HIZAL
HIGH VOLTAGE and HIGH CURRENT ELECTRIC TEST LABORATORY
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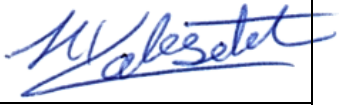
Rapor / Report No
090423-KLR-1

TEST REPORT

1.RAPOR BİLGİLERİ / Report info:

Müşteri *Customer*	Kalre Paratoner Ltd. Şti.
İletişim Bilgileri *Contact info*	Arzu YILMAZ Address:2841 Sokak No: 9/C 1.Sanayi Sitesi Konak – İzmir Phone:+90 533 238 07 61 Phone:+90 538 077 26 00 EMail:info@kalreparatoner.com EMail:export@kalreparatoner.com
Numune *Sample*	E.S.E Lightning Conductor
Marka *Trade Mark*	ALR-07
Deney Tarihi *Date of Test*	09/04/2023
Rapor Sayfa Sayısı *Number of Pages of Report*	11

2.TEST KATILIMCILARI / Test authority and observers:

Testi izleyen ve Koordine eden kurum *Test Monitored & Coordinated by*	OTU -E.E.B./ YGAM-OYGEM	
Teste katılan firma ve yetkilisi *Test Customer represantative*		
Test Laboratuarı *Test Lab. Conducted In*	HIZAL San.Tic.Ltd. Yüksek Gerilim Laboratuvarı Ankara -Turkey	
Laboratuvar Sorumlusu-Deneyi Uygulayan Mühendis *Lab Official-Test Executed by*	*HÜSEYİN KABASAKAL* *Elektrik Elektronik Mühendis*	
Deney Sorumlusu-Deneyi İzleyen ve Kontrol eden *Test Official-Test Monitored and controlled by*	*MUSTAFA FAKILI* *Elektrik Elektronik Mühendis*	

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3.NUMUNELERİN TANIMI / Description of Samples:

No:	Tip / Type	Seri No /*Serial Number*
1	ALR-07	001

*Deney Metodu: *Method of Test*	Yok/N.a.
*Varsa deney metodundan sapmalar, eklemeler, çıkarmalar: *if applicable deviation, addition, cutback from test method*	Yok/N.a.
*Şartname veya standartlara uygunluk / uygunsuzluk *Conformity / non-conformity to specifications (if necessary)*	Yok/N.a.
*Ölçüm Belirsizliği (talep halinde) *Uncertainty (if required)*	Yok/N.a.

Beyan edilen genişletilmiş ölçüm belirsizliği, standart belirsizliğin k=2 olarak alınan genişletme katsayısı ile çarpımı sonucunda bulunan değerdir ve % 95 oranında güvenilirlik sağlamaktadır.
The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2 which for a normal distribution corresponds to a coverage probability of approximately 95 %.

4.DENEYDE KULLANILAN ÖLÇÜM CİHAZLARI /Measurement instruments used at test:

Cihaz *Device*	İmalatçı *Manufacturer*	Seri No *Serial Number*	Sertifika No *Certificate Nr*	Kalibrasyon Tarihi *Cal.Date*
Digital Multimetre	TT T-ECHNI-C / V C97	093289721	UMS, 040218	11.18
High Voltage Impulse Measurement System	HIZAL / Rigol Electronic	H-220 IVD-09 / DS1102E	UMS, E-1918	01.20
High Current Measurement Current Probe	HIZAL / Fluke-	i-2000 Flex Rogwsky Coil/Schunt Serial: 0094	UMS, 020517	03.17
Torque Wrench	HIZAL/ BRITOOL	P035769	UMS, 2072488	09.20

Kalibrasyon geçerlilik Süreleri (Calibrations valid through): IEC 60060-2-(Madde 10.3) 5 yıl/years
10.3 Referans ölçme sistemlerinin birbirini izleyen kalibrasyonları arasındaki zaman Aksine bir husus olmadıkça belgelendirme işlemi, en az her beş yılda bir tekrarlanmalıdır.
(10.3- Interval between successive calibrations of reference measuring systemsThe interval between calibrations shall be determined according to national regulations. If there is no regulation it is recommended that the calibrations shall be repeated at least once every five years, provided that regular performance checks demonstrate the stability of the reference measuring system.)

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5. DENEY SONUÇLARI / Test results:

Deney sonuçları, sadece deneyi yapılan numunelere aittir.
Test results are just belong to tested item.

No	Numuneler/ Samples	Deney Adı / Test	Sonuç/ Result
1	ALR-07	NFC-17-102 (Appendix C) /Version 2011 standart tests as below order: 1. Current withstand test for both 100kA and 200KA - As per NFC 17-102 2. Lightning impulse Early Streamer Time Gain test- As per NFC 17-102	OK/Passed

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6. RAPOR AÇIKLAMALARI / Test descriptions:

6.1. CURRENT –VOLTAGE WITHSTAND IMPULSE TESTS EXPLANATION:

Stages of HV current impulse generator (50kV , 250 KJ) was connected in paralel to produce current impulses . Three successive current impulses with a waveform shown in Fig. 1. was applied to the sample and visually inspected for any damage . The sample connections were also checked if any change occurred in the tightening torque before and after the test . No noticable damage and no significant change in the connections were observed.

- STANDART CATEGORIES TABLE:

Table from standart-Yıldırım darbesi akım (*Iimp*) parametreleri/ Standart parameters

Sınıflandırma/Classification	*Iimp* kA □□%10	W/R kJ/Ω □□% 35
H	100	2500
N	50	625

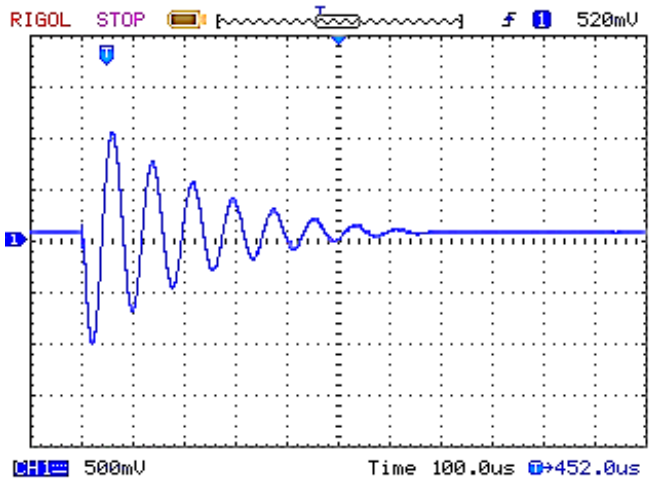
Not - Çizelge 1'de belirtilen parametreler, tipik olarak 10/350 µs'lik aralıkta üssel azalan akımla gerçekleşebilir.

The current waveform is analysis according to the related standart (NFC17-102 (Appendix C) /Version 2011 , Electrical Test) and the energy / ohm in the sample conductor is calculated as follows related to standart :

Energy transferred due to the standart through the test object:

Imax.=100 kA (10/350 µs) Ipeak-ort = 50 kA , Δ t = 2 ms measured , $W = (I\ rms)^2 . R . \Delta t$,

$W = (50/\sqrt{2} . 10^3)^2 . 10^{-3} . 2 . 10^{-3}$ = 2500 kJ , ve W/R = 2500 kJ/ 10^{-3} = 2.500 (MJ / ohm) is found. The calculation according to the standard is made in this way.



Şekil 1 /Fig .1. Örnek Akım darbe Osilogramı / Example Impulse current oscillogram

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The test set – up is shown in Test Pictures.

- Current Impulse withstand test Photos:

ALR-07:

- Impulse current recording system and the current probe

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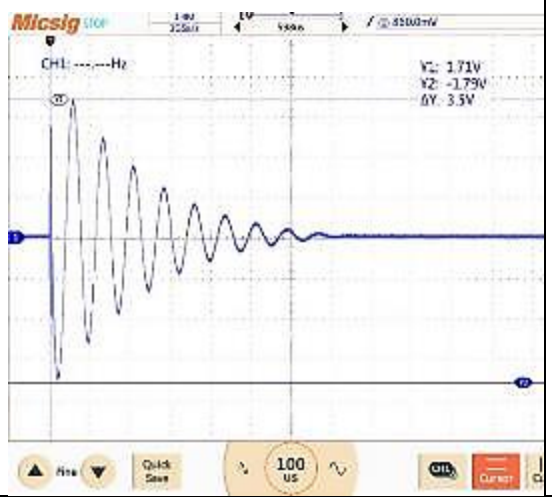
TEST ÖLÇÜMLERİ / TEST Measurements:

TEST Numune SAMPLE	OSİLOGRAM/ 100us	TEST MEASUREMENT	TEST RESULT
ALR-07		Impulse Current: Imax.= 204 kA Ipeak-ort = 102 kA , Δ t = 2 ms measured ,W= (I rms)^2. R . Δ t, W =(102/√ 2. 10^3) ^{2}. 10^{-3}. 2. 10^{-3} = 5300 kJ , and W/R = 5300 kJ/ 10^{-3} = 5300 (MJ / ohm))	GEÇTİ/ Passed

6.2. ÇEVRE ŞARTLARI KAYITLARI/Recording of Climatic Environmental conditions:

Test süresince bu değerlerde gözlenir bir değişiklik olmamıştır .
These values were observed not change appreciably during the test.

	Başlangıç/ Start	Orta/ Middle	Son/ Final
Ortam Sıcaklığı *Ambient Temperature*	18 C	18 C	18 C
Ortam Nemi *Relative Humidity*	% 50	% 50	%50
Ortam Hava Basıncı *Relative Air Pressure*	1003 hPa	1003 hPa	1003 hPa

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6.3-Lightning Impulse Early Streamer Emission Time Gain Test descriptions:
Execution of Test:

Tests were carried out using a high voltage electrode prepared according to the criteria mentioned in the related standart with dimensions ; edge radius R = 20 cm , diameter Φ = 300 cm and as the ground electrode , in the first case a simple catching rod and in the second case the sample active catching device (ESE) head.

In each case 100 negative impulses of approximately 250 / 2500 µS (Rise time = 170 µS) waveform were applied and the streamer initiation time lags were recorded by DSO. The spacing between the cathing rod or device and the High Voltage plane electrode was set to 100 cm , the test impulse voltages were applied by using a 1.2 MV , 60 kJoule capacity impulse generator.

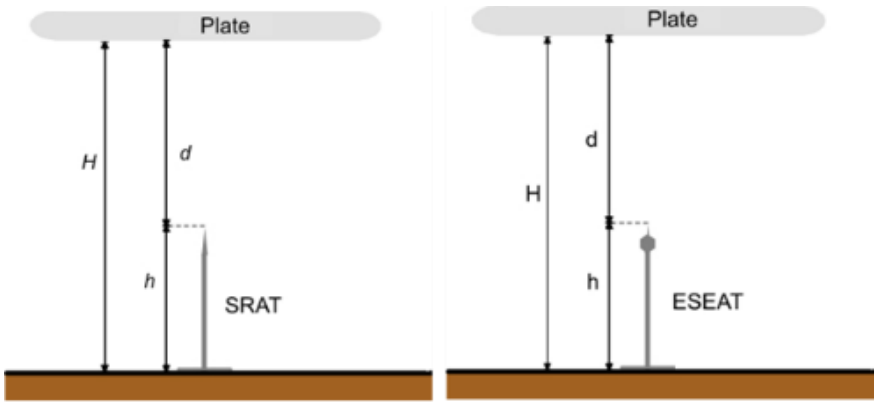
Test impulses executed at 980kV (+/-20kV)
The tests were applied using the ESE device under the test and a simple cathing rod diameter of 28mm electrolytic pure copper of the same tip geometry and total height to electrode/plate and ground distance.

TABLE of Measurements:

Sample	Time lag (µS)		
Serial No	Minimum	Maximum	Average
Standart Rod	128	228	165
ALR-07	82	134	96

Test set-up is shown in Figure.1 and the test pictures shown in pic.1.

FIG.1. Test Scheme



d: 100cm
h: 140cm
*The stand height is 800mm and length of the sample is 600mm.
H: 240cm

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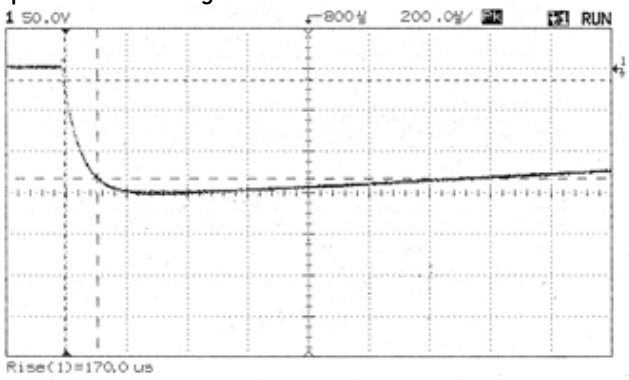
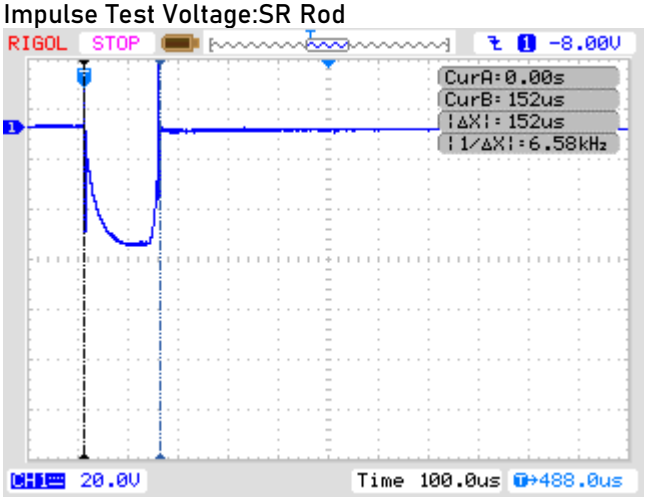
Impulse Test Voltage: V_{min}= - 981 kV



Impulse Test Voltage:SR Rod



Impulse Test Voltage:ESE Sample

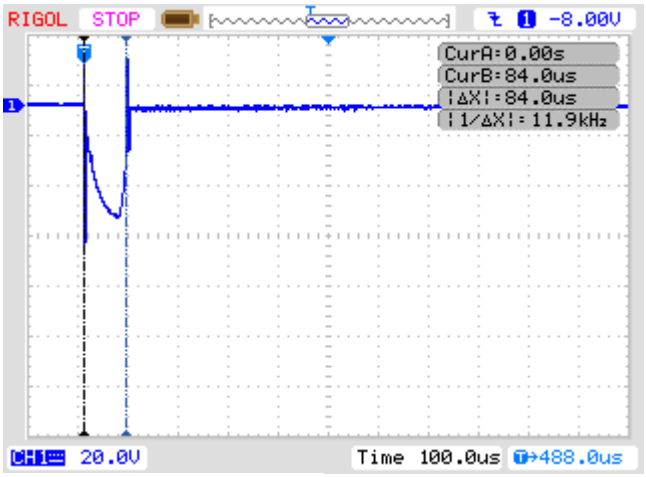


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Photo of Test System and Test: ESE Test Pic.

- ALR-07

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EVALUATION of THE TEST RESULTS

As described in NFC17-102 (Appendix C) /Version 2011, the average time lags are applied to the reference curve and the test curve and the difference between the corresponding values are obtained as the time lag gain ΔT for the ESE sample;

- ALR07/Sample 1: ΔT = 71 µs

Streamer Time Gain determination for the ESE Samples

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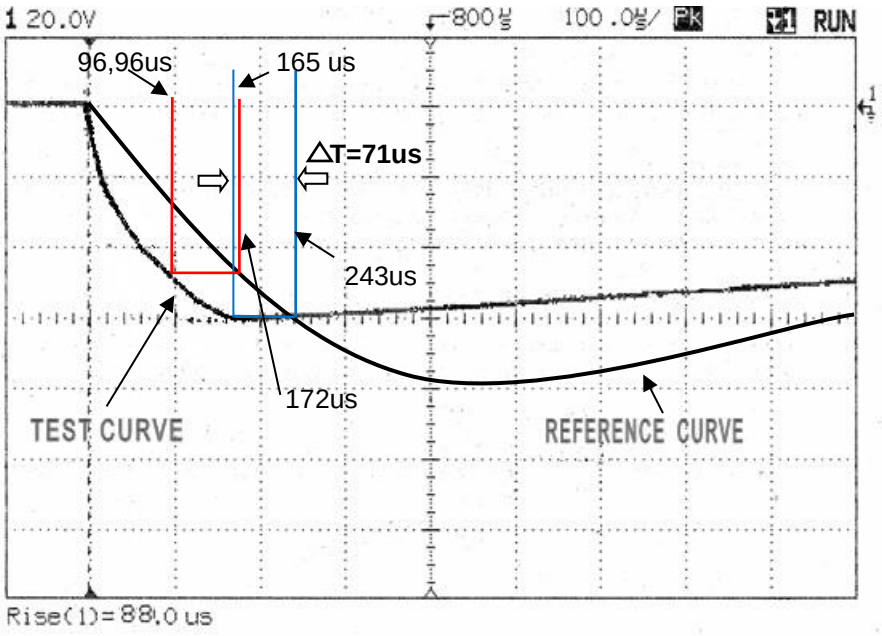

RESULT

In context of the tests described above , it was determined that the ESE Sample has provided a certain time gain against the SR catching rod and therefore can be termed as ESE Lightning Catching Device according to the criteria described in ve NFC 17-102/2011

7. RAPOR SONUCU / REPORT CONCLUSION

In the context of the applied tests the samples above was found to be in accordance with and above performance to the related standart specification as below:

Delta T measurement is more than 10micro second to standart rod	ΔT = 71 µs ESEAT

Deneyi İzleyen ve Kontrol eden
MUSTAFA FAKILI
Elektrik Elektronik Mühendis

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