«SEBA KMT» Holding (Germany) and Joint Venture «Seba Spektrum» offers equipment and mobile diagnostic laboratories for solution of following problems:

ENERGY INDUSTRY

Search of cable route
Search for power cable damage points
High-voltage tests
Diagnostics of transformers
Testing of relay protection and automatics of electric power substations

WATER SUPPLY AND SEWAGE

Search of pipeline route
Search of pipeline leaks
Testing of low-head pipelines and sewage channels

COMMUNICATION MEANS

Diagnostics and testing of copper and fiber-optic cables
Search for cable damage points
Elimination of flaws in communication lines

Our Internet address: *www.sebaspectrum.ru*

History of creation of the Russian-German Joint Venture „Seba Spektrum“

MNPO „Spektr“

West German Company „Seba Dynatronic“

LLC „Seba Spektrum “

1990

seba spektrum

History of creation of the Seba KMT Holding

1951 seba dynatronic®

1980 METROTECH®

1989 PKI

1995 hagenuk KMT KABELMESSTECHNIK GmbH

1995 Death of Dr. Herbert Iann, the Company's founder
New management of the Company:
Adriane Iann, Dr. Max Iann and Christian Stolz

1996 HDW ELECTRONICS

2000

1946 HDW Elektronik

1948 R-F-T VEB Funkwerk Dresden

1952 robotron MESSELEKTRONIK

1987 SALZGITTER ELEKTRONIK GmbH

1991 hagenuk

1995 hagenuk KMT KABELMESSTECHNIK GmbH

seba KMT

28 sales and servicing points of SebaKMT in Europe
> 82 worldwide representations on sales servicing and training

German-speaking countries

Middle and Eastern Europe

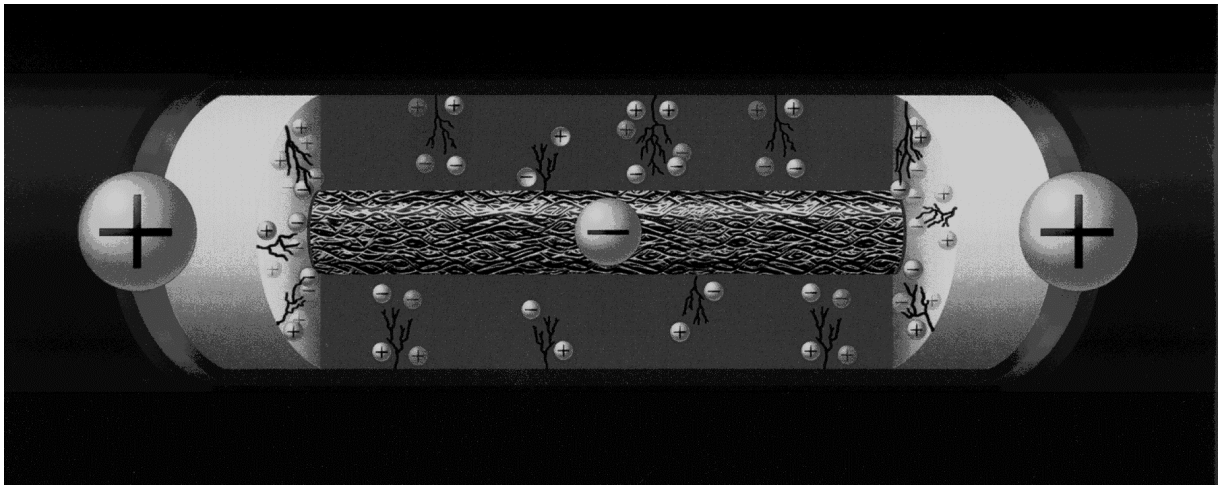
CIS

English-speaking countries

French-speaking countries

America / China / Scandinavian states

VLF voltage test



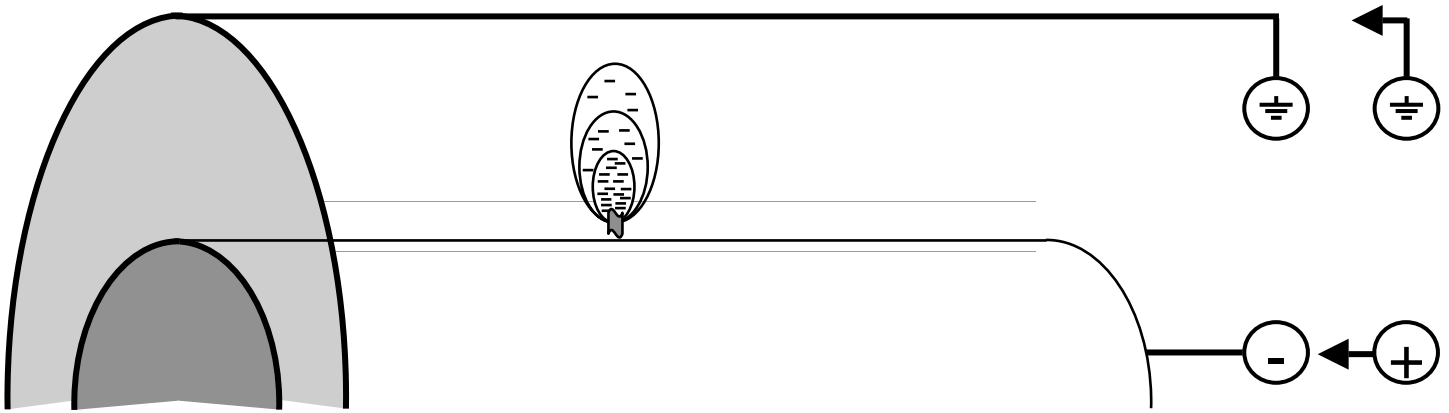
Testing of cables with insulation of polyethylene (PE) and cross-linked polyethylene (CLPE)

Under results of scientific researches, cables with PE and CLPE insulation should not be subjected to constant voltage tests; formally, testing under VLF (0.1 Hz) voltage is recommended (VDE 0276-620 standards)

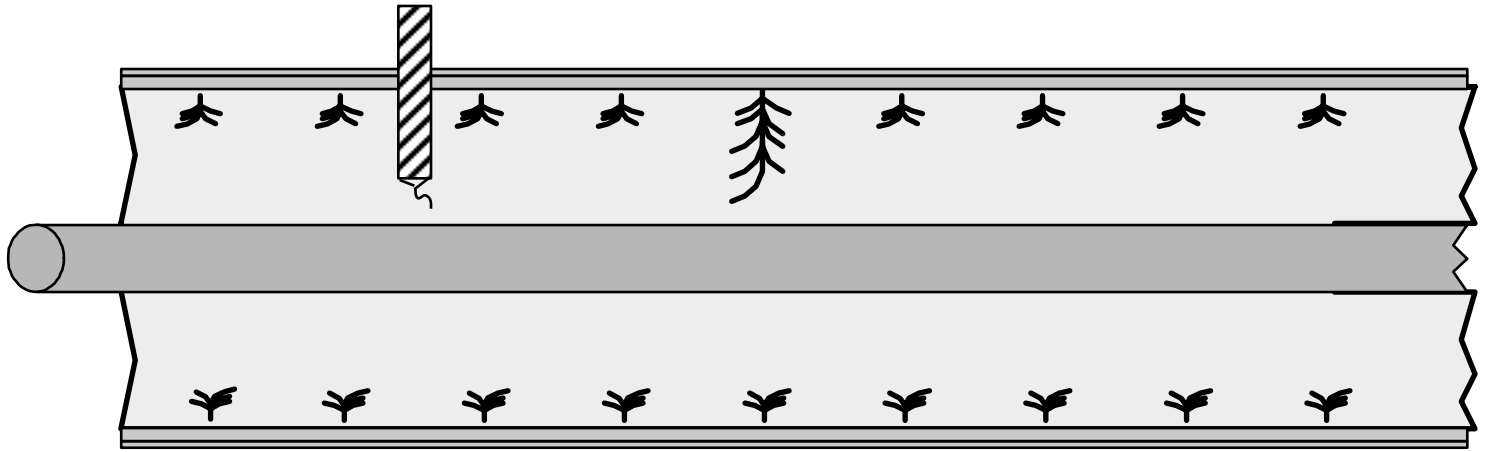
Due to occurrence of space charges during constant voltage tests, cables with PE and CLPE insulation can be damaged or destructed.

Dielectric losses in CLPE insulation are smaller. Running waves formed during breakdown attenuate weaker and, therefore act for longer time.

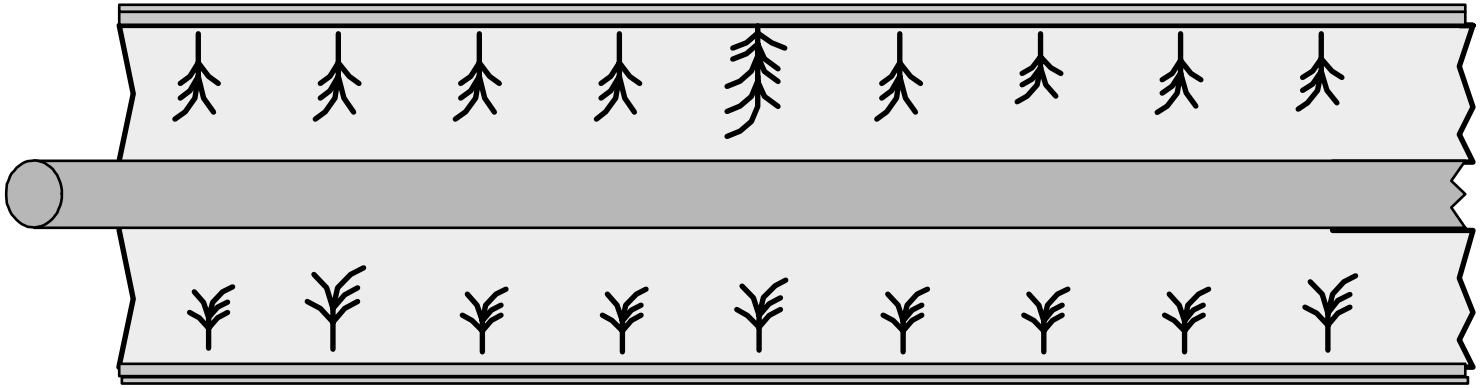
Space charges during constant voltage test



Negative constant voltage injects electrons into dielectric and forms space charges around the damaged point. On test completion, space charges persist. When operating voltage is switched on, voltage gradient and negative space charge increases due to positive half wave.



Cable A: small damages



Cable B: Extensive damages due to water treeings

1. In both cables, VLF voltage testing results in breakdown.
2. Insulation state is determined by cable diagnostics only

Advantages of VLF (0.1 Hz) voltage testing

- During testing of cables with PE and CLPE insulation, there are no space charges in dielectric formed.
- VLF voltage testing is suitable also for cables with oil-paper insulation and lines of cables of both types
- Polarity changes during testing under VLF (0.1 Hz) voltage of cosine-rectangular shape coincide with ones occurred during testing under 50 Hz alternating voltage.

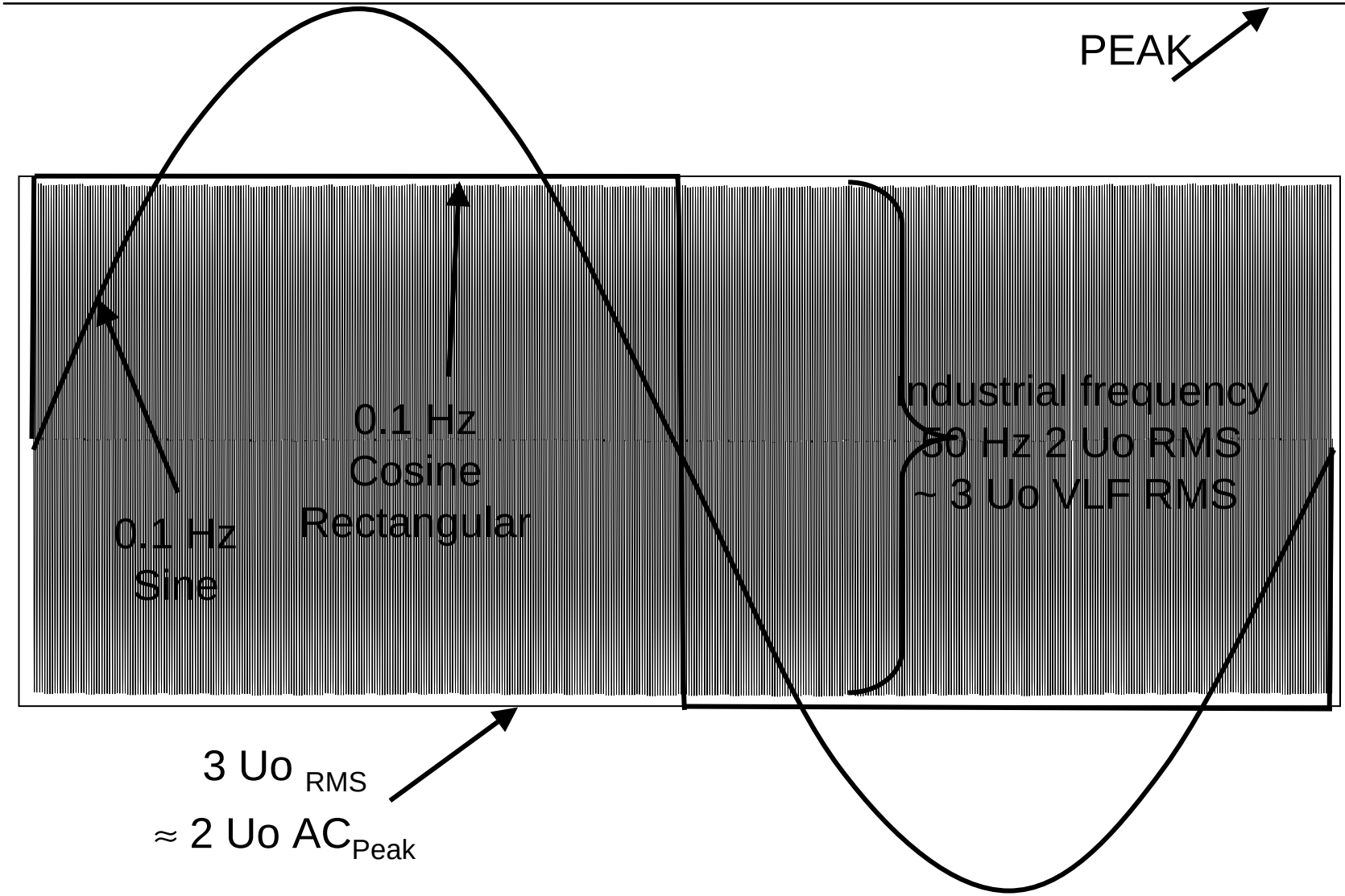
Drawbacks of above testing methods

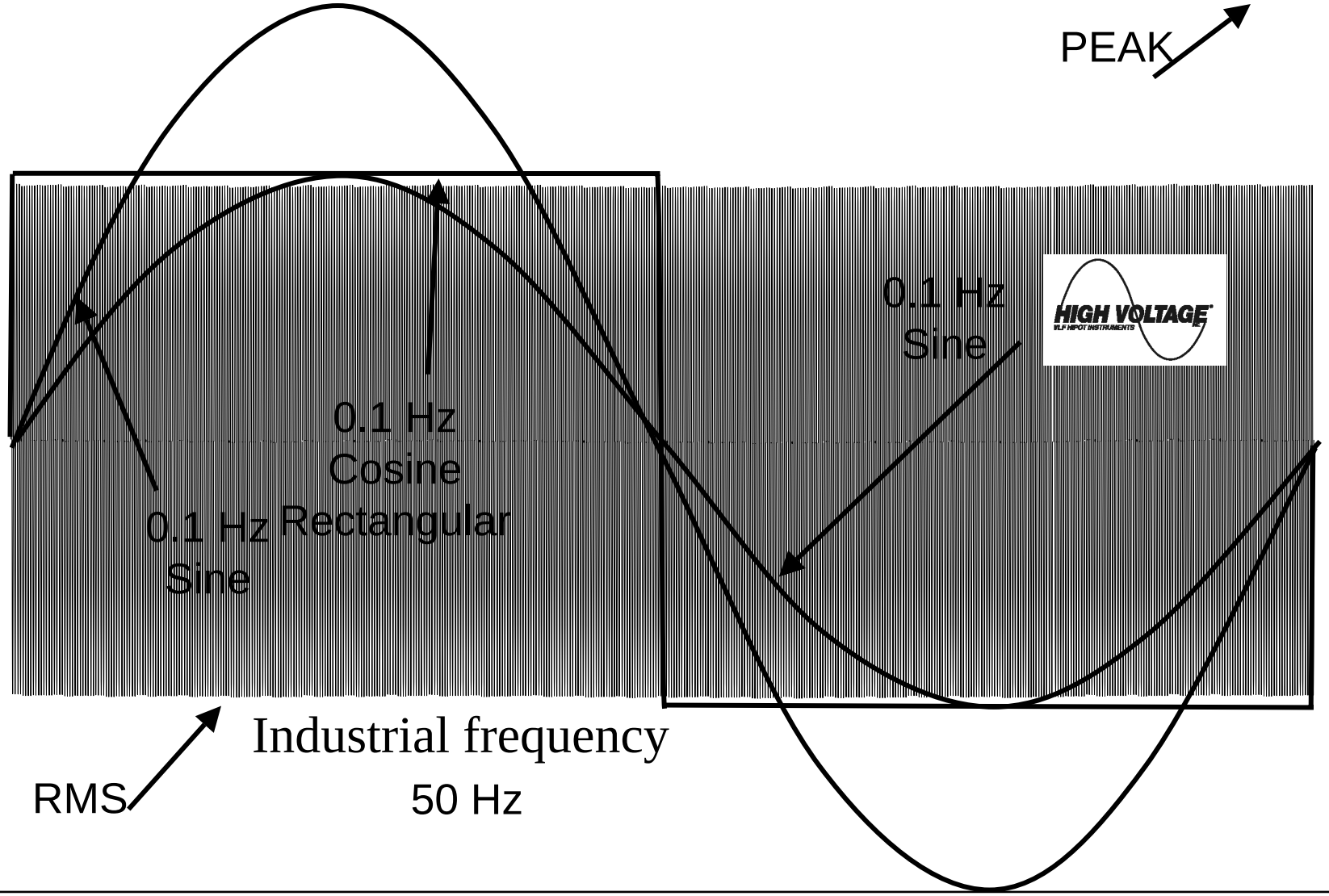
1. Testing under VLF (0.1 Hz) voltage of sine shape

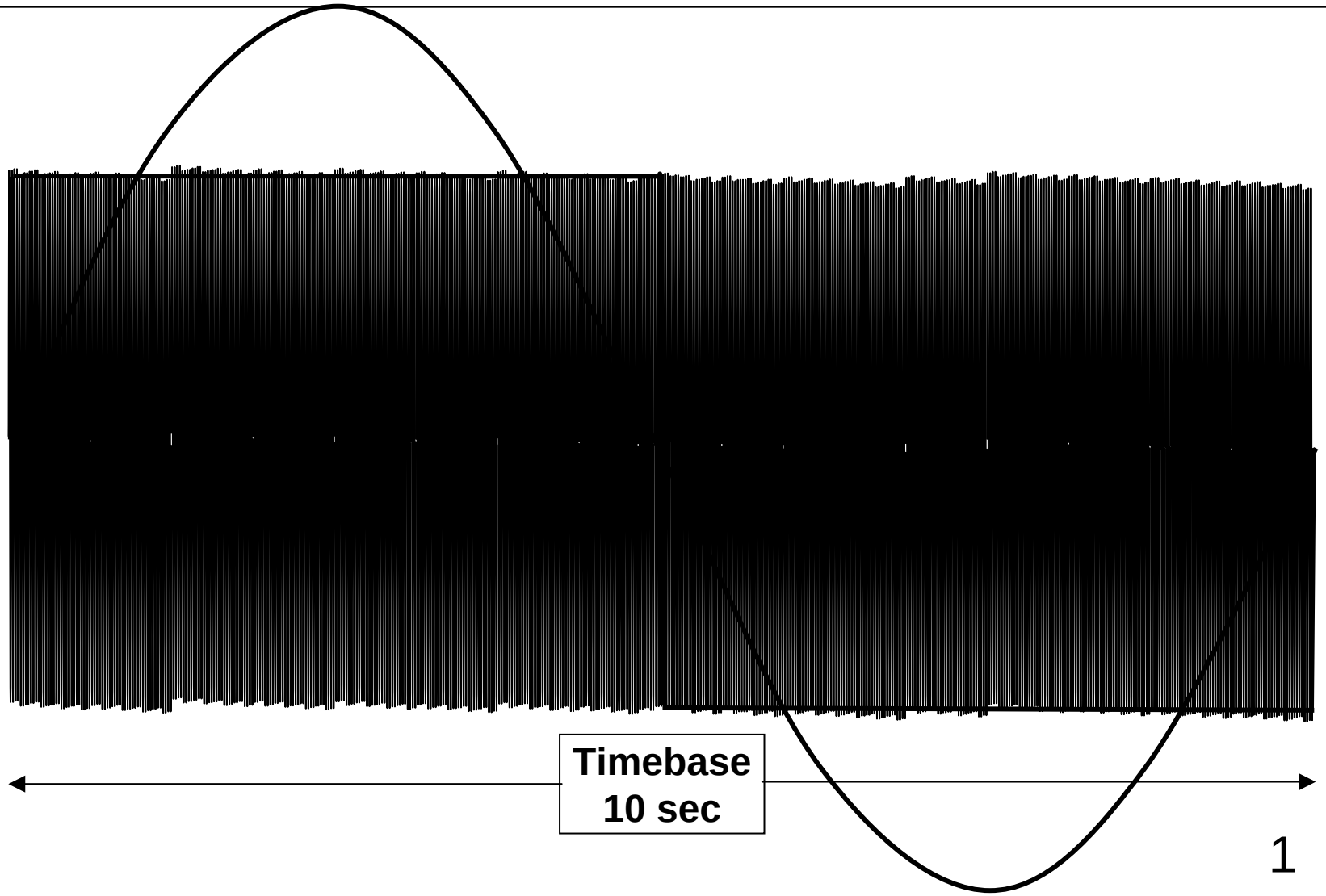
Testing under VLF (0.1 Hz) voltage of sine shape causes continuous growth of water treeings; however, smooth transition of sine voltage results in slow increment of water treeings.

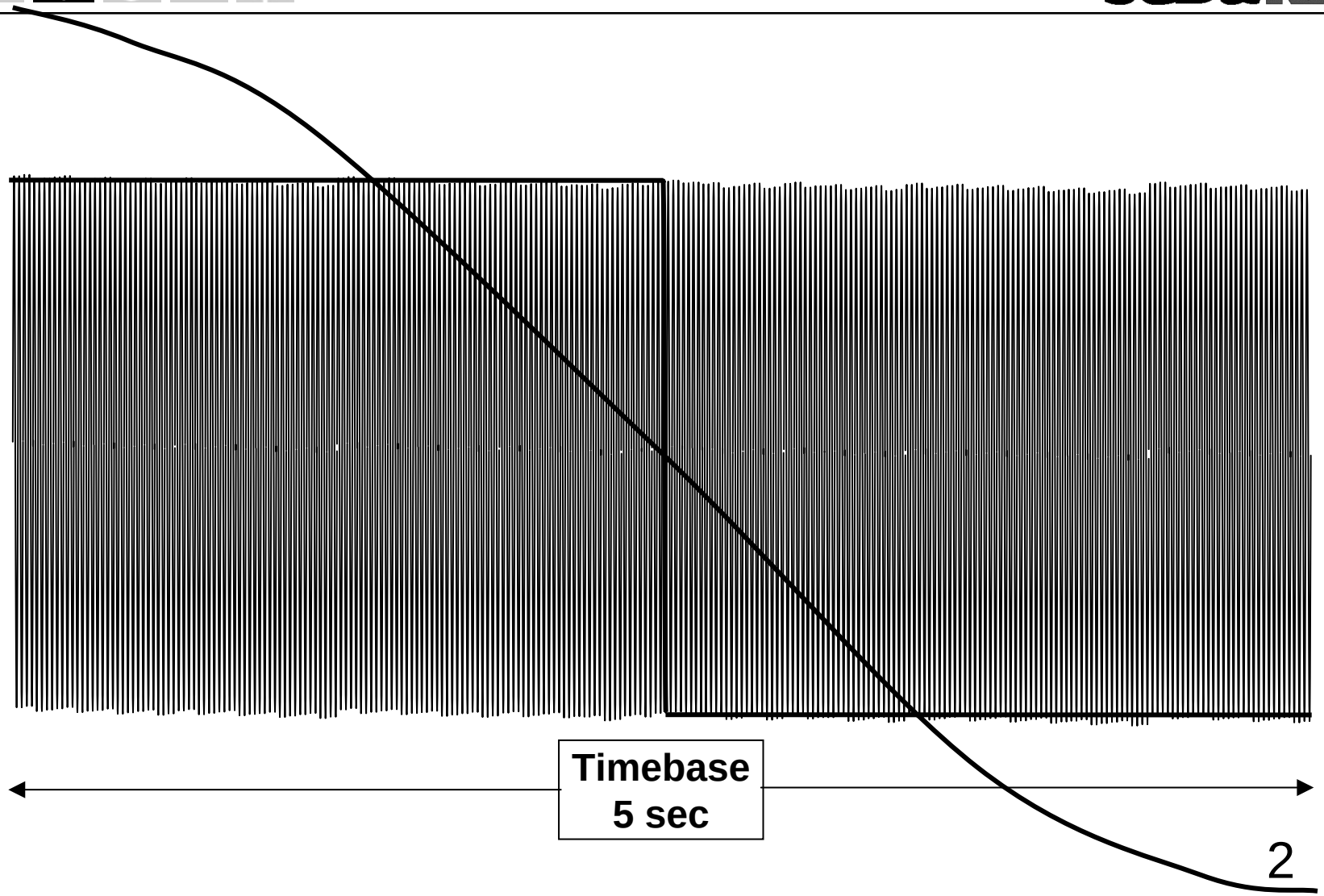
2. Testing under VLF (0.1; 0.05 and 0.02 Hz) voltage

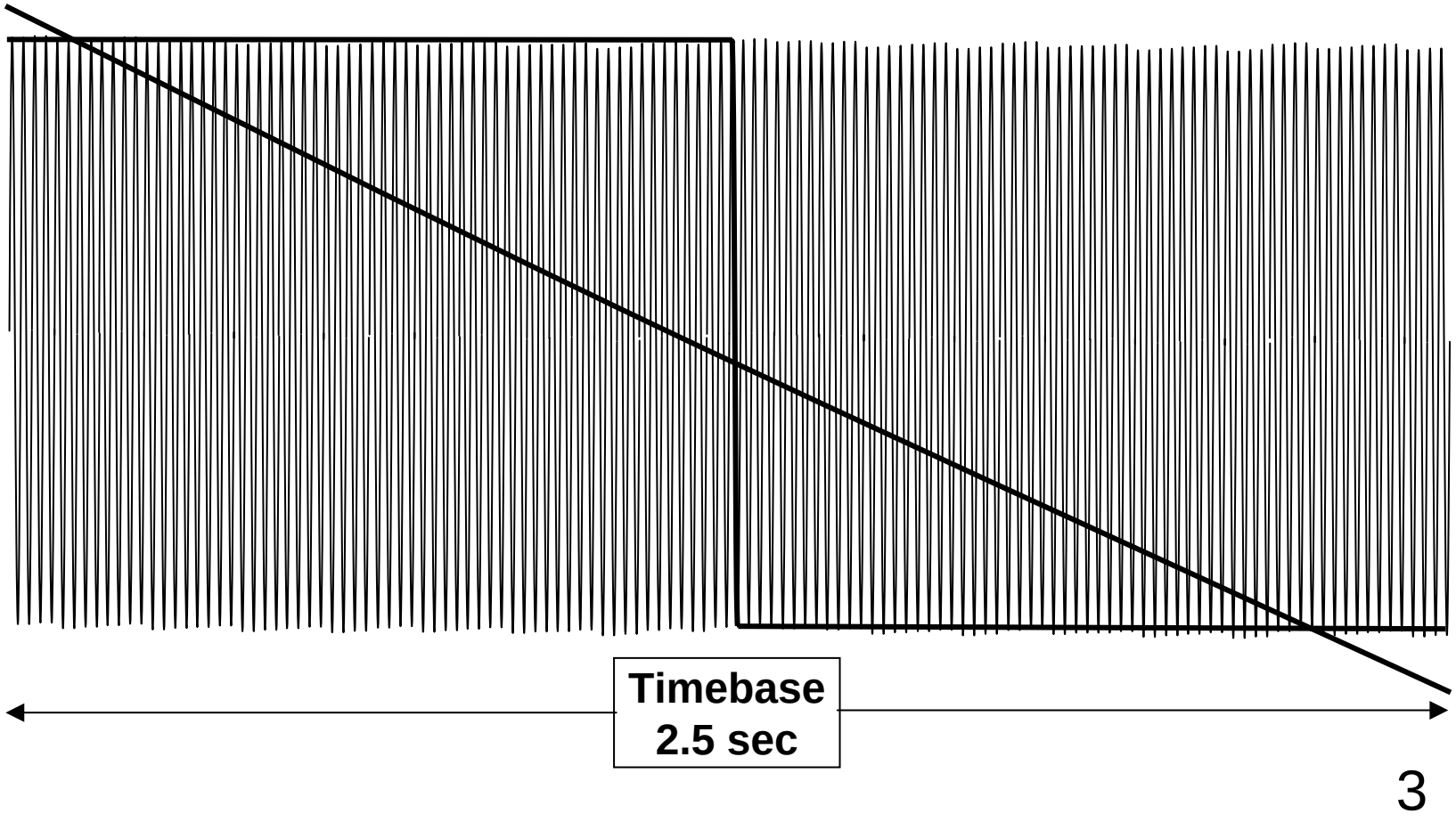
All frequencies below 0.1 Hz are inefficient for tests, since increment rate of water treeings decreases with reduction of frequency; thus, testing time increases from 120 to 180 minutes.


PEAK
0.1 Hz
Cosine
Rectangular
0.1 Hz
Sine
Industrial frequency
50 Hz 2 Uo RMS
~ 3 Uo VLF RMS
3 Uo RMS
≈ 2 Uo ACPeak

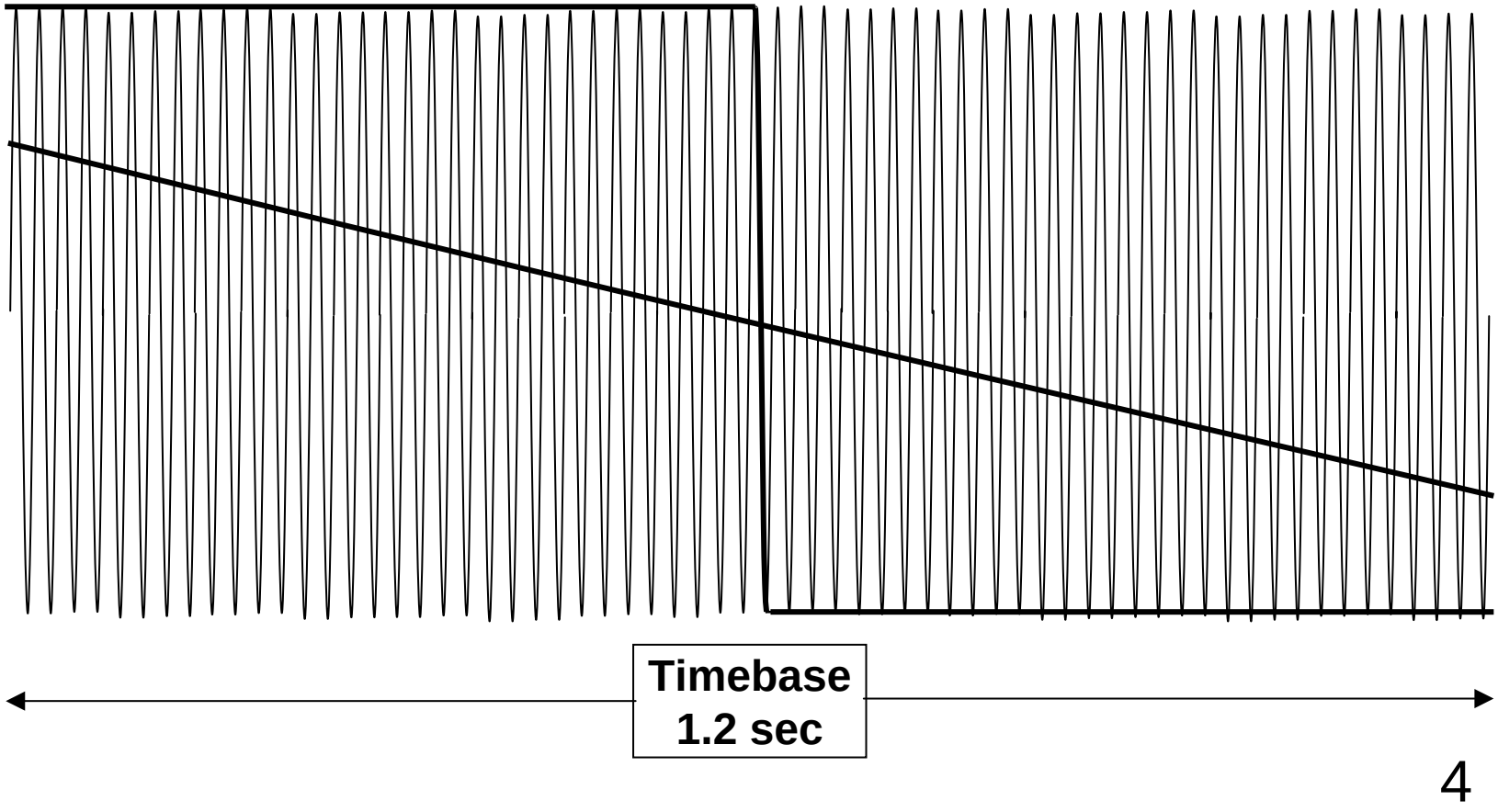

PEAK
0.1 Hz
Sine
HIGH VOLTAGE
VLF HIPOT INSTRUMENTS
0.1 Hz
Cosine
0.1 Hz Rectangular
Sine
Industrial frequency
50 Hz
RMS

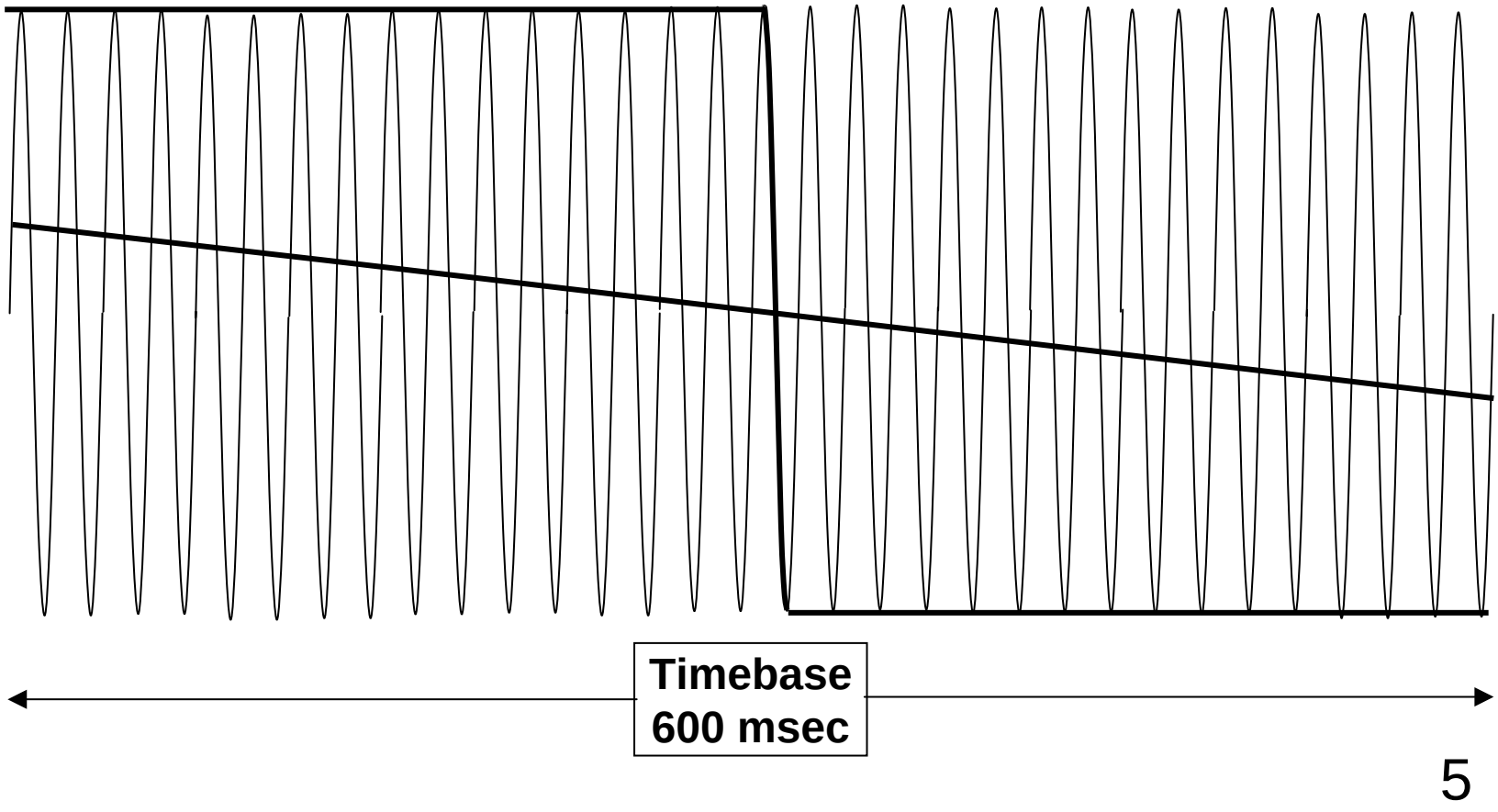

Timebase
10 sec
1


Timebase
5 sec
2

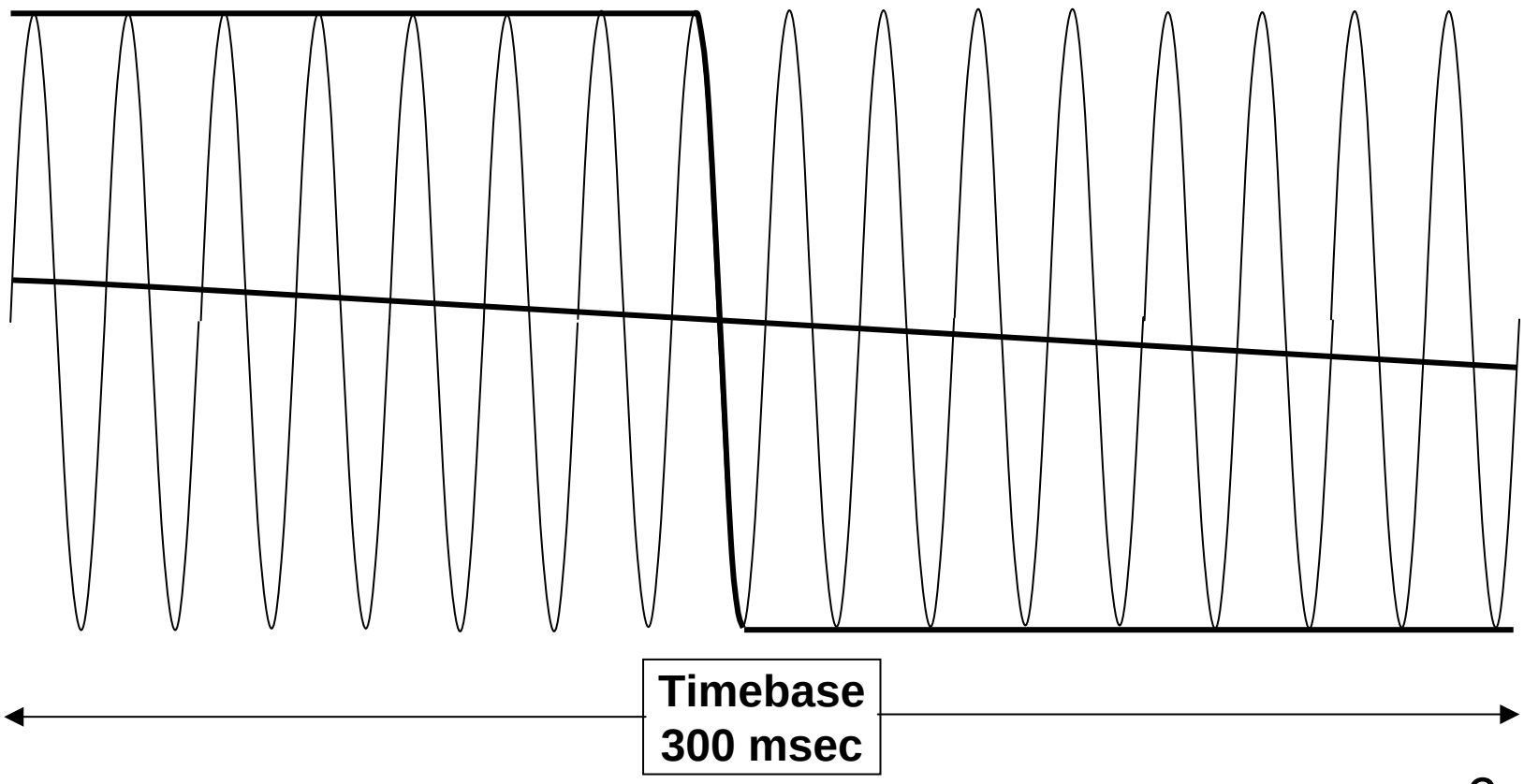

Timebase
2.5 sec
3

≈ 60 Cycles





5



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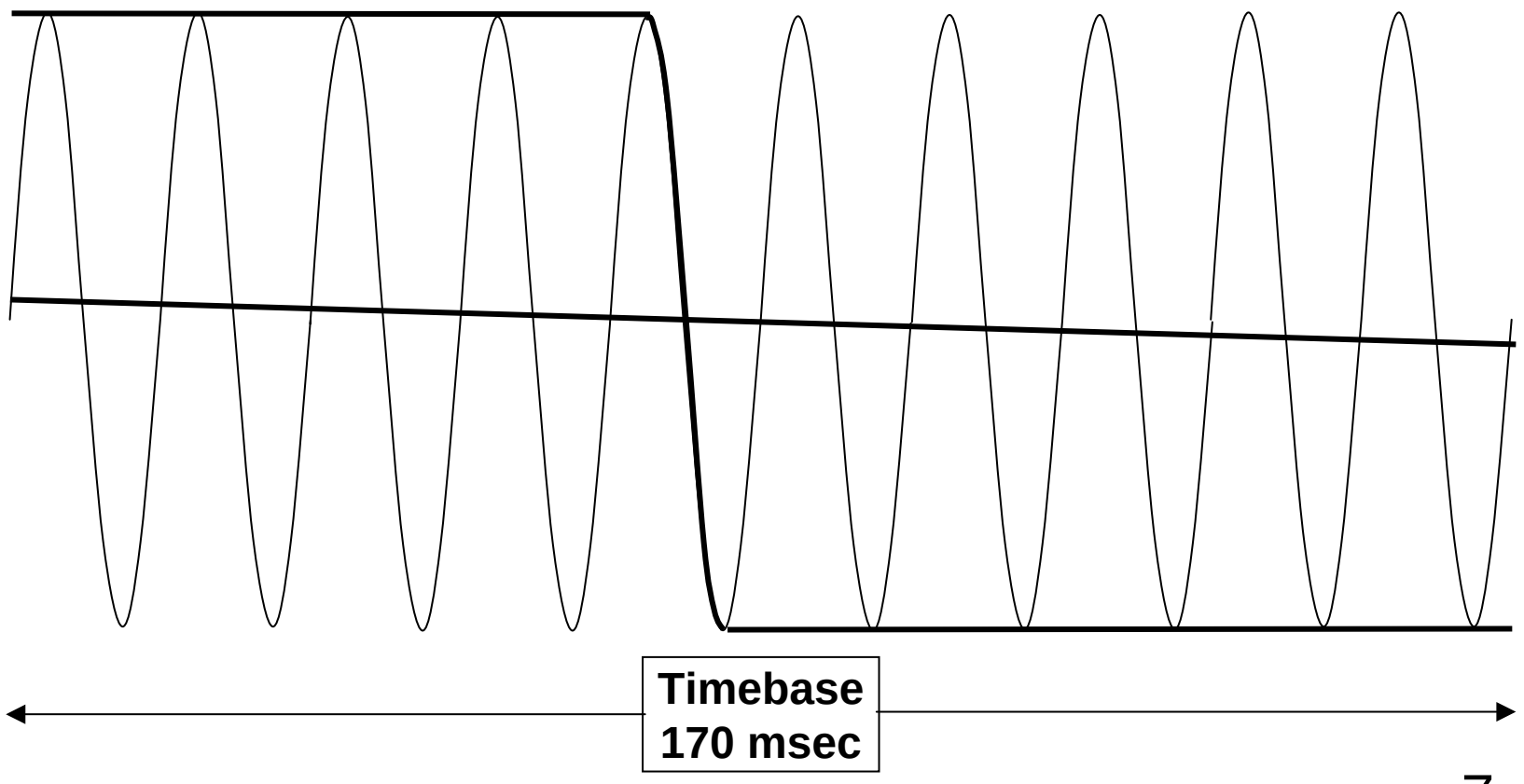

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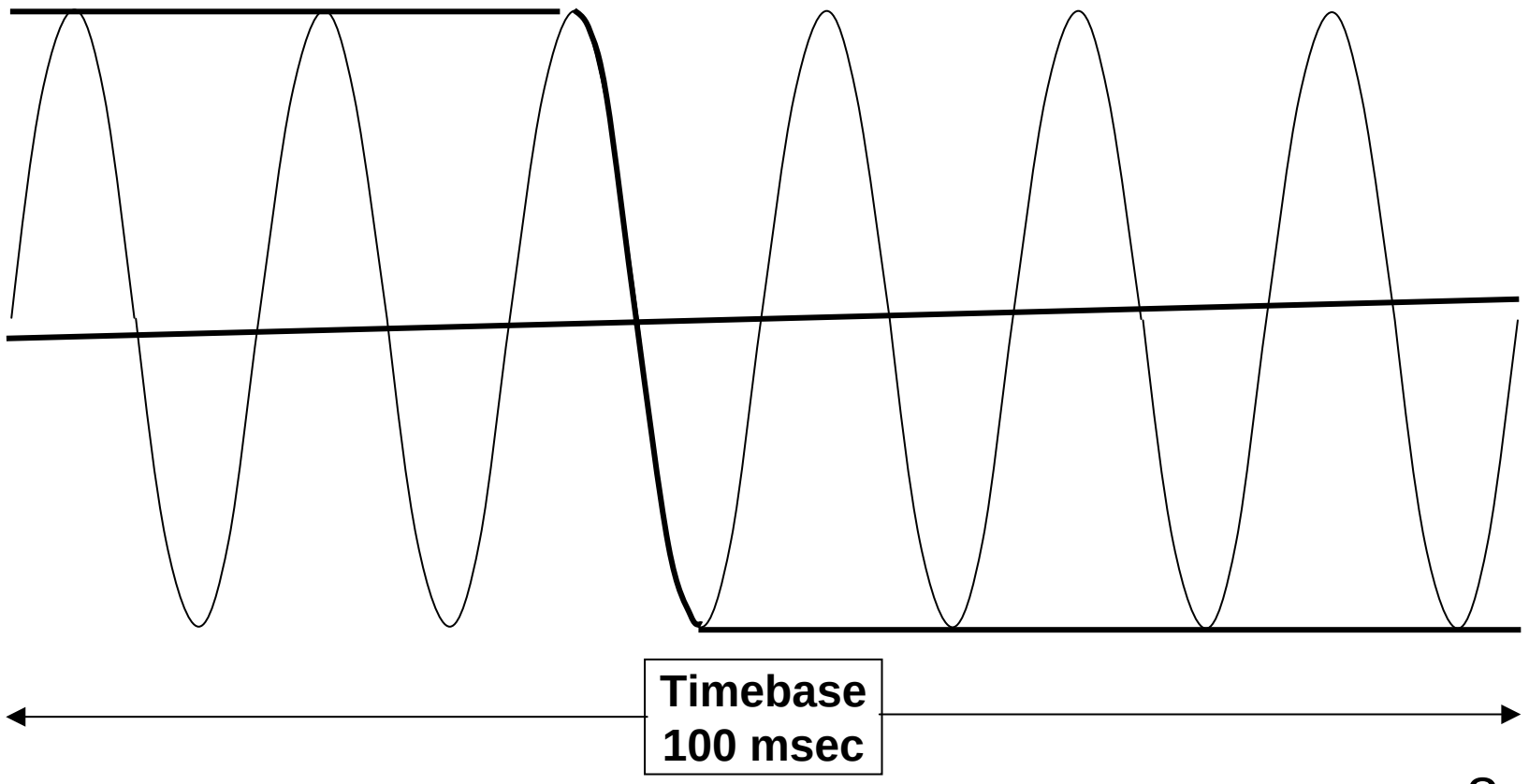
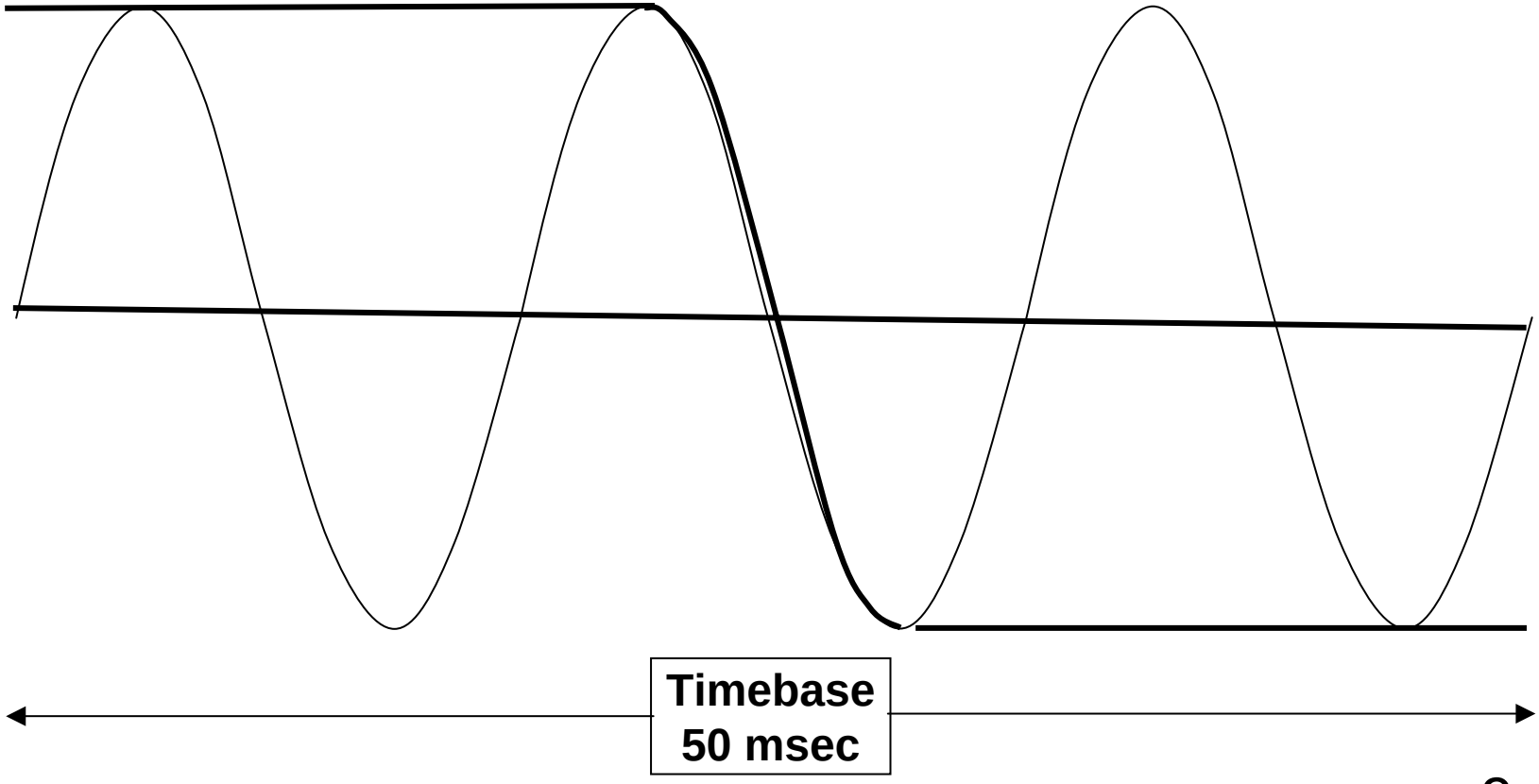
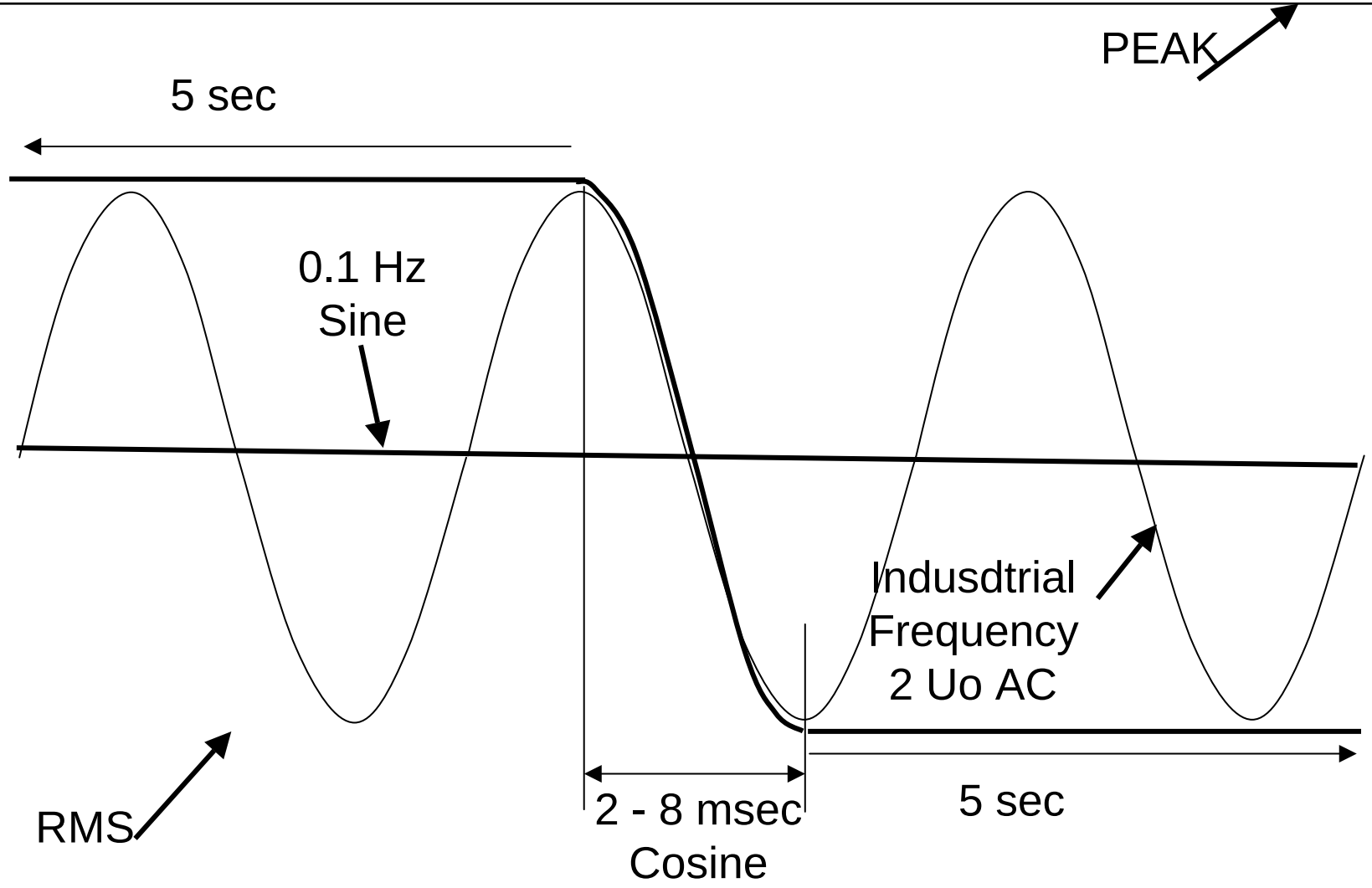
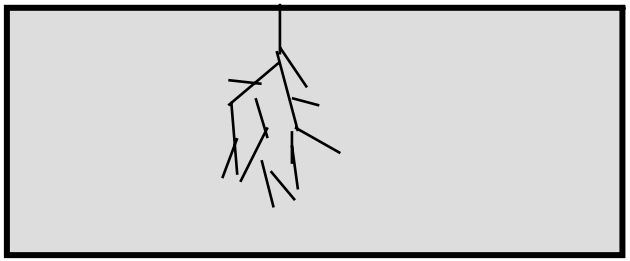

Timebase
100 msec


Timebase
50 msec

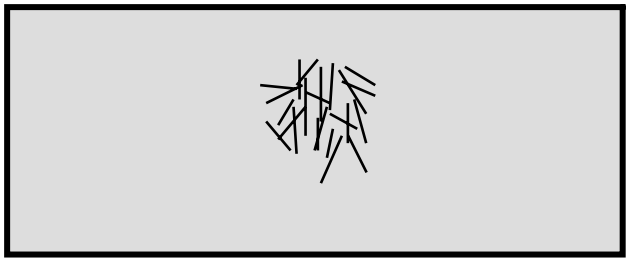

PEAK
5 sec
0.1 Hz
Sine
Indusdtrial
Frequency
2 Uo AC
RMS
2 - 8 msec
Cosine
5 sec

3. AC voltage (50 Hz) testing; resonance method (20..300 Hz)

AC voltage affects water treeings stronger. Rapid alternation with 50 Hz frequency opposes quick increment of water treeings and, thus, does not result in breakdown. Water treeings grow in the form of a bush.



Low frequencies



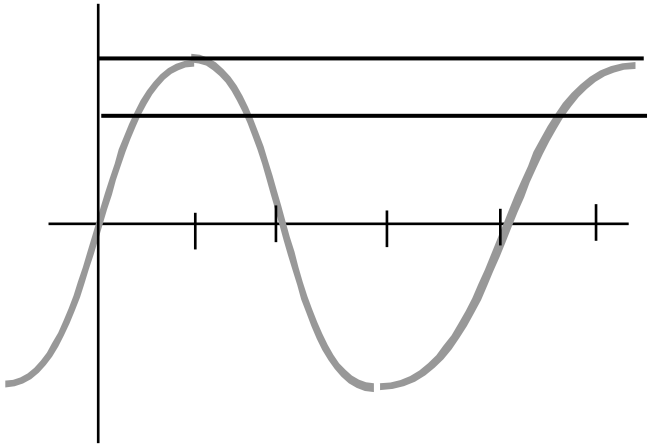
Higher frequencies

At 50 Hz, cable capacitance creates high reactive power; therefore, such test-benches are featured by large dimensions, weight and high power consumption.

Comparison of AC voltage (50 Hz) and VLF (0.1 Hz) voltage tests

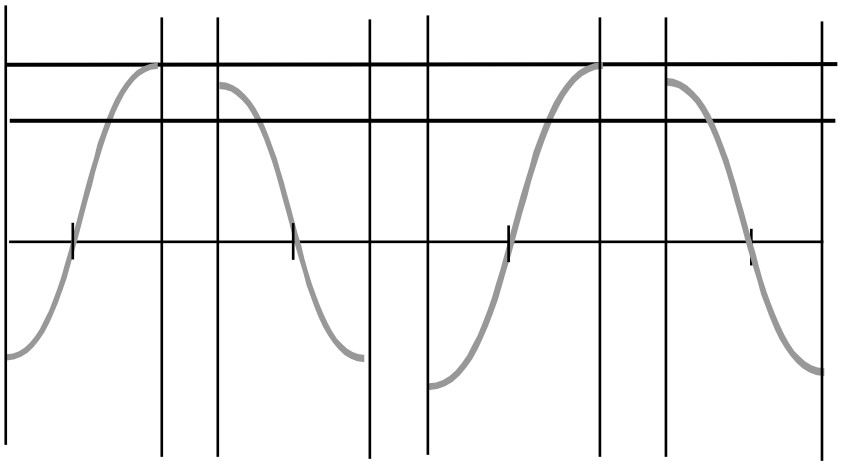
50 Hz voltage test

2 x Uo eff = 2.82 Uo



VLF (0.1 Hz) voltage test

3 x Uo

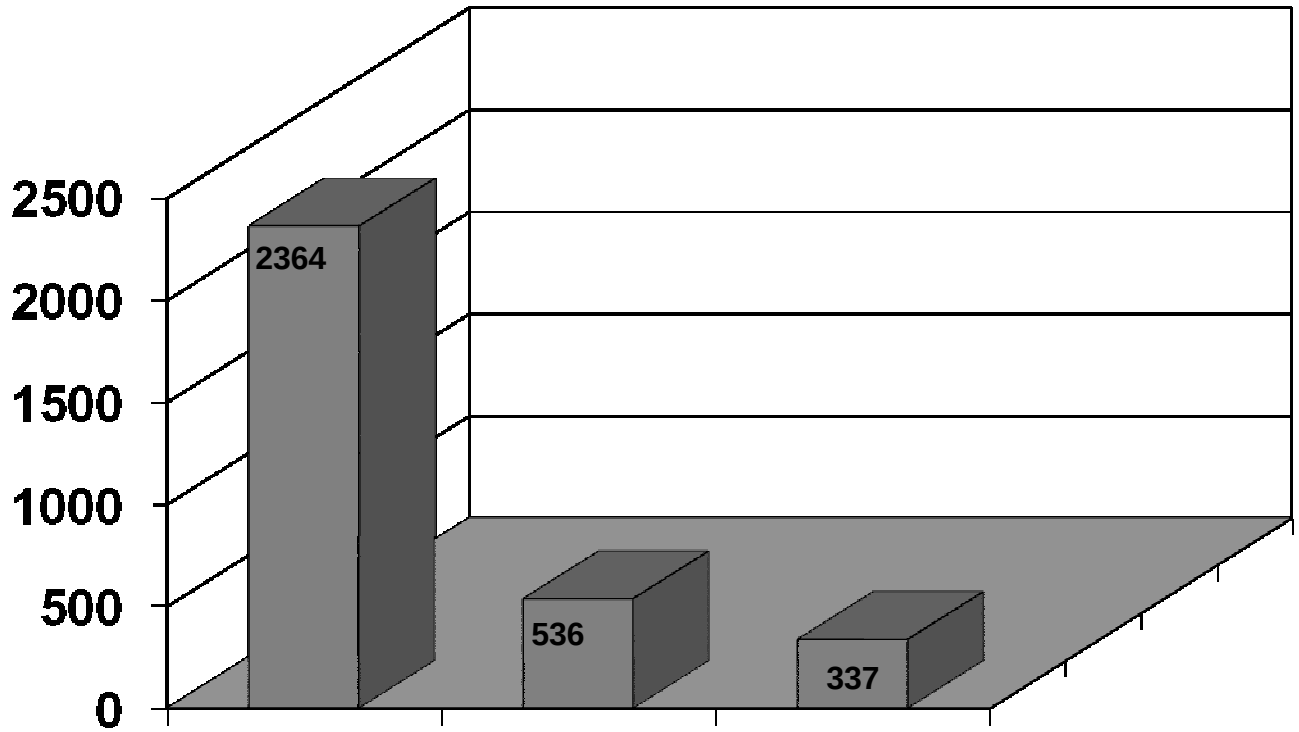


Differences during VLF voltage testing of new and used cables

Urated 60-80 %	New cable VDE recommendation $U_{VLF\ test,\ peaks}$	Used (old) cable $U_{VLF\ test,\ peaks}$
10 kV	18 kV	10 ... 14 kV
11 kV	20 kV	12 ... 16 kV
13.8 kV	25 kV	15 ... 20 kV
20 kV	36 kV	22 ... 28 kV
22 kV	39 kV	23 ... 31 kV
Test time	60 minutes	60 minutes

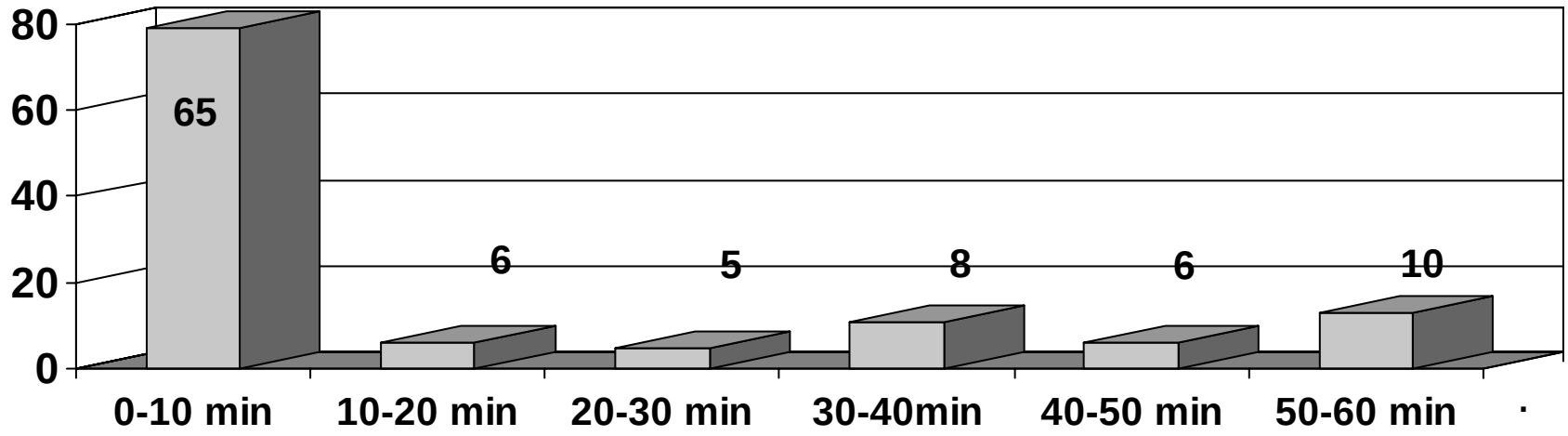
Following testing, cable should be grounded for 30 minutes.

Within 1987 – 1998, cable lines with different insulation were tested by means of VLF systems



Tested systems	mixed	plastic	paper
length (km)	2425 km	454 km	305 km

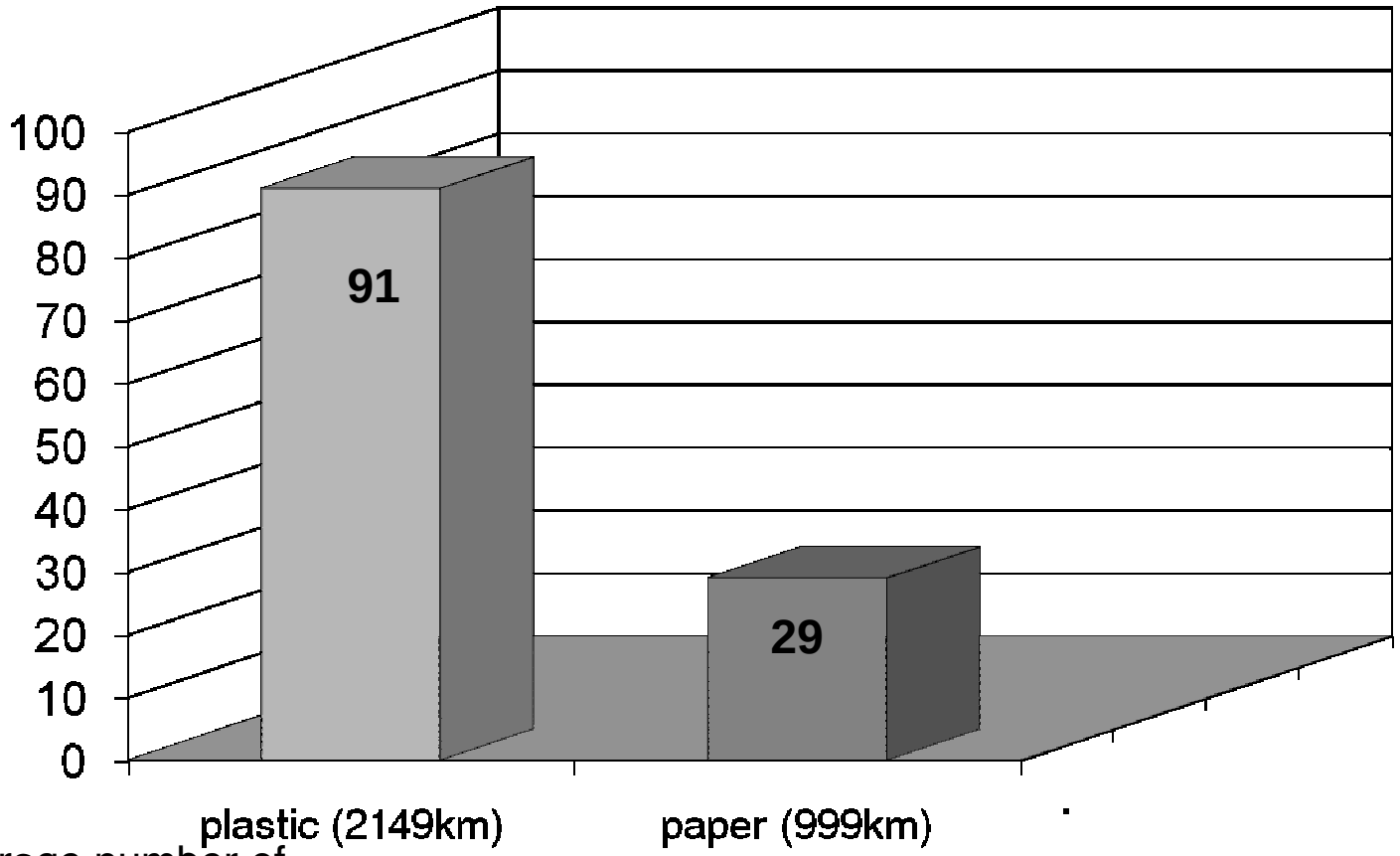
Breakdown recorded during such tests by the time of their occurrence



65 % of all breakdowns are detected within first 10 minutes
76 % of all breakdowns are detected within first 30 minutes

Experience shows that no new damages in operable cables are formed during VLF voltage testing.

Average number of breakdowns per 100 km



Average number of breakdowns per 100 km:	4,2	2,9

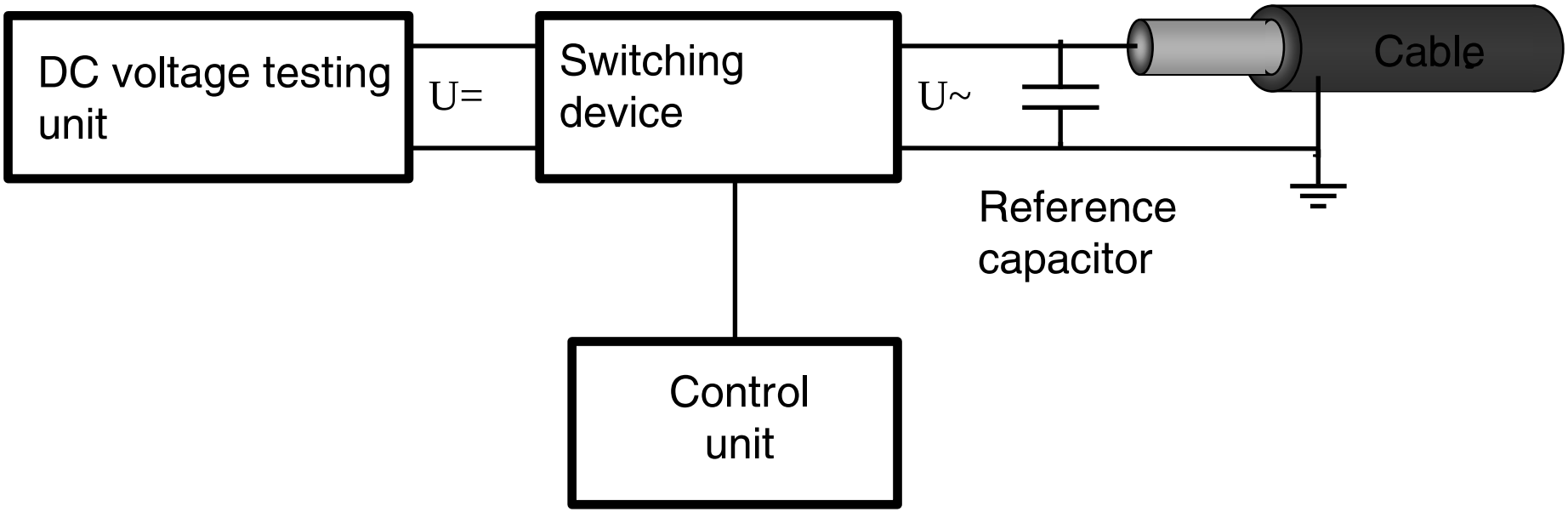
Analysis of recorded damages

All damages in couplings result in breakdown within first 20 minutes (with majority of 88% detected even within first 10 minutes).

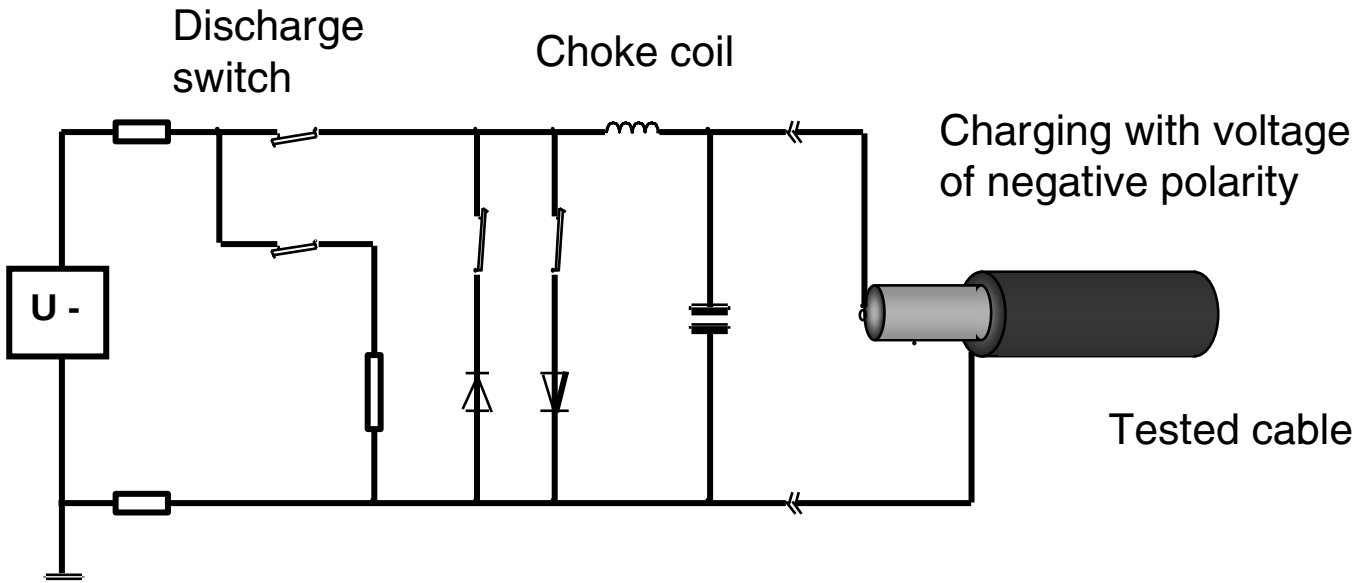
Cables with plastic and oil-paper insulation have comparable properties with regard to breakdowns. More than 75 % of all damages result in breakdown within the first half-hour (with majority of 65 % - within first 10 minutes).

During VLF voltage testing (despite of lower lever of VLF voltage as compared with DC voltage testing), damages presented in cables with oil-paper insulation result in breakdown for very short time. Thus, this ntesting is well suited to cables with oil-paper insulation.
In considerable number of cases, water treeings in CLPE insulation result in breakdown only within the short time prior completion of testing. Thus, 1 hour is justified as time for testing.

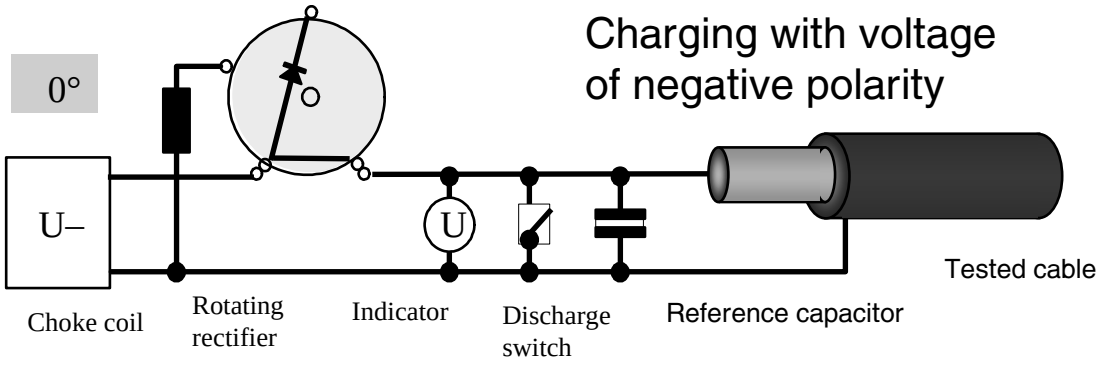
Operation principle of VLF generator

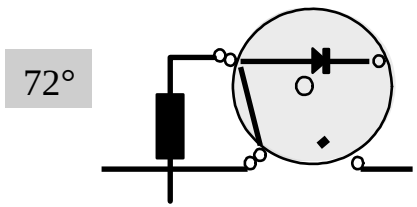


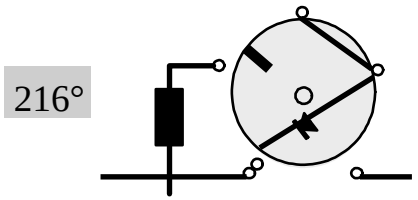
Operation principle of VLF generator (27 kV)

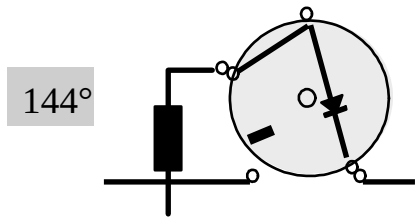


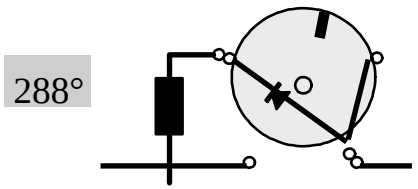
Operation principle of VLF generator (52 kV)



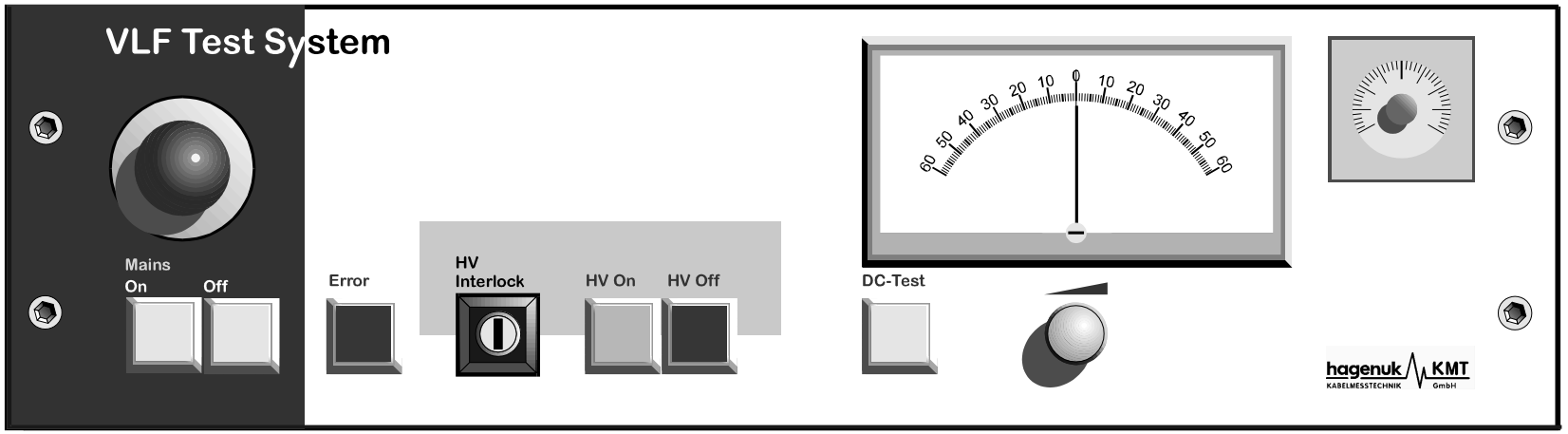






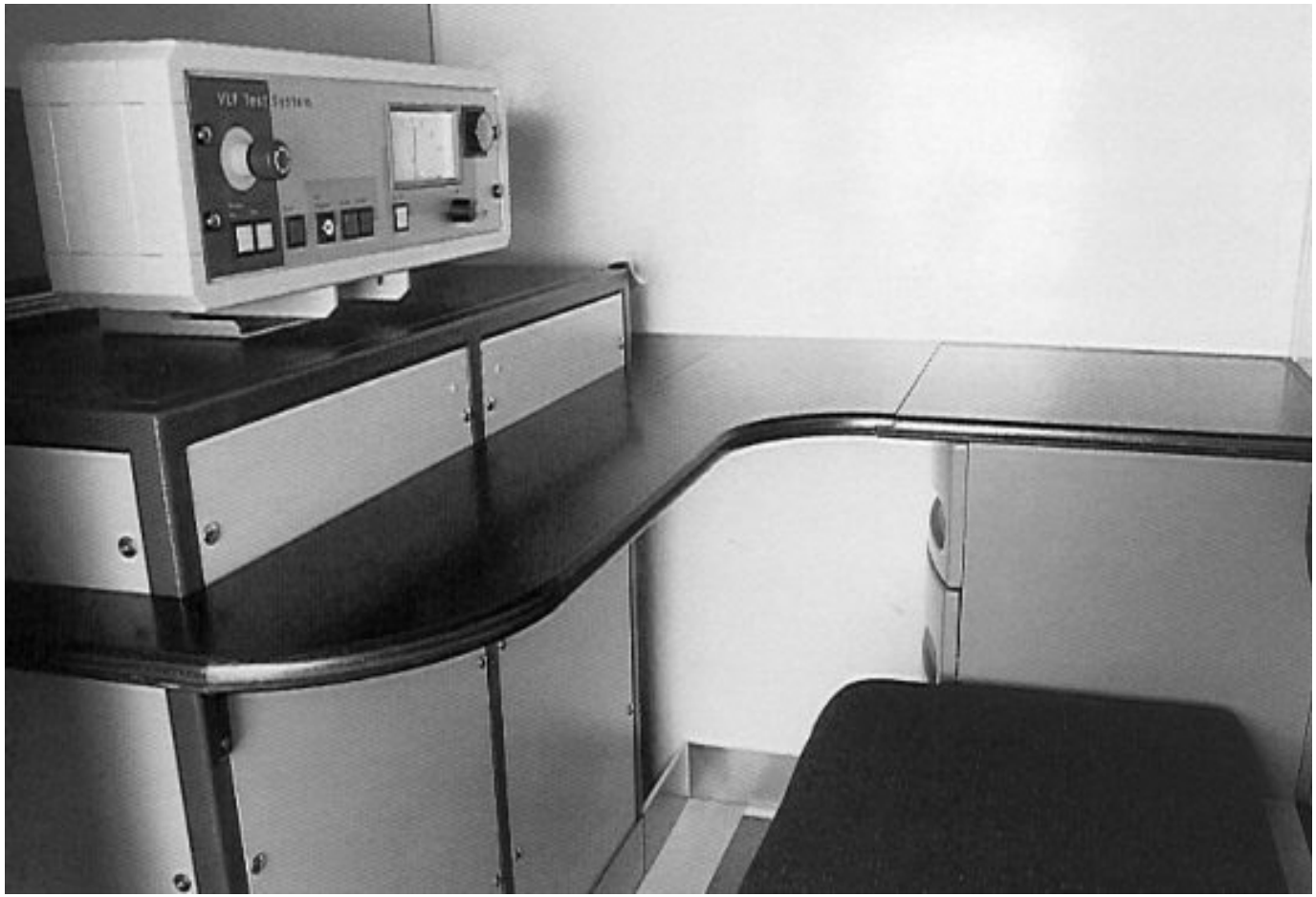


VLF system control unit (52 and 70 kV)



Trailer-mounted VLF systems (52 and 70 kV)

52 kV VLF system (inside trailer view)



Technical data of 114 kV VLF system

Output DC voltage	0 -114 kV
Output current I_{max}	4 mA
Safety circuit	Activation in the event of breakdown
Output VLF voltage	0 -114 kV
Frequency	0.1 Hz
Oscillation shape	Cosine-rectangular, symmetric
Voltage measurement	Directly at output
Max. tested capacitance	1 µF at 114 kV/ 2.5 µF at 57 kV
Discharger	System component part
Discharge capacitance	5 µF per 3 s
Supply voltage	115/230 V ± 10% 50/60 Hz
Consumed power	2.5 kVA
Overall dimensions	(width x height x depth)
	1500 x 1400 x 2200
Cable length	50 m
Climatic conditions	Operating temperature:-25°C to +55°C Max. humidity: 93% at 30°C
	Storing temperature:-40°C to +70°C Max. humidity: 95% at 40°C
Total weight	400 kg without cable reels


VLF Test System 114 kV
hagenuk KMT
KABELMESSTECHNIK GmbH

Portable VLF system (20 kV)

Portable VLF system (20 kV)
Technical data

• DC testing voltage	• 0...20 kV
• Voltage shape	• cosine-rectangular
• VLF testing voltage	• 0...20 kV / 0.1 Hz
• Cable capacitance testing	• 3 μF / 0... 20 kV
• Discharger	• 10 μF per 3 s
• Operating temperature	• -20^0C to $+40^0$C
• Power supply	• 230 V, 50 / 60 Hz 115 V, 50 / 60 Hz
• Overall dimensions (B x H x T)	• 520 x 600 x 300 mm
• Instrument weight	• < 50 kg, carried

Portable VLF systems (40 and 60 kV)

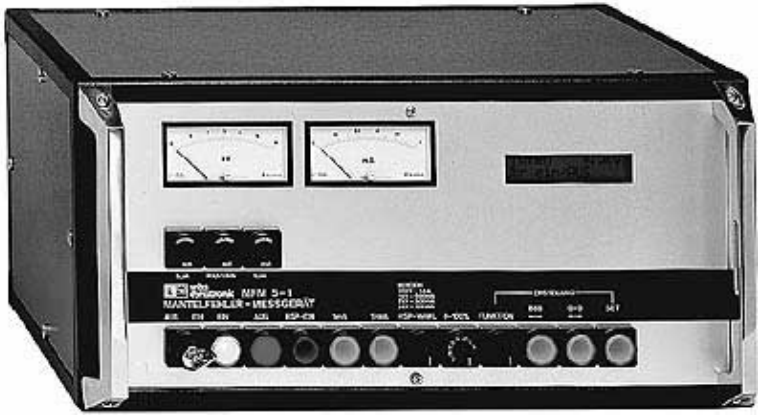
Technical data of portable VLF systems (40 and 60 kV)

Option	40 kV VLF		60 kV VLF	
Max. tested cable series under HD 620S1	**22 kV**		**35 kV**	
Execution	**Basis**	**Plus**	**Basis**	**Plus**
Max. tested capacitance during 0.1 Hz voltage (eff.) testing	**2.2 µF**	**4.4 µF**	**0.8 µF**	**1.5 µF**
Max. tested length of 33 kV cable CLPE/PE with Up= 57kVA= 500 mm^2			**3 km**	**5.5 km**
Max. tested length of 33 kV cable CLPE/PE with Up= 57kVA= 240 mm^2			**4 km**	**7.5 km**
Max. tested length of 22 kV cable CLPE/PE with Up= 38kVA= 500 mm^2	**6 km**	**12 km**	**5.5 km**	**9 km**
Max. tested length of 22 kV cable CLPE/PE with Up= 38kVA= 240 mm^2	**8 km**	**16 km**	**7 km**	**13 km**

Options of portable VLF systems (40 and 60 kV)

- Double power due to two sources of positive and negative polarities
- Recognition of breakdown in cables with automatic shutdown and storing breakdown voltage value
- Measurement of VLF leak current
- On-site printing out of brief test protocol
- Logging system using magnetic card; setting and storing of parameters on magnetic card

Cable measurement system MFM 5-1



Technical data

•Test voltage	*0.5 - 1 - 2 - 5 kV, DC*
•Test current	*1 mA, 10 mA*
•Current in the mode of damaged point localization	*0.15 – 0.3 – 0.6 – 1.5 A, DC*
•Clock train	*1:3 – 0.5:3 – 0.5:6 s*
•Measuring instruments	
Voltmeter	*0-6 kV/m*
Ammeter	
•LCD	*2 x 16 characters, with backlight*
•Length setting	*1 - 9999 m*
•Measurement time	*1 - 99 min*
•Power supply	*230 V AC ± 10%, 45...60 Hz*
•Consumed power	*600 VA*
•Weight	*30.6 kg (including cables)*

Measurement system for cable shell MFM 5-1 is multi-purpose instrument. In addition to cable shell testing, it allows preliminary and accurate localization of damage in such a shell. Instrument is controlled by means of a menu.
In testing mode, 1 and 10 mA current can be measured within the full range. It allows detection of smallest insulation flaws in cable shell.
To reduce thermal load in the place of defect, following measures are undertaken in order to prevent damaging of conductor insulation:
•Preliminary localization of damage point (reduction of measurement time)
•Current pulses (reduction of load in the damage point)
•Limitation of current (also, for reduction of load)

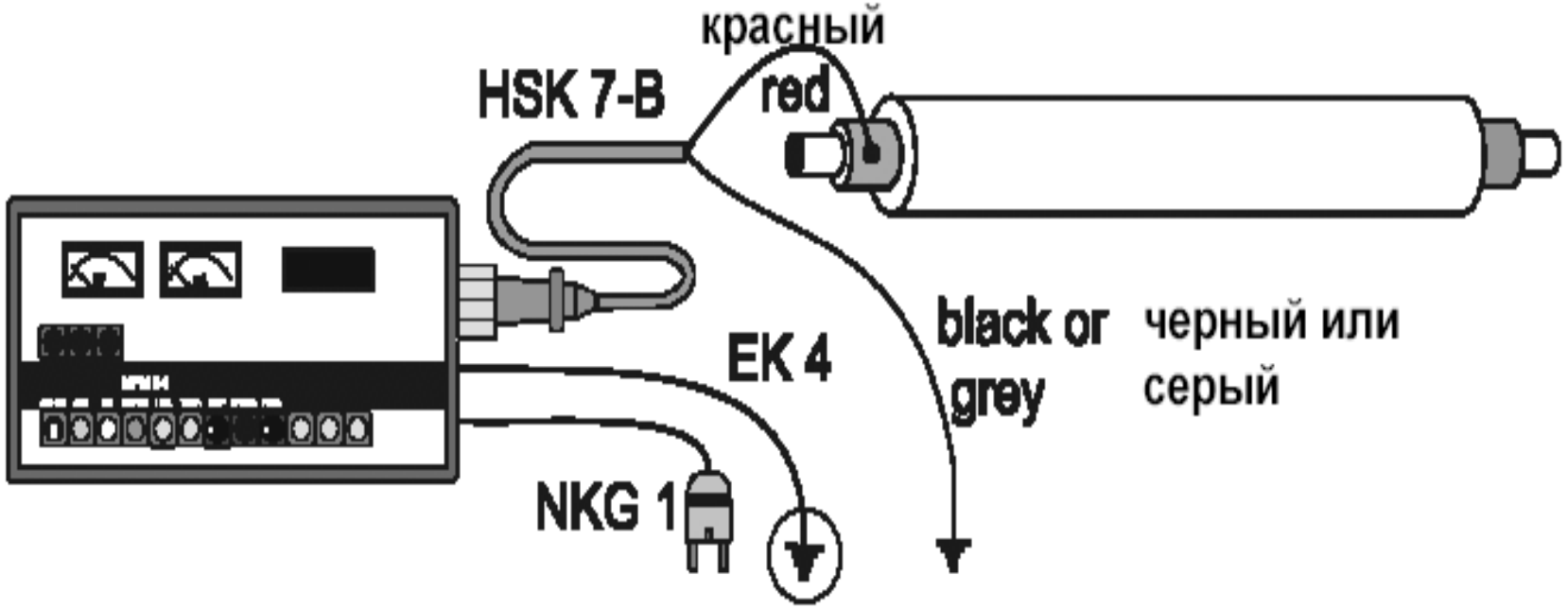
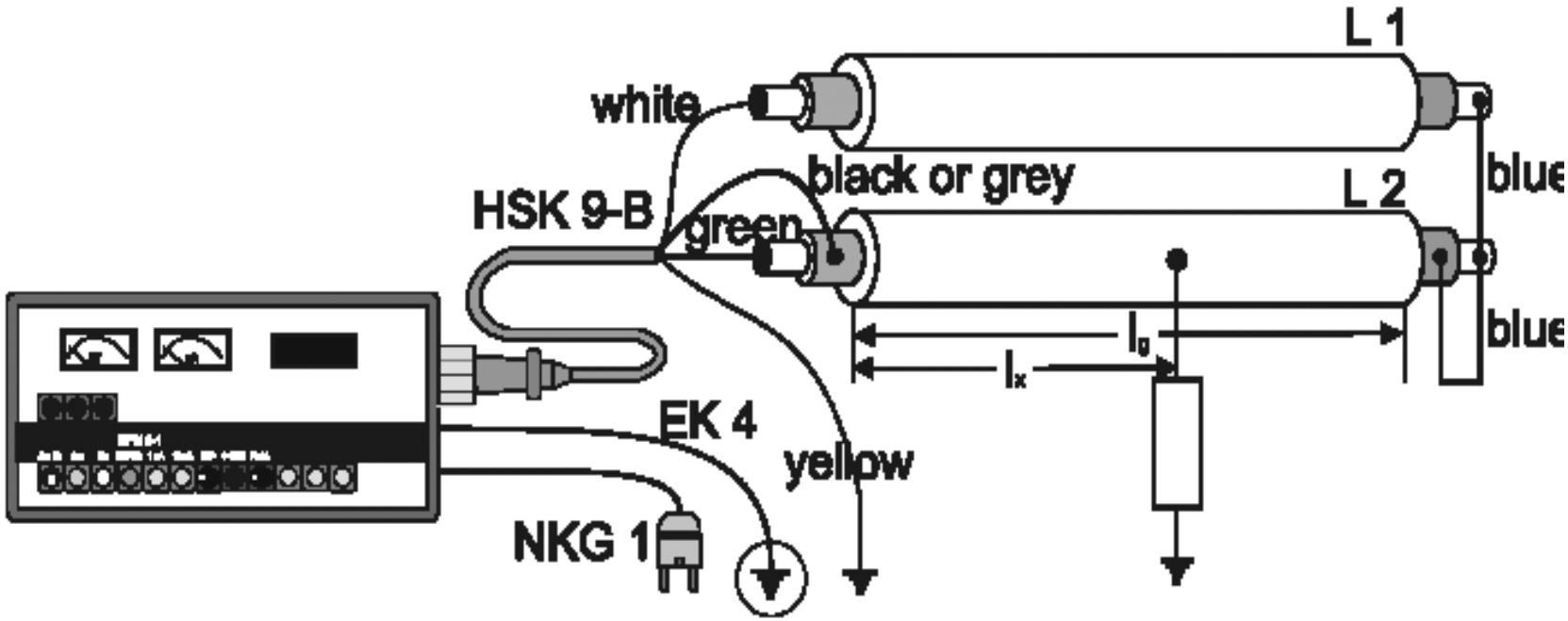


Рис. 1: Схема соединений 1 для испытания оболочки и точной локализации места дефекта

Fig.1: Connection diagram 1 for shell testing and accurate localization of damage point



(white – белый; black or gray – черный или серый; blue – синий; green – зеленый; yellow – желтый)

Рис. 2: Схема соединений 2 для тестирования оболочки с предварительной и точной локализацией дефектов

Fig.2: Connection diagram 2 for shell testing with preliminary and accurate localization of flaws

ESG 80 instrument for accurate localization of ground fault in cable shell

Technical data:

Measuring instrument	**50 - 0 - 50 µA**
Sensitivity without amplifier	
Depending on sensitivity control setting	
	***6 0.14 V**
	***5 0.40 V**
	***4 1.20 V**
	***3 2.60 V**
	***2 3.80 V**
	***1 4.60 V**
Sensitivity with amplifier	
	***6 0.5 mV**
	***5 5.0 mV**
	***4 30.0 mV**
	***3 125.0 mV**
	***2 500.0 mV**
	***1 2000.0 mV**
Input resistance without amplifier	**max . 700 kOhm**
Input resistance with amplifier	**100 kOhm**
Compensation in all ranges:	**+/- 100%**

Fault localizer ESG 80 represents sensitive DC millivoltmeter for searching of ground fault places in cable shells or conductors in plastic insulation.
Its main destination is localization of shell flaws in plastic cables.
It can be used in combination with following generators of constant current pulses:

- *BT 500-IS-1 (0-0.5/1/2 kV)*
- *HPG 12/24 (0-12 or 24 kV)*
- *MFM 5-1 (0-0.5/1/2/5 kV)*

Easytest 10/20 kV

Reliable and simple testing following cable repair and laying

Simple control
Programmable testing sequence
Compact-size, robust housing, small weight
With no polarization
Full AC voltage testing

Technical data:

AC tests (10/20 kV) 2.5/0.5 µF @ 0.1 Hz
DC tests (0 – 10/20 kV) with leak current measurement
Leak current measurement - 1mA measurement range
Recognition of breakdown – Visual alarm
Timer: 0 – 60 min.; 5 min. increment
Shell testing: 0 – 5 kV, 0-10 kV
Localization of shell damages: 0 – 5 kV, 0-10 kV, DC clock pulse - 1:3
Safety F-Ohm control/ emergency shutdown, high voltage locking
Power supply: 110 V or 230 V, 750 W
Overall dimensions: 480 x 290 x 495 mm; weight: 17 kg
Protection class: IP 56, with closed cover
Operating temperature: -20 ° C … +50 ° C
Storing temperature: -20 ° C … +60 ° C