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RESEARCH , DEVELOPMENT AND TESTING NATIONAL INSTITUTE FOR ELECTRICAL ENGINEERING

ICMET CRAIOVA ROMANIA HIGH VOLTAGE LABORATORY - LIT

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TEST REPORT No. 41105 / 25.05.2007

- 1. Product: Early Streamer Emission Lightning Conductor-ESELC type SCHIRTEC - DAS
2. Test: Evaluation of the initiation advance according to NFC 17 - 102 / 1995 Standard
3. Test order: INVOICE No. 10148
4. Customer: SCHIRTEC Trading GmbH
5. Customer's address: Ignaz - Kock Strasse 10/Top 1.6, A - 1210 Wien, Austria
6. Test result: There are presented the measurements results
7. Test responsible: Eng. I.Badea

Test Supervisor Eng. A. Ungureanu

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Q.A. Responsible: Eng. Gh. Macovei



- 8. The test report contains 12 pages.
9. The test report was edited in 4 ex.; 1 ex. to LIT and 3 ex. to customer.

CAUTION:

- a. The test result makes reference only to tested product.
b. Integral reproduction of the test report is forbidden.
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1. Tested material

Early Streamer Emission Lightning Conductor (ESEL) type SCHIRTEC - DAS
See photo on page 9 and drawing on page 10.
Lightning Conductor supplied by SCHIRTEC Trading GmbH

2. Type of tests

A switching impulse wave negative polarity and a DC voltage of negative polarity are applied on the upper metallic plane.

3. Specification

N F C 17 – 102 / 1995 Appendix C

4. Test equipment

Laboratory inner dimensions: 48 m x 32 m x 27 m (height)

Altitude: 100 m above sea level

4200 kV High Voltage Impulse Generator type SPF 340; 340 kW, TUR
Dresden - Germany

1000 kV Rectifier cascade type GS 1000 / 30; 30 mA; TUR Dresden –
Germany

1400 kV Damped capacitive divider, ICMET Craiova, Romania;

TR – AS transient – recorder, Dr. Strauss System Elektronik, GmbH- Germany

Impulse calibrator type KAL – 1000, 0.84 / 60 μ s and 20 / 3000 μ s Dr. Strauss
System Elektronik, GmbH – Germany

Fluke calibrator type 5500 A.

5. Test circuit

See the test circuit diagram on page 11

The 1400 kV damped capacitive divider was calibrated by official Accredited Laboratory DKD – K – 18702, Romania with certificate 0060 of 14th January 2004 and checked before beginning of measurement with the impulse calibrator KAL 1000, calibrated by PTB – Braunschweig – Germany, calibration certificate 2727 PTB 02, and Fluke 5500 A calibrator calibrated by Metrology National Institute of Romania, order calibration certificate No.3.1 – 112 / 26.02.2004

The TR – AS transient – recorder was calibrated by Accreditation laboratory DKD – K – 11701 – Germany, with calibration certificate 275 of 10th Sept.2002 and checked before beginning of measurement with KAL 1000 calibrator.



Expanded uncertainty of measurements parameter inside of limits, prescribed by IEC 60060 – 2 / 1994 for SI Approved Measuring Systems (3 % for peak values and 10 % for time parameters).

6. Mounting arrangement

See the test set up on page 12

See photo on the pages 9

The lightning conductor tested is put on a 5 x 5 m grounded metallic plane and connected to ground.

A square metallic plane, dimensions: 4.5 m / 4.5 m / 0.2 m with the edges rounded, is suspended above the lightning conductor and connected the high voltage.

7. Test procedure

The DC polarization of the upper plane is adjusted on the square metallic plane.

The negative impulse wave is adjusted in order to obtain a flashover.

The height of the lightning conductor (h) and the distance between the ground and the square plane (H) are measured at the beginning of each test.

The atmospheric conditions taken before and after each test.

The peak value (U_p) of the impulses and the triggering time (T_B) are recorded at each impulse.

One hundred significant impulses are applied on the lightning conductor.

The early streamer emission lightning conductor (ESEL) is to be compared with a simple rod lightning conductor (SRLC).

Tests are performed in the same conditions and configuration for each lightning conductor: ESEL and SRLC.

The test on SRLC (100 significant impulses) was performed in two series and compared by the test on the ESEL.

Height of lightning conductor (h) adjusted to: 1081 mm

Distance between ground / square plane (H) adjusted to: 2319 mm

h / H: 0.47

Polarization voltage: 55 kV

Front time of the full wave: 486 μ s

Time interval between consecutive impulses: > 1 min

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8. TEST ON SRLC BEFORE AND AFTER TEST OF ESELC type SCHIRTEC - DAS

8.1. Reception date: 15.04.2007

8.2. Test date: 25.05.2007

8.3. Atmospheric conditions

	FIRST SERIES	SECOND SERIES
BEFORE TEST	Beginning of the test: 11h10 p = 1001 mb t = 21 °C hr = 65.8 %	Beginning of the test: 15h30 p = 998 mb t = 21 °C hr = 64.7 %
AFTER TEST	End of the test: 13h00 p = 1000 mb t = 20.6 °C hr = 66.7 %	End of the test: 17h00 p = 997 mb t = 20.9 °C hr = 63.6 %

8.4. Results

See tables on page 6

Number of significant impulses: 100

Average of significant T_B :

- calculated from the experimental wave $T_{PTS} = 284.2 \mu s$ Stdev: 21,26 %
- transferred on the reference waveform: $T_{PTS} = 346.33 \mu s$

See curves on page 8

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9. TEST ON ESELCTYPE SCHIRTEC - DAS

9.1. Reception date: 15.04.2007

9.2. Test date: 25.05.2007

9.3. Atmospheric conditions

BEFORE TEST	Beginning of the test: 13h10 p = 1000 mb t = 20.6 °C hr = 66.6 %
AFTER TEST	End of the test: 17h00 p = 997 mb t = 20.9 °C hr = 63.6 %

9.4. Results

See tables on page 7

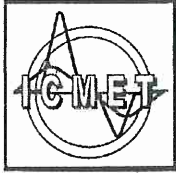
Number of significant impulses: 100

Average of significant T_B :

- calculated from the experimental wave $T'_{PDA} = 245.7 \mu s$ Stdev: 14.75 %
- transferred on the reference waveform: $T_{PDA} = 300.75 \mu s$

See curves on page 8

Triggering advance: $\Delta T = T_{PTS} - T_{PDA} = 346.33 - 300.75 = 45.58 \mu s$



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Test on SRLC before and after test on
ESELc type SCHIRTEC - DAS

Impulse no.	T _B μs	Impulse no.	T _B μs	Impulse no.	T _B μs
1	NS	41	280	80	330
2	255	42	NS	81	233
3	409	43	NS	82	NS
4	470	44	232	83	248
5	292	45	203	84	238
6	444	46	313	85	311
7	392	47	244	86	268
8	NS	48	228	87	243
9	NS	49	314	88	218
10	274	50	320	89	NS
11	243	Second	series	90	287
12	304	51	344	91	258
13	407	52	365	92	409
14	216	53	240	93	271
15	252	54	304	94	405
16	248	55	230	95	348
17	NS	56	294	96	236
18	219	57	318	97	207
19	280	58	NS	98	235
20	NS	59	247	99	249
21	250	60	228	100	334
22	257	61	244	101	210
23	259	62	286	102	307
24	NS	63	229	103	291
25	207	64	263	104	302
26	349	65	254	105	284
27	297	66	237	106	205
28	NS	67	205	107	358
29	337	68	218	108	320
30	201	69	316	109	310
31	321	70	239	110	284
32	243	71	255	111	294
33	237	72	308	112	264
34	285	73	251		
35	298	74	204		
36	377	75	334		
37	249	76	397		
38	278	77	351		
39	342	78	239		
40	443	79	239		

NS: No significant
T_B: Break-down time

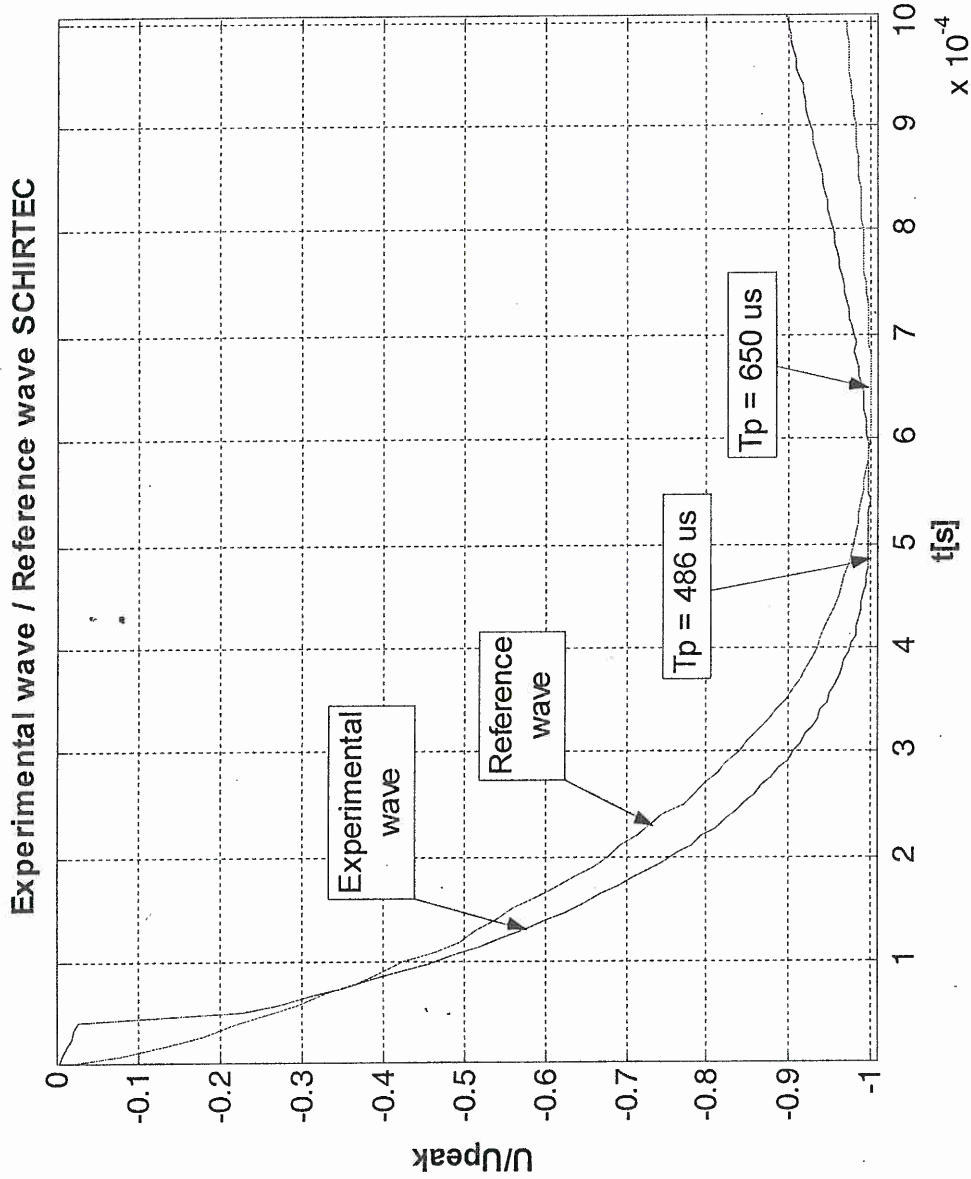
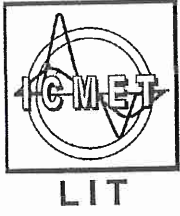


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Test on ESELC type SCHIRTEC - DAS

Impulse no.	T _B μs	Impulse no.	T _B μs	Impulse no.	T _B μs
1	265	44	302	87	219
2	255	45	291	88	185
3	239	46	204	89	223
4	227	47	283	90	252
5	371	48	233	91	220
6	276	49	276	92	207
7	251	50	235	93	273
8	233	51	288	94	229
9	251	52	271	95	205
10	236	53	287	96	251
11	225	54	226	97	215
12	293	55	225	98	260
13	274	56	230	99	207
14	244	57	242	100	299
15	233	58	227	101	283
16	255	59	248		
17	240	60	208		
18	NS	61	231		
19	199	62	217		
20	250	63	247		
21	264	64	237		
22	260	65	232		
23	306	66	232		
24	222	67	264		
25	222	68	249		
26	206	69	220		
27	207	70	232		
28	220	71	262		
29	398	72	200		
30	235	73	180		
31	374	74	221		
32	241	75	244		
33	277	76	255		
34	229	77	268		
35	215	78	224		
36	272	79	263		
37	268	80	243		
38	233	81	241		
39	225	82	253		
40	248	83	238		
41	197	84	203		
42	307	85	244		
43	253	86	218		

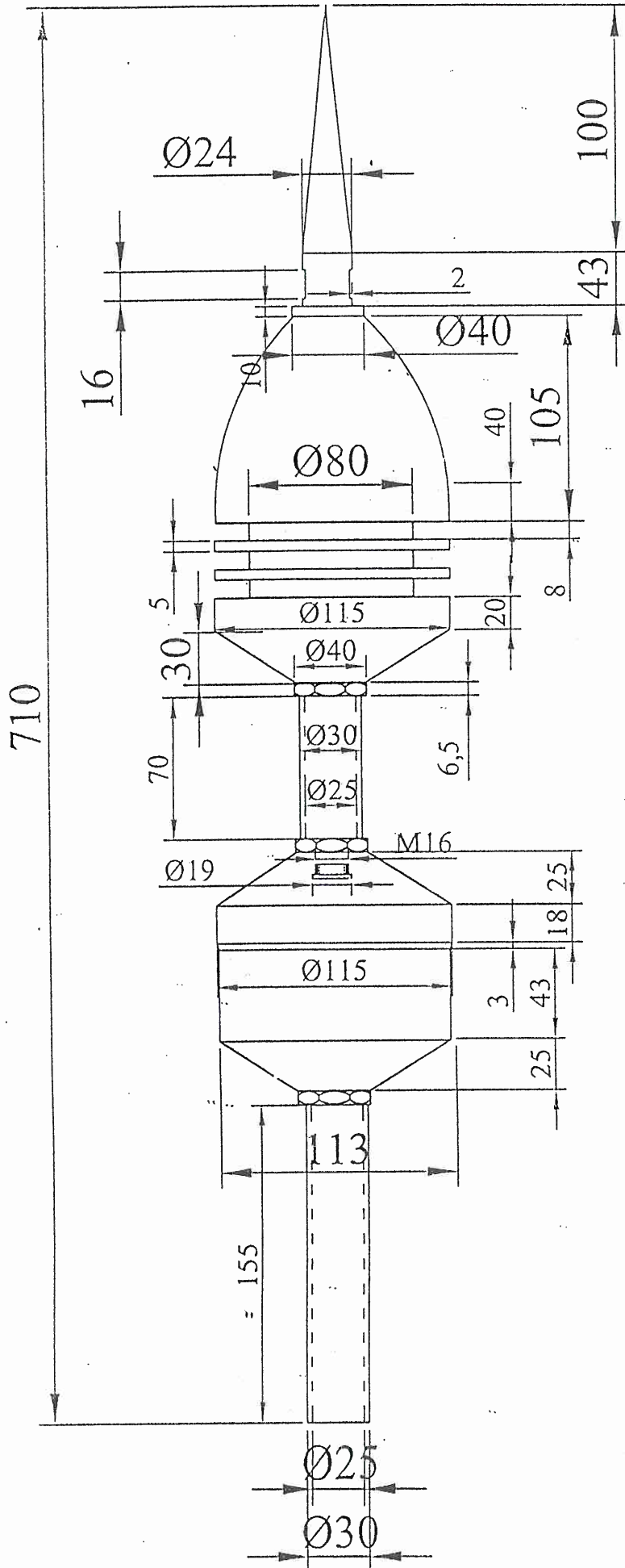
NS: No significant
T_B: Break-down time



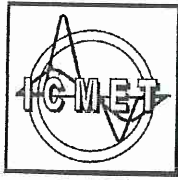
$T_{PTS} = 284,2 \text{ } \mu\text{s}$
 $T_{PDA} = 245,7 \text{ } \mu\text{s}$
 $T_{PTS} = 346,33 \text{ } \mu\text{s}$
 $T_{PDA} = 300,75 \text{ } \mu\text{s}$
 $\Delta T = T_{PTS} - T_{PDA} = 45,58 \text{ } \mu\text{s}$



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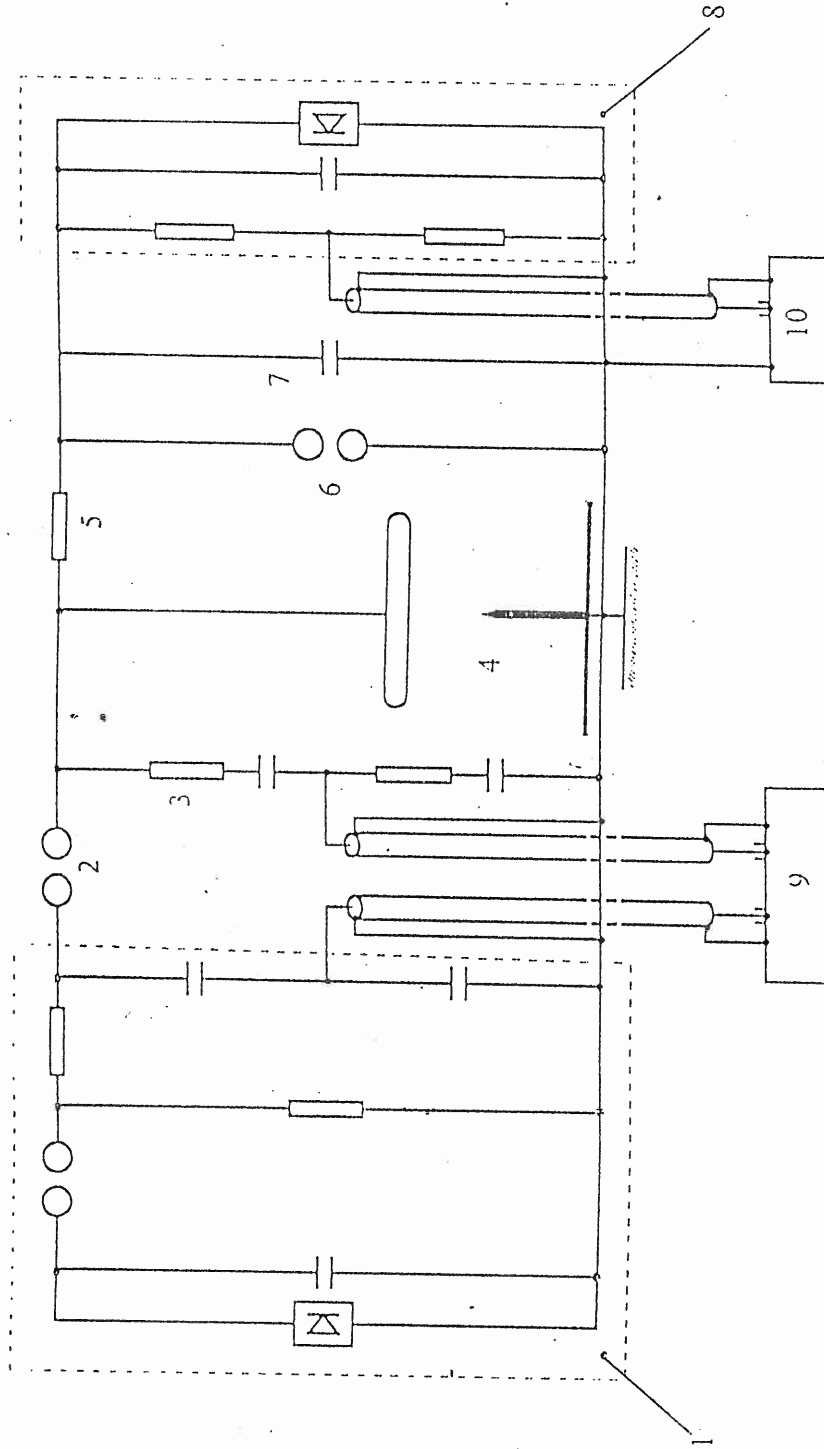


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Test circuit diagram on lightning conductor

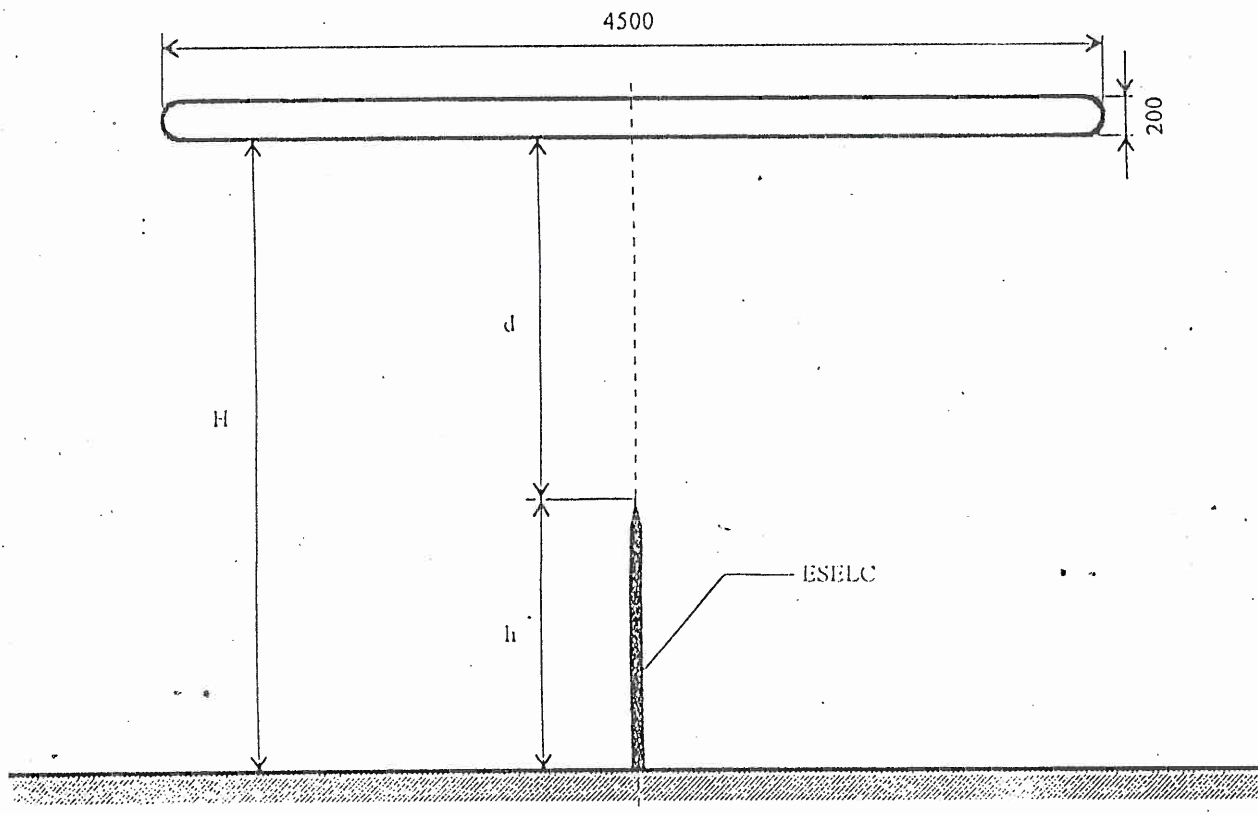


- 1 - HV Impulse Generator SPF 340/4200
- 2 - Serial protective gap, $\Phi = 250$ mm
- 3 - Damped capacitive divider, 1600 kV
- 4 - Test configuration
- 5 - Resistance 2 M Ω
- 6 - Parallel protective gap, $\Phi = 500$ mm
- 7 - Capacitor 4,5 nF
- 8 - Rectifier cascade GS 1000/30
- 9 - Transient recorder TR - AS 100 - 10
- 10 - Measurement voltmeter

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TEST SET UP ON EARLY STREAMER
EMISSION LIGHTNING CONDUCTOR
(ESELIC)



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