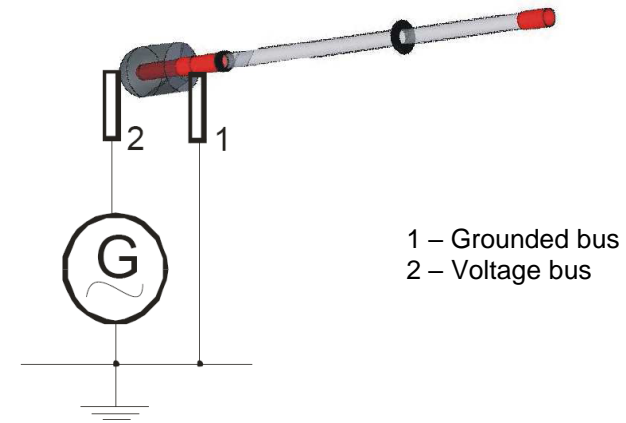
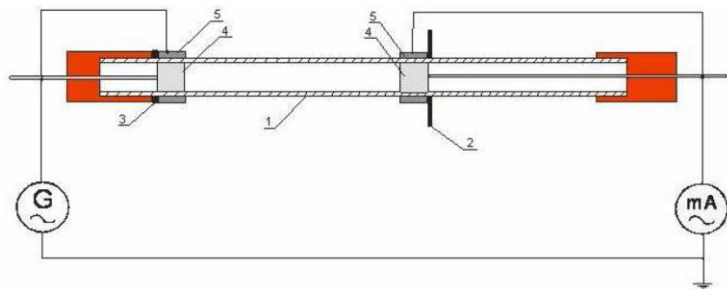


Fig. 28: Bridging protection testing circuit

The effective testing voltage value must be 43.2 kV / 50 Hz. Apply the maximum voltage for 10-20 seconds. Testing the tube for 1 minute after achieving the required test voltage. Measure the leakage current during the last 30 seconds of the test.

The test is passed, if the leakage current does not exceed 0.2 mA.



1. Main suction tube
2. Reach limiter
3. Limit mark
4. Inner electrodes
5. Outer electrodes

Fig. 27a: Leakage current testing circuit

10.3.2 Testing Electric Strength

Only the main suction tube is tested. See Fig. 27b for the meter circuit setup. The effective test voltage must be 84 kV / 50 Hz. Apply the maximum voltage for 10-20 seconds. Test the tube for 1 minute after achieving the required test voltage.

The test is passed when no spark-over or electric discharges are observed.

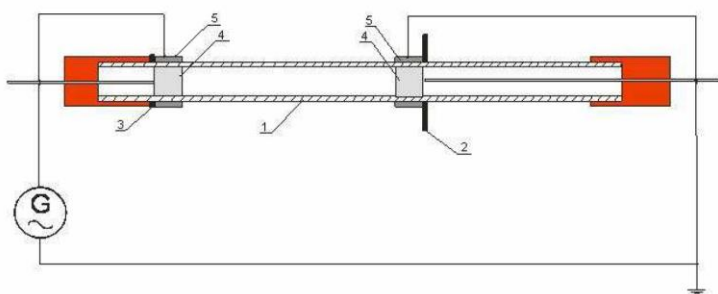


Fig. 27b: Electric strength testing circuit

10.3.3 Testing Protection Against Bridging (Short Circuit)

Test tubes extension, elbows, nozzles, brushes and the mirror for protection against bridging. The test voltage should be 1.2 Un (of the



Fig. 19 and 19a: Forked brush H091-08



Fig. 20: Small right angle brush H091-09

Fig. 21: Long brush H091-10



Fig. 22: Suction nozzle H091-12

Fig. 23: Wide suction brush H091-15



Fig. 24: Wide-angle suction nozzle H091-13



25: TURBO Standard brush H091-18



Fig. 26: TURBO brush for insulators H091-14

8. REPLACING WORN OR DAMAGED SYSTEM COMPONENTS

Excessively worn or damaged system components must be replaced. The Manufacturer shall not be held responsible for the consequences of unauthorized modification of any system component or using any component not included in the set or unfit for live working. The Manufacturer provides full service coverage for its equipment. Please specify the name and code of each component in your order.

9. SYSTEM MAINTENANCE

Clean all system components after each use. Clean inner surface of the pipe and extension surfaces with a special brush. Use dry cloth for cleaning the outer surfaces. Moisten the cloth with a gasoline-based thinner for

cleaning heavily contaminated parts. It is recommended to wipe outer tube/extension surfaces with the silicone cloth (attached) once the components are dry. Clean elbows and nozzles with a cloth: either dry or moistened with a gasoline-based thinner. Shake or vacuum each brush (including the one for cleaning the system) to remove contamination. If a brush is strongly contaminated, wash it with a gasoline-based thinner and dry thoroughly. Perform the cleaning with the thinner in an open or ventilated space.

10. REGULAR CHECKS

The system requires regular checks. Follow the recommendations of the Manufacturer provided below. (These are the minimum requirements. You can do the checks more frequently, if the conditions and intensity of use so require)

10.1 Preparing the System for a Check

Do not clean the system after last use before the check. It is recommended to leave the system for at least 4 hours in the conditions of the check (approved also for live equipment cleaning) before the check.

10.2 Visual Inspection

Conduct visual inspection of the components of the system before running electrical tests. Each component must be labelled as fit for live working. Any component unfit for live working must be clearly marked. No damaged or excessively worn components must be used with live equipment. The minimum length of the insulated pipe section must be 600 mm.

10.3 Electrical Tests

10.3.1 Voltage Test with Leakage Current Measurement

Only the main suction tube is tested. See Fig. 27a for the meter circuit setup. Insert metallic electrodes (at least 20 mm wide brushes made from soft wire) in the tube and position them at the reach limiter and limit mark points.

Wrap tape electrodes of width equal to that of inner electrodes around the outer tube surfaces above the inner electrodes so that the outer electrodes touch the reach limiter and the limit mark. Connect each inner electrode to the corresponding outer electrode.

Connect the reach limiter electrodes to an earth conductor and the limit mark electrodes to an alternating current source.