29 YEARS
29yıl
SEKTÖR TECRÜBESİ
EXPERINCES






POLiPAR®

Aşırı Gerilim Çözümleri...
Over Voltage Solutions...

Uyumlu Birleşenler...
Logical Connections...

POLiPAR®

Catalogue No: POLIPAR-2019

kalite quality

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IEC

ISO 9001:2015 CERTIFIED

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ENERJiDE ÖZGÜR YENiLiKÇi ÇÖZÜMLER

FREE INNOVATIVE SOLUTIONS IN ENERGY

Selection of medium and high voltage surge arresters

1. Introduction

In this section, it is aimed to present the technical parameters to be considered during the determination of POLIPAR® surge arresters for Medium Voltage - MV and High Voltage - HV surge arresters with relevant standards, test experiences and field feedbackS.

For standardized metal oxide MO, nominal discharge current In, nominal voltages Un, highest system voltages Us, highest voltage for equipment Um, lightning impulse protection level Upl and withstand voltages ACWV (Standard rated short-duration (60 s) power frequency withstand voltage of an equipment or insulation configuration – ACWV) and LIWV (Lightning Impulse Withstand Voltage of equipment to be protected – LIWV)

The following commonly used voltage ranges of surge arrester are given for completeness

System voltages acc. IEC 60038: IEC standard voltages

Distribution: voltage range between Us= 3.6 kV and Us= 40.5 kV

Sub transmission: voltage range between Us= 3.6 kV and Us= 145 Kv

Transmission: voltage range between Us= 170 kV and Us= 1200 kV

The protection level Upl of an MO surge arrester must be well below the LIWV of the equipment to be protected. On the other hand, the MO surge arrester must withstand all stresses from the system. Therefore, the continuous operating voltage Uc must be well above the maximum power frequency voltage of the system Us (or UTOV).

The chosen value for Uc should be in all cases higher than the minimum calculated value. Typical values of the lightning impulse withstand voltage LIWV of the equipment (based on Um) and the lightning impulse protection level Upl of the MO surge arrester. As can be seen, there is in all distribution systems a safe margin between LIWV and Upl. **POLIPAR® surge arresters have high protection margins as shown in type tests.**

Figure 1:

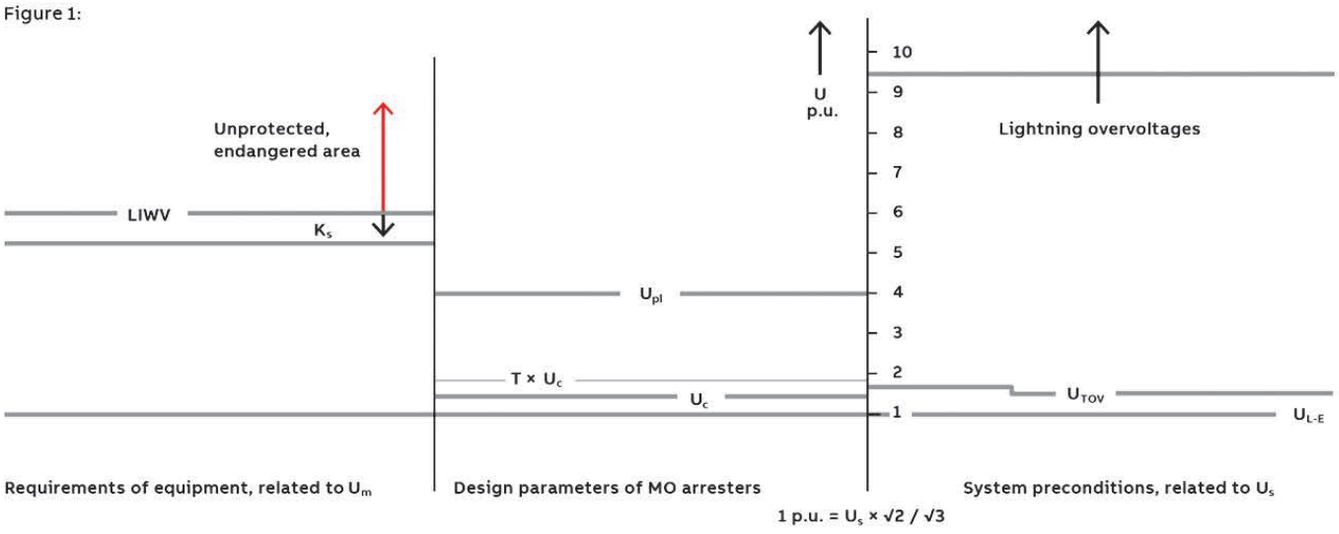


Figure 1: Comparison of the possible occurring voltages in atypical high voltage-medium voltage system, the withstand voltages of the electrical equipment and the parameters of the MO surge arrester. The lightning over voltages are decisive in medium voltage systems.

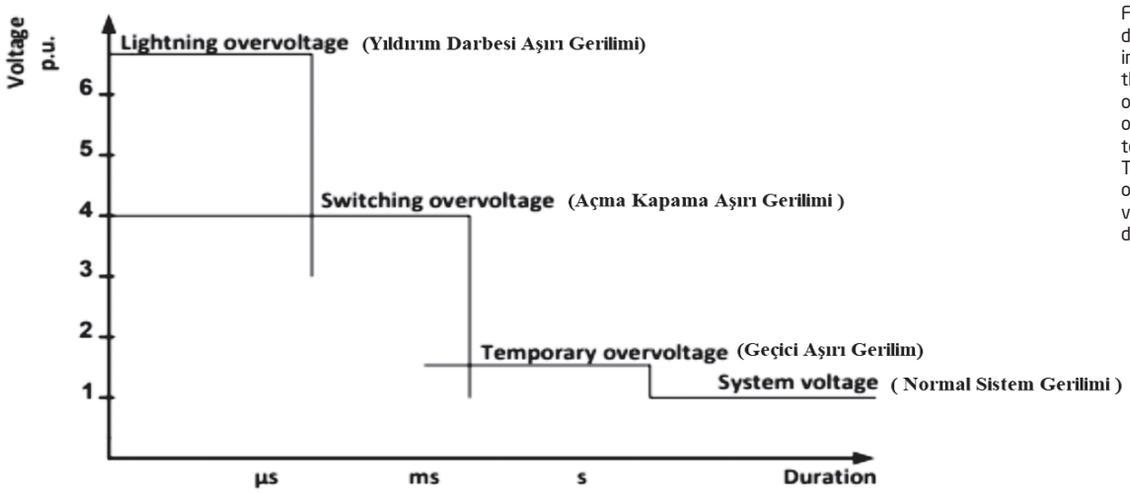


Figure 2: Related standards divide the overvoltages in power system into three categories: lightning overvoltages, switching overvoltages and temporary overvoltages. The characteristics of overvoltages regarding the voltage magnitude and duration are illustrated.

U_m in kV rms	3.6	7.2	12	17.5	24	36
LIWV in kV pv	40	60	75	95	125	170
U_{pl} in kV pv	11.8	23.5	39.2	57.2	78.4	117.6
LIWV/U_{pl}	3.39	2.55	1.91	1.66	1.59	1.45

Table 1: Medium Voltage or Distribution Systems, typical values of the lightning impulse withstand voltage LIV and the lightning impulse protection level Upl= 4 p.u.

2. Required information

In an ideal case all the following information should be given with inquiries by users to POLIPAR customer services before orders.

System Data

- Highest system voltage Us
- Frequency (Hz)
- Earth fault factor or type of neutral earthing
- Maximum duration of earth fault (clearing time)
- Maximum value of UTOV
- Short circuit current Is of the system (per phase)
- Load rejection factor (in case of generator protection)

Service conditions

- Normal ambient conditions acc. IEC?
- Pollution class or creepage distance
- Insulation withstand voltage or flash over distance
- Altitude
- Ambient temperature
- Abnormal earthing conditions
- Mechanical requirements

Arrester application

- Connection phase to earth
- Connection neutral to earth (transformer)
- Connection phase to phase

Equipment to be protected

- Highest voltage for equipment Um
- Lightning Impulse Withstand Voltage (LIWV) of equipment to be protected

Type of equipment

- Transformer (directly connected to line or via cable)
- Rotating machines
- Cables
- Cable sheath (length of cable and short circuit current per phase)
- Capacitors

Equipment to be protected

- Highest voltage for equipment Um
- Lightning Impulse Withstand Voltage (LIWV) of equipment to be protected

Type of equipment

- Transformer (directly connected to line or via cable)
- Rotating machines
- Cables
- Cable sheath (length of cable and short circuit current per phase)
- Capacitors
- Etc.

3. Selection of Uc

The calculation of the continuous operating voltage Uc, which depends on the maximum system voltage Us and the earthing conditions. The Uc should be generally chosen 10% higher than the calculated minimum, and then the next higher value from the POLIPAR data sheet should be taken.

4. Selection of arrester class in POLIPAR Distribution and Station Class Surge Arresters

The class is given by the nominal discharge current In, the repetitive charge transfer rating Qrs, the thermal charge transfer rating Qth for distribution class arresters or the thermal energy rating Wth for station class arresters, respectively. The IEC 60099-4 recommend fallowing the figures for surge arrester classifications.

Nominal discharge current, In

The choice acc. IEC 60099-4, Ed. 3.0 is between In= 2.5 kA, 5 kA, 10 kA and 20 kA. In all these rated discharge currents determined, POLIPAR enable to produce with experiences.

For MO surge arresters for application in medium voltage systems the nominal current is In= 10 kA. This is true for distribution class arresters DH and all station class arresters (except for station class arresters SH with In= 20 kA).

Repetitive charge transfer rating, Qrs

Qrs is defined as the maximum charge transfer capability in the form of a single current impulse or group of current impulses that may be transferred through the arrester without causing mechanical damages or unacceptable electrical changes. This rating is verified on single MO resistors and, therefore, is a MO resistor related material test. It can be compared with the long duration current withstand test, see Table 2.

Thermal charge transfer rating Qth and thermal energy rating Wth

Qth and Wth are the maximum thermal charge transfer rating and maximum thermal energy rating, respectively, that may be injected in an MO surge arrester without causing thermal runaway. These tests are thermal stability tests, and the results can be compared with the values of the operating duty tests (W in kJ/kV, Uc) acc. Ed.2.2 of IEC 60099-4, see Table 2.

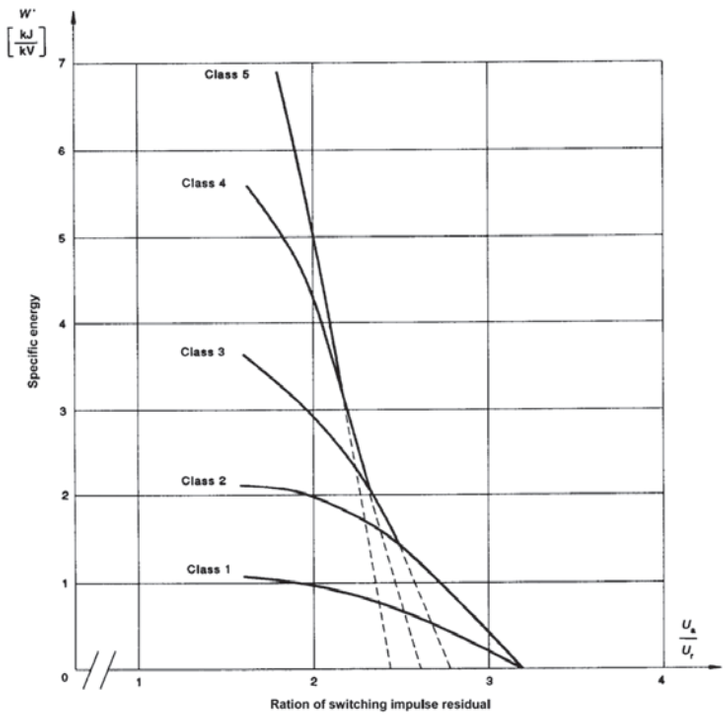


Figure 3: Specific energy in kJ per kV rating dependant on the ratio of switching impulse residual voltage (Ua) to the r.m.s. value of the rated voltage Ur of the arrester.

Arrester class	Station			Distribution		
Designation	SH	SM	SL	DH	DM	DL
Nominal discharge current[a]	20 kA	10 kA	10 kA	10 kA	5 kA	2,5 kA
Switching impulse discharge current[a]	2 kA	1 kA	0,5 kA	--	--	--
Q_{rs} (C)	≥ 2,4	≥ 1,6	≥ 1,0	≥ 0,4	≥ 0,2	≥ 0,1
W_{th} (kJ/kV)	≥10	≥ 7	≥ 4	--	--	--
Q_{th} (C)	--	--	--	≥ 1,1	≥ 0,7	≥ 0,45
[a] Other currents may be specified upon agreement between manufacturer and user.						
NOTE The letters "H", "M" and "L" in the designation stand for "high", "medium" and "low" duty, respectively.						

Table 2: Arrester classes, IEC 60099-4, Ed. 3.0

5. Selection of housing

The housing of MO surge arresters must fulfil two requirements, the creepage distance (depends on the pollution class) and the flashover distance (depends on the required external withstand voltage of the insulation). **Special attention is paid to these two key points in the design phase of the POLIPAR surge arrester.**

The pollution classes and the corresponding reference unified specific creepage distances (RUSCD) are specified in IEC 60507:2013 and IEC/TS 60815-1:2008,

IEC/TS 60815-3:2008 refers to polymer insulators for AC systems. For the purpose of standardization, five classes of pollution characterizing the site severity are qualitatively defined. It is possible, however, to specify the reductions of the creepage distances for synthetic materials that have a regenerative hydrophobicity, such as silicone, towards ceramic insulations., are based on general recommendations given in IEC 60815-3, results from tests and field experience.

Site pollution severity class	Pollution level	Specific creepage in mm/kV (U_s)	Unified specific creepage distance mm/kV (Us/ √3)
a	Very light	12.7	22.0
b	Light (L)	16	27.8
c	Medium (M)	20	34.7
d	Heavy (H)	25	43.3
e	Very heavy (V)	31	53.7

Table 3: Pollution groups as defined in IEC 60815 and determined creepage distance per kV in these groups. USCD value must be corrected with √3. After correction SCD value getted.

The flashover distance of the external insulation is generally not critical for MO surge arresters for application in distribution systems. The POLIPAR surge arrester required values of the designs are verified during the insulation withstand tests under dry and wet conditions. 1,000 m above 1,800 m above sea level an increase of the flashover distance by 10 percent should be considered.

6. Mechanical requirements

The mechanical requirements for MO surge arresters in distribution systems are generally not critical. Polipar surge arrester have superior mechanical performance due to their design. It has excellent mechanical properties due to its hollow-design reinforced fiberglass structure, especially in high voltage surge arresters. Therefore, the carrier post insulator function in various power plants and grids even used.

- Normally the short circuit requirements are given by the customer in the inquiries, or not mentioned at all.
- Seismic loads can be normally neglected.
- Wind loads are not critical, terminal loads in standard applications are not critical as well.
- In all cases the requirements are given in the inquiries.

7. Final check before POLIPAR order

As a final check the following should be considered:

- Is the required ambient temperature higher than the standard value of 40°C? If yes, the continuous operating voltage has to be increased accordingly, or the MO arrester (thermal rating Wthor Qth, respectively) derated.
- Installation in altitudes above 1,800 m? If yes, check if flash over distance has to be increased.
- Check if the residual voltage Upl is well below the required LIWV of the equipment. As a general rule, please keep in mind that surge arresters with low residual voltage levels will protect your system more strongly due to the wide range of protection margins they offer.

8. Voltages in 3 phases A.C. distribution systems above 1 kV

Polipar Surge Arresters are designed and manufactured not only surge arrester IEC norm, but also considered all other related IEC standards.

System IEC 60038	
U_n kV rms	U_s kV rms
3	3.6
6	7.2
10	12
15	17.5
20	24
30	36

Table 4: According to IEC 60038 standards, Nominal voltage Un and demonstration of highest system voltages Us

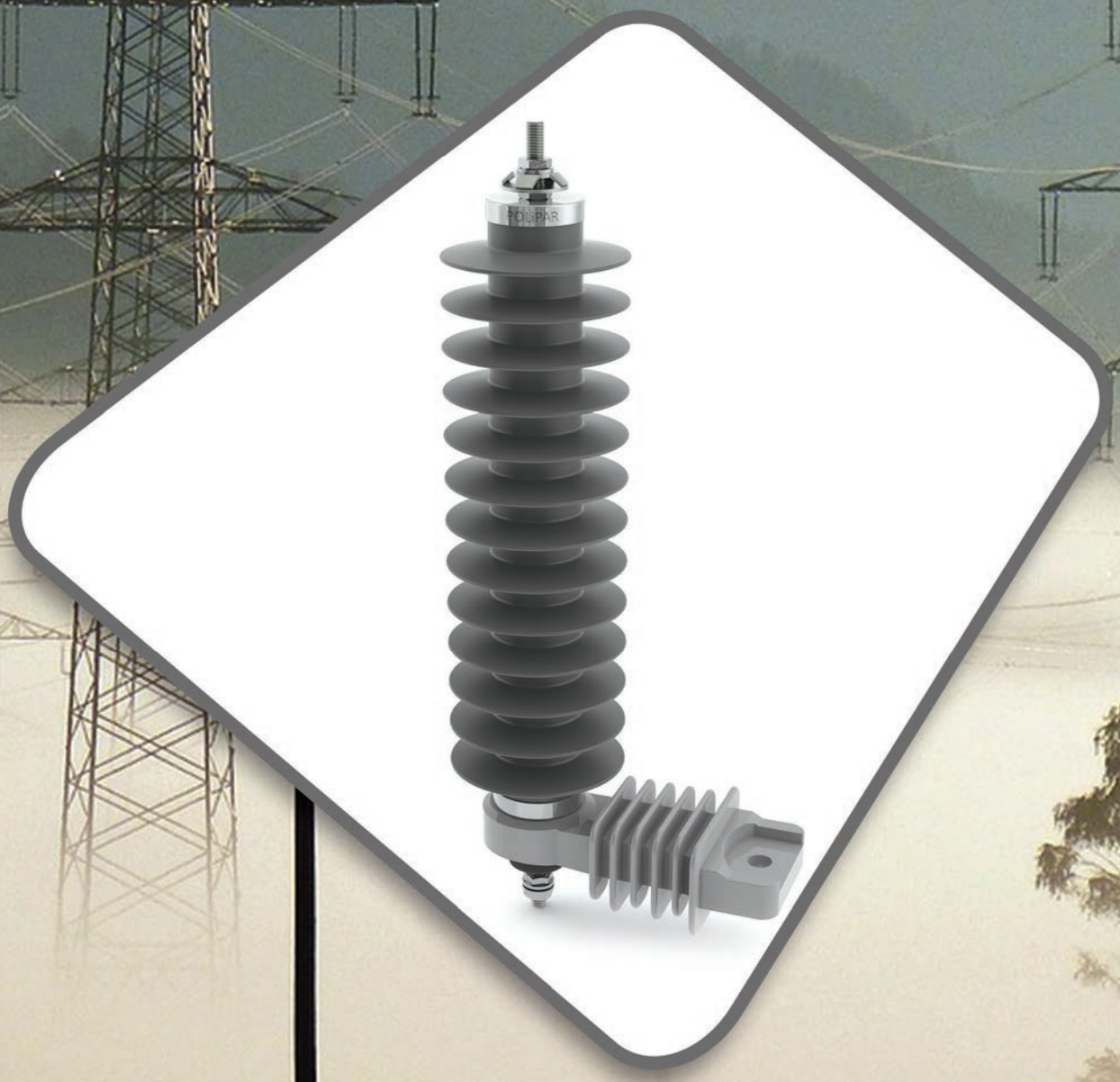
Equipment IEC 60071-1		
U_m kV rms	ACWV kV rms	LIWV kV peak
3.6	10	20 40
7.2	20	40 60
12	28	60 75 95
17.5	38	75 95
24	50	95 125 145
36	70	145 170

Table 5: According to IEC 60071-1 standards the highest withstand voltage for other equipment in the system Um and demonstration of Lightning strike protection level ACWV (Standard rated short term (60 s) and power frequency withstand voltage equipment or insulation configuration) and Lightning Impact Resistance Voltage of the equipment to be protected - Displaying according to LIWV.

Tip deneyleri Uluslararası Akredite Laboratuvarlarda yapılmıştır.
Type tests were conducted in International Accredited Laboratories.

HP SERİSİ DAĞITIM TİPİ ORTA GERİLİM PARAFUDRLARI

HP Series Distribution Type Medium Voltage Surge Arresters



> POLİPAR Metal Oksit parafudrların kullanım alanları

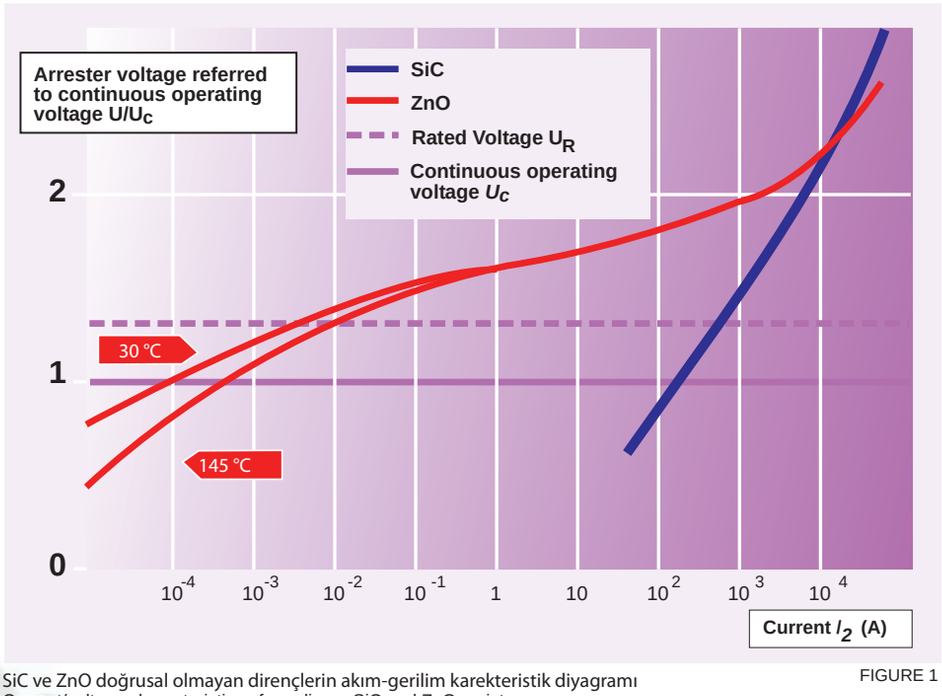
O.G. parafudrlar dağıtım ve istasyon sistemlerinde; transformatörleri ve diğer şebeke elamanlarını, atmosferden (özellikle yıldırımlardan) ve işletme koşullarından kaynaklanan aşırı sistem gerilimlerine karşı korumak için kullanılmaktadır.

Metal Oksit tip atlama aralıksız parafudrlar, normal işletme geriliminde enerji sistemine olumsuz etkisi olmayan ancak şebekedeki tipik dalgalanmalarda olası hasara meydan vermeyecek şekilde tasarlanmışlardır. Atlama aralıksız parafudrların bu özelliği yüksek değişkenlik gösteren metal oksit dirençlerin gerilim-akım karakteristiklerinden kaynaklanmaktadır. Bu değişkenlik özelliği SiC parafudrlara nazaran çok daha yüksektir.

> Application of POLIPAR Metal-Oxide type arresters

OM.V. surge arresters are used to protect transformers and other equipments in station and distribution systems against the damage caused by atmospheric (especially lightning effects) and operational conditions.

Metal oxide type surge arresters without gaps are designed to prevent probabledamages in the case of typical surges in energy systems while it has no negative effect on energy systems in normal operation voltage.This special feature of gappless arresters originating from non-linear characteristics of metal-oxide varistors between voltage and current scales.The non-linear feature is much more higher compared to SiC surge arresters.



SiC ve ZnO doğrusal olmayan dirençlerin akım-gerilim karekteristik diyagramı
Current/voltage characteristics of non-linear SiC and ZnO resistors

FIGURE 1

> YÜKSEK DEĞİŞKENLİK Özelliğindeki Metal Oksit Parafudrların avantajları

>>> Enerji sistemindeki dalgalanmalara karşı düşük direnç gösterir. Bu saye de aşırı gerilimi sınırlar.
>>> Stabil işletimler için yeterli enerji soğurma kapasitesine sahiptir.
>>> Düşük artık gerilim oluşturur (özellikle dik akım darbesine karşı).
>>> Geniş koruma aralığına sahiptir.
>>> Ardı sıra akımları soğurma kapasitesi yüksektir.
>>> Uzun Ömürlü olup bakım gerektirmez.

> Advantages of NON-LINEAR metal-oxide type arresters

>>> *Low resistance to the surges in energy systems,therefore limits the over voltage.*
>>> *Sufficient energy absorption capacity for stable operations.*
>>> *Low residual voltage (especially for steep current impulse).*
>>> *Wide protection range.*
>>> *High absorption capacity for follow current.*
>>> *Long duration and no maintenance*

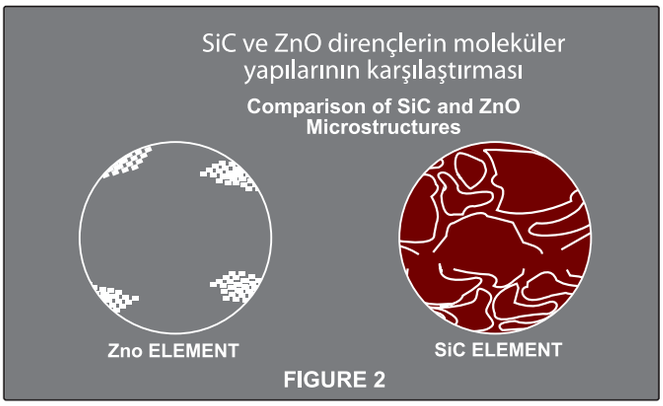


FIGURE 2


Metaloksit (ZnO) dirençler / *Metaloksit (ZnO) dirençler*

Her iki direnç türü karşılaştırıldığında, iki materyal arasındaki boyut ve partiküller farklılık açık olarak gözükmektedir. Silisyum Karbür partiküller (200 mikron), Metal oksit partiküllerden(10-15 mikron) ortalama olarak 15 ile 20 kat daha büyüktür. Bu nedenle Metal Oksit dirençlerin nominal gerilimle, aşırı gerilim arasındaki hassasiyeti Silisyum Karbür dirençlere oranla çok daha yüksek olmaktadır.

When both resistor type is compared the differences in size and grain are obvious. Silicone carbide particles (200microns) are 15 to 20 fold greater than metal oxide particles (10-15 microns). Therefore, the sensitivity of metal oxide resistors between nominal voltage and extreme voltage are higher than those of silicone carbide resistors.

>> Metal oksit varistörler günümüz modern parafudrlarının tasarımını oluşturur.
>> Varistörler yaklaşık olarak 90% ZnO ve 10% diğer metal oksit türevlerinden oluşurlar.
>> Üretim aşamaları süresince metal oksit bileşenleri, varistör özelliği gösteren sıkıştırılmış bir seramik disk şeklini alır.

>> Metal oxide varistors are the design of today's modern surge arresters.
>> Varistors consist of approximately 90% ZnO and 10% other metal oxide derivatives.
>> During the production stages, the metal oxide components take the form of a compressed ceramic disc which has a varistor feature.

> poli-EL POLİMER GÖVDE
Güvenli, pratik, uzun ömürlü...

Porselen gövdenin taşıma, montaj ve işletim dezavantajlarının yanında polimer gövde birçok avantajı birlikte sunmaktadır:

>>> Hidrofobik (su tutmaz) özellikte oluşu, en sert iklim koşullarında dahi kusursuz koruma sağlar.

>>> Özel etek şekli sayesinde her türlü nem ve pisliğin parafudr yüzeyinde birikmesini engeller.

>>> Polimer yapıdan ileri gelen mekanik dayanıklılık sayesinde taşıma ve montajda kolaylık sağlar.

>>> Endüstriyel alanlar gibi aşındırıcı atmosfer koşullarına dayanıklıdır.

>>> Özel üretim tekniği sayesinde uzun işletim ömrüne sahiptir.

>>> Güvenli aşırı yükleme değerlerine sahiptir.

>>> Uzun süre bakım gerektirmez.

>>> UV dayanıklılığı vardır.

> poli-EL POLYMER MATERIAL
Safe, durable, practical...

Compared to transportation, mounting and operational disadvantages of porcelain housing, polymer housing provides many advantages:

>>> *The hydrophobic characteristics ensures perfect protection,even under the thoughest climatic conditions.*

>>> *Special polymer design prevents moisture and pollution to accumulate on arrester surface.*

>>> *Provide easiness in transport and mounting due to mechanical strenght of polymer structure.*

>>> *Endurance in corrosive atmospheres such as industrial areas.*

>>> *Latest manufacturing techniques ensures the exceptional service life.*

>>> *Safe overload characteristics.*

>>> *Maintenance free for a long time.*

>>> *It has UV resistance.*

Site pollution severity class	Pollution level	Specific creepage in mm/kV (U_s)	Unified specific creepage distance mm/kV (Us/ √3)
a	Very light	12.7	22.0
b	Light (L)	16	27.8
c	Medium (M)	20	34.7
d	Heavy (H)	25 ✓	43.3
e	Very heavy (V)	31 ✓	53.7

IEC 6815'e göre belirlenen bölge kirlilik seviyeleri - kaçak yolu mesafesinin hesaplanması. USCD degeri √3 ile bölünerek gerçek SC değeri elde edilir.

(SC: Gerçek atlama mesafesi)

Specific creepage distance is calculated by dividing USDC to√3according to the IEC 6815 standards.

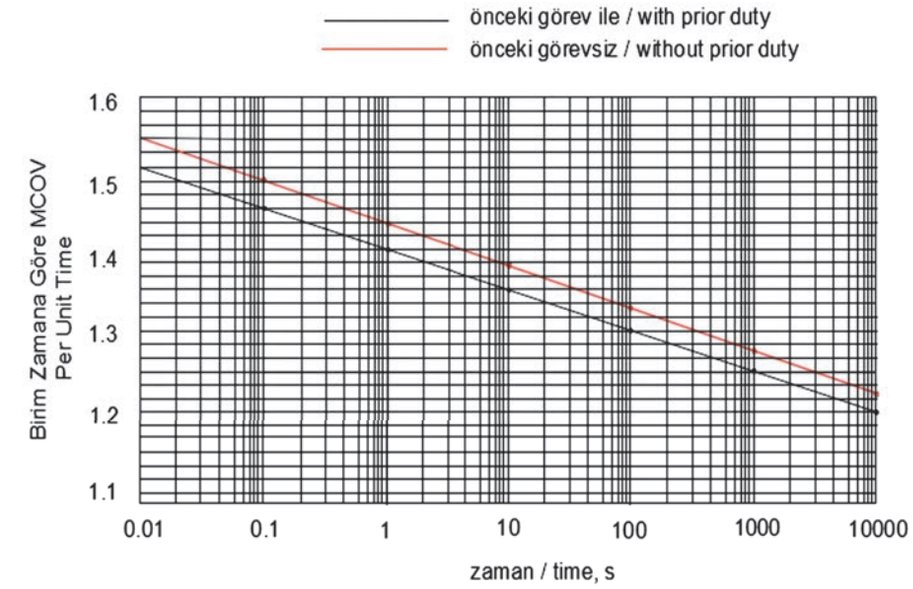
POLİMER GÖVDE TEKNİK ÖZELLİKLER
TECHNICAL PARAMETERS OF POLYMER HOUSING

Yüzeyel Direnç Oranı Rate of resistance on surface (ohm)	Delinme Dayanımı Puncture strenght (kV/mm)	Gerilme Dayanımı Tensile strength (Mpa)	Yırtılma Dayanımı Tearing strenght (N/mm)	Genişleme Oranı Rate of expansion (%)	Ortam Kaybı Loss of medium (tgd/ %)
≥10^{13}	≥15	≥4	≥9	≥150	≤10

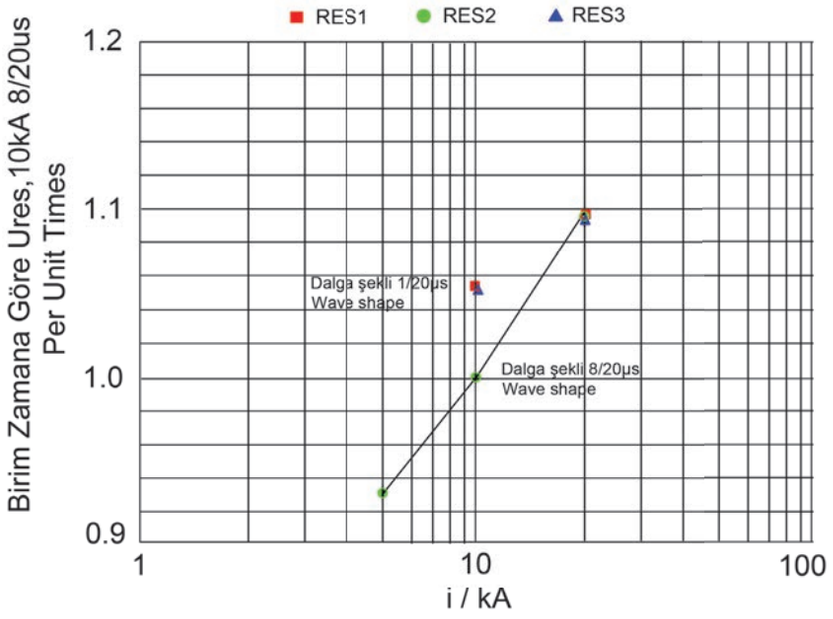
> 3-45kV/10kA serisi koruma parametreleri

> 3-45kV/10kA series protective characteristics

GEÇİCİ AŞIRI GERİLİM KAPASİTESİ
TEMPORARY OVERVOLTAGE CAPACITY (TOV)



ARTIK GERİLİM KARAKTERİSTİĞİ
RESIDUAL VOLTAGE CHARACTERISTIC



Karakteristik, PSW BERLIN 16-013-HA-1 nolu test raporumuzdan alınmıştır.
The characteristic is taken from our PSW BERLIN 16-013-HA-1 test report.

> 3-45 kV / DM serisi (5 kA) HP tipi polimer gövdeli

> 3-45 kV / DM series (5 kA) HP type surge arrester with polymer housing

GENEL TEKNİK DEĞERLER / GENERAL TECHNICAL PARAMETERS

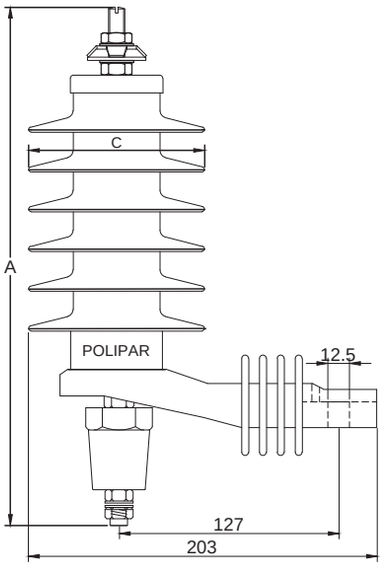
En Yüksek Sistem Gerilimi Max. System Voltages	3-45 kV	En Küçük Mahfaza Kaçak Yolu Uzunluğu Min. Creepage Distance of Housing	Tip 1 / Type 1 : 25 mm/kV Tip 2 / Type 2 : 31 mm/kV
Anma Gerilimleri Rated Voltages	3-45 kV	Ortam Sıcaklığında Referans Akım Reference Current in Ambiance Temperature	1mA,peak
Anma Boşalma Akımları Nominal Discharge Current	5 kA	Ortam Sıcaklığında Referans Gerilim Reference Voltages in Ambiance Temperature	> Beyan Gerilimi (Ur)
Basınç Sınırlama Akımı Pressure Limiting Current	16 kA	Uzun Süreli Akım Dayanım Kapasitesi Long Duration Current Impulse Temperature	75 A / 1000µs
Enerji Yeteneği Energy Capability	1.8 kj/kV	Yüksek Akım Darbesi Dayanımı High Current Impulse Withstand	65 kA (4/10 µs)

GARANTİLİ TEKNİK DEĞERLER / GUARANTEED TECHNICAL PARAMETERS

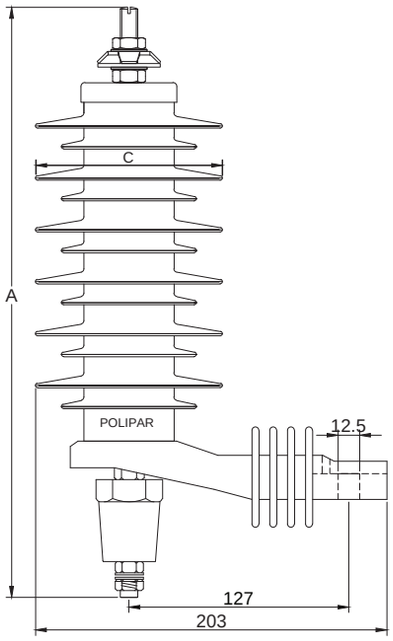
Anma Gerilimi Rated Voltage	Sürekli İşletme Gerilimi Continious Operating Voltage	Geçici Aşırı Gerilimler TOV Capability For		Maksimum Artık Gerilimler (kVpeak) Maximum Residual Voltage (kVpeak)			
		1sn	10sn	1/20 µs Dik Akım Darbesi Steep Current Impulse	8/20 µs Yıldırım Akım Darbesi Lightning Impulse With Current Wave		
kVrms	kVrms	kVrms	kVrms	5kApeak	2.5kApeak	5kApeak	10kApeak
3	2,5	3,9	3,7	12	8	9	10
6	5,1	8,1	7,6	21	15	17	19
9	7,5	11,9	11,2	33	24	26	29
10	8,4	13,3	12,6	36	27	31	33
12	10,2	16,2	15,3	43	32	36	39
15	12	20	18,9	55	40	45	49
18	15,3	24,3	22,9	65	47	53	60
21	17	27	25,5	76	57	63	69
24	19,5	31	29,2	87	67	72	79
27	22	34,5	33	98	73	82	89
30	24,4	38,7	36,6	106	82	91	98
33	27	42,9	40,5	119	90	99	108
36	29	46,1	43,5	128	97	108	118
42	34	50,3	49,2	133	103	119	124
45	36	54,7	53,4	139	109	123	135

> 3-45kV/ DM serisi (5 kA)
HP tipi polimer gövdeli parafudrların fiziksel özellikleri

> 3-45kV/DM series (5 kA)
Physical dates of HP type polymer housing arresters



TİP 1 / TYPE 1



TİP 2 / TYPE 2

Beyan Gerilimi Rated Voltage	Amax		Cmax		Maks. Ağırlık Max. Weight		Min. Kaçak Yolu Uzunluğu Min. Creepage Distance		Parafudr Mahfaza Izolasyon Dayanımı Housing Basic Insulation Level (BIL)	
kV	Tip 1 Type 1 mm	Tip 2 Type 2 mm	Tip 1 Type 1 mm	Tip 2 Type 2 mm	Tip 1 Type 1 kg	Tip 2 Type 2 kg	Tip 1 Type 1 mm	Tip 2 Type 2 mm	Yaşta şebeke frekanslı Wet Power Frequency 1 dakika-minute (kVp)	Kuruda Yıldırım Darbesi Dry lihtning Imulse 1,2/50 µs (kVp)
3	190	190	100	100	1,00	1,20	90	120	25	90
6	260	220	100	100	1,20	1,40	315	210	30	95
9	280	250	100	100	1,30	1,50	385	300	35	100
10	280	280	100	100	1,35	1,55	385	390	35	100
12	280	280	100	100	1,40	1,60	385	390	40	105
15	310	310	100	100	1,54	1,74	455	490	45	110
18	330	340	100	100	1,78	1,98	525	585	60	145
21	360	370	100	100	1,95	2,15	595	680	65	150
24	380	400	100	100	2,15	2,35	665	775	80	170
27	410	430	100	100	2,25	2,45	775	870	85	175
30	440	460	100	100	2,52	2,72	815	960	95	200
33	460	490	100	100	2,65	2,85	875	1050	100	205
36	480	520	100	100	2,86	3,06	945	1150	105	210
42	480	520	100	100	3,00	3,20	945	1150	120	225
45	480	520	100	100	3,20	3,40	945	1150	130	240

> 3-45 kV / DH serisi (10 kA,Sınıf 1) HP tipi polimer gövdeli

> 3-45 kV / DH series (10 kA,Class 1) HP type surge arrester with polymer housing

GENEL TEKNİK DEĞERLER / GENERAL TECHNICAL PARAMETERS

En Yüksek Sistem Gerilimi Max. System Voltages	3-45 kV	En Küçük Mahfaza Kaçak Yolu Uzunluğu Min. Creepage Distance of Housing	Tip 1 / Type 1 : 25 mm/kV Tip 2 / Type 2 : 31 mm/kV
Anma Gerilimleri Rated Voltages	3-45 kV	Ortam Sıcaklığında Referans Akım Reference Current in Ambiance Temperature	1mA,peak
Anma Boşalma Akımları Nominal Discharge Current	10 kA	Ortam Sıcaklığında Referans Gerilim Reference Voltages in Ambiance Temperature	> Beyan Gerilimi (Ur)
Basınç Sınırlama Akımı Pressure Limiting Current	16 kA	Uzun Süreli Akım Dayanım Kapasitesi Long Duration Current Impulse Temperature	250 A / 2000µs
Enerji Yeteneği Energy Capability	2.9 kj/kV	Yüksek Akım Darbesi Dayanımı High Current Impulse Withstand	100 kA (4/10 µs)

GARANTİLİ TEKNİK DEĞERLER / GUARANTEED TECHNICAL PARAMETERS

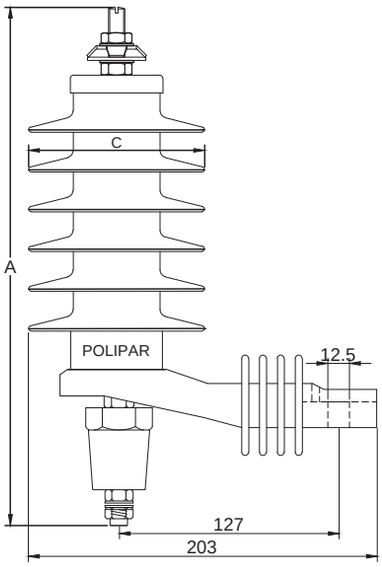
Anma Gerilimi Rated Voltage	Sürekli İşletme Gerilimi Continuous Operating Voltage	Geçici Aşırı Gerilimler TOV Capability For		Maksimum Artık Gerilimler (kVpeak) Maximum Residual Voltage (kVpeak)					
		1sn	10sn	1/20 µs Dik Akım Darbesi Steep Current Impulse	30/60 µs Anahtarlama Darbesi Switching Impulse With Current Wave		8/20 µs Yıldırım Akım Darbesi Lightning Impulse With Current Wave		
kVrms	kVrms	kVrms	kVrms	10kApeak	125Apeak	500Apeak	5kApeak	10kApeak	20kApeak
3	2,5	3,2	3,0	10,9	7,1	7,6	9,0	9,8	10,7
6	5,1	6,5	6,2	20,5	14,1	15,1	18,2	19,4	21,2
9	7,5	9,7	9,2	29,1	21,3	22,7	27,0	29,2	30,1
10	8,4	10,8	10,3	32,3	22,6	24,1	29,3	31,1	35,0
12	10,2	12,9	12,3	36,8	28,3	30,3	36,1	39,0	43,2
15	12	16,3	15,5	46,0	34,3	36,6	44,0	48,2	53,0
18	15,3	19,4	18,5	56,7	42,6	45,5	54,5	59,4	65,0
21	17	22,7	21,6	64,5	45,1	48,2	58,0	63,0	69,1
24	19,5	25,6	24,4	73,6	52,2	55,8	67,4	73,0	80,3
27	22	31,1	29,7	82,9	60,6	64,8	77,7	84,8	93,0
30	24,4	32,5	31,0	91,9	66,0	70,5	84,0	92,0	102,0
33	27	36,0	34,3	102,5	75,0	80,1	96,0	105,0	116,0
36	29	38,8	37,0	114,0	79,3	84,7	102,0	113,0	125,0
42	34	45,3	49,2	129,0	85,2	90,5	119,0	124,0	134,4
45	36	48,8	46,5	138,0	91,3	96,2	120,6	127,6	139,7

> 3-45kV/ DH serisi (10 kA,Sınıf 1)

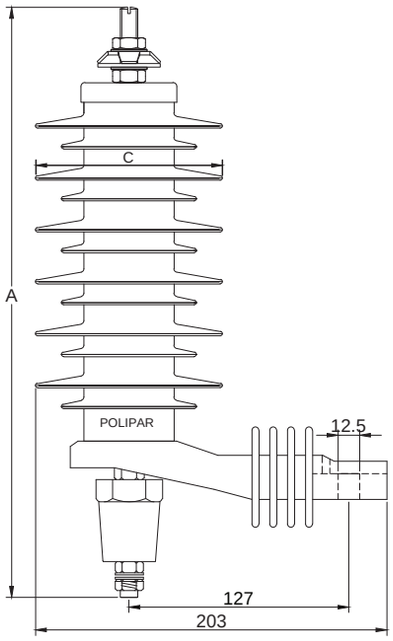
HP tipi polimer gövdeli parafudrların fiziksel özellikleri

> 3-45kV/DH series (10 kA,Class 1)

Physical dates of HP type polymer housing arresters



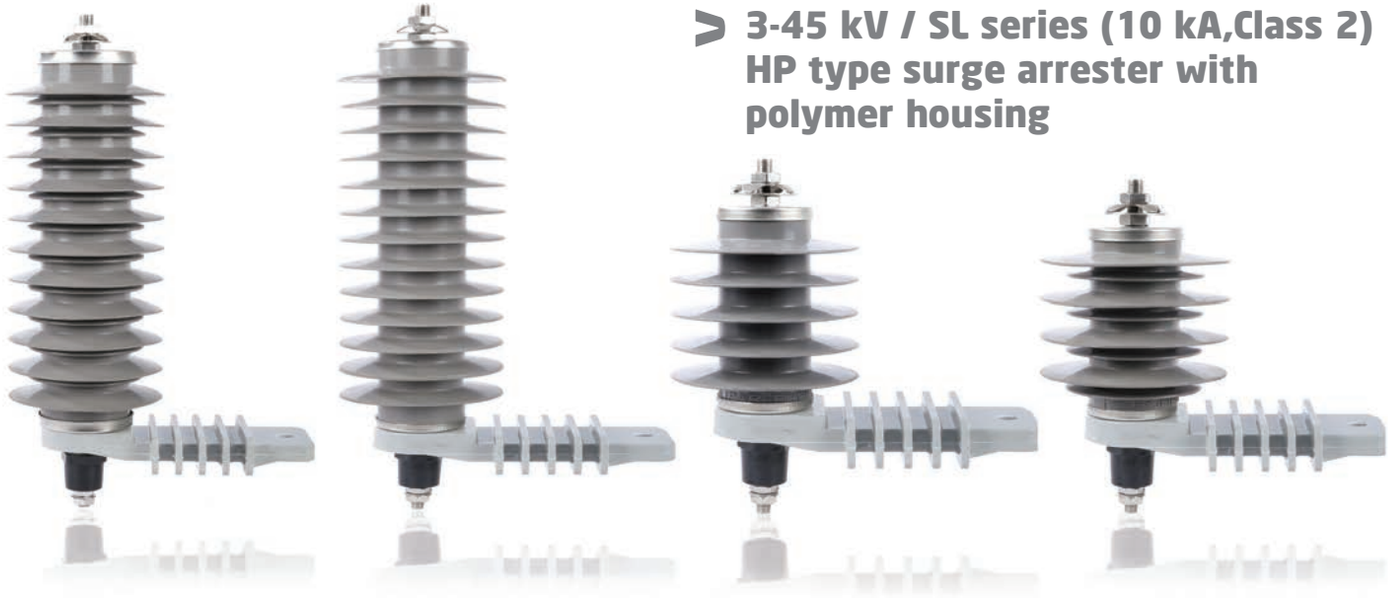
TİP 1 / TYPE 1



TİP 2 / TYPE 2

Beyan Gerilimi Rated Voltage	Amax		Cmax		Maks. Ağırlık Max. Weight		Min. Kaçak Yolu Uzunluğu Min. Creepage Distance		Parafudr Mahfaza Izolasyon Dayanımı Housing Basic Insulation Level (BIL)	
kV	Tip 1 Type 1 mm	Tip 2 Type 2 mm	Tip 1 Type 1 mm	Tip 2 Type 2 mm	Tip 1 Type 1 kg	Tip 2 Type 2 kg	Tip 1 Type 1 mm	Tip 2 Type 2 mm	Yaşta şebeke frekanslı Wet Power Frequency 1 dakika-minute (kVp)	Kuruda Yıldırım Darbesi Dry lihtning Imulse 1,2/50 µs (kVp)
3	210	190	105	108	1,20	1,40	145	120	30	75
6	260	220	105	108	1,55	1,75	295	220	35	85
9	280	250	105	108	1,65	1,85	370	320	40	95
10	280	280	105	108	1,65	1,95	370	420	40	95
12	280	280	105	108	1,75	1,95	370	420	45	105
15	310	310	105	108	2,00	2,20	445	520	50	115
18	330	340	105	108	2,30	2,50	520	620	60	145
21	360	370	105	108	2,50	2,70	595	720	75	155
24	380	400	105	108	2,70	2,90	670	820	80	170
27	410	430	105	108	2,90	3,10	745	920	85	175
30	440	460	105	108	3,20	3,40	820	1020	95	200
33	460	490	105	108	3,30	3,50	895	1120	100	205
36	480	490	105	108	3,60	3,80	970	1120	110	215
42	480	520	105	108	3,90	4,10	970	1220	120	225
45	480	520	105	108	4,20	4,40	970	1220	130	245

> 3-45 kV / SL serisi (10 kA,Sınıf 2) HP tipi polimer gövdeli



> 3-45 kV / SL series (10 kA,Class 2) HP type surge arrester with polymer housing

GENEL TEKNİK DEĞERLER / GENERAL TECHNICAL PARAMETERS

En Yüksek Sistem Gerilimi Max. System Voltages	3-45 kV	En Küçük Mahfaza Kaçak Yolu Uzunluğu Min. Creepage Distance of Housing	Tip 1 / Type 1 : 25 mm/kV Tip 2 / Type 2 : 31 mm/kV
Anma Gerilimleri Rated Voltages	3-45 kV	Ortam Sıcaklığında Referans Akım Reference Current in Ambiance Temperature	1mA,peak
Anma Boşalma Akımları Nominal Discharge Current	10 kA	Ortam Sıcaklığında Referans Gerilim Reference Voltages in Ambiance Temperature	> Beyan Gerilimi (Ur)
Basınç Sınırlama Akımı Pressure Limiting Current	40-50 kA	Uzun Süreli Akım Dayanım Kapasitesi Long Duration Current Impulse Temperature	600 A / 2000µs
Enerji Yeteneği Energy Capability	5.5 kj/kV	Yüksek Akım Darbesi Dayanımı High Current Impulse Withstand	100 kA (4/10 µs)

GARANTİLİ TEKNİK DEĞERLER / GUARANTEED TECHNICAL PARAMETERS

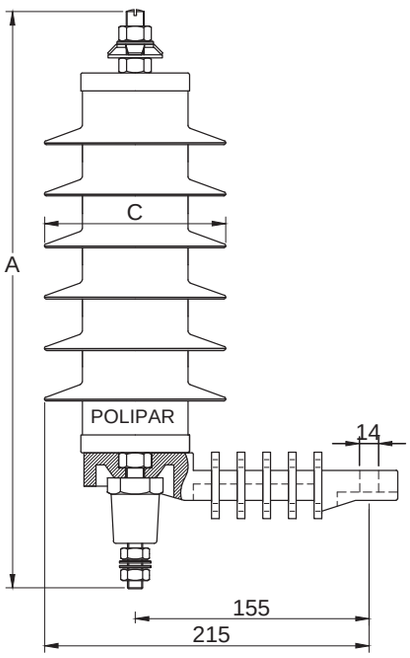
Anma Gerilimi Rated Voltage	Sürekli İşletme Gerilimi Continuous Operating Voltage	Geçici Aşırı Gerilimler TOV Capability For		Maksimum Artık Gerilimler (kVpeak) Maximum Residual Voltage (kVpeak)					
		1sn	10sn	1/20 µs Dik Akım Darbesi Steep Current Impulse	30/60 µs Anahtarlama Darbesi Switching Impulse With Current Wave		8/20 µs Yıldırım Akım Darbesi Lightning Impulse With Current Wave		
kVrms	kVrms	kVrms	kVrms	10kApeak	125Apeak	500Apeak	5kApeak	10kApeak	20kApeak
3	2,5	3,4	3,2	8,6	6,1	5,5	7,5	8,1	9,0
6	5,1	6,9	6,6	17,7	12,2	13,0	15,0	16,2	17,9
9	7,5	10,4	9,9	25,4	18,3	19,5	22,6	24,4	27,0
10	8,4	11,5	11,0	28,2	20,1	21,4	24,9	26,9	29,8
12	10,2	13,8	13,2	33,9	24,4	26,0	29,9	32,3	35,8
15	12	17,3	16,5	42,4	30,4	32,4	37,6	40,6	44,9
18	15,3	20,7	19,8	50,8	36,5	38,0	45,2	48,8	54,0
21	17	24,2	23,1	59,3	40,7	43,4	49,9	53,8	59,6
24	19,5	27,6	26,4	67,8	46,7	49,8	58,5	64,6	71,5
27	22	31,1	29,7	76,2	52,7	56,0	67,9	73,2	81,0
30	24,4	34,5	33,0	84,7	58,4	62,2	74,8	80,7	89,3
33	27	38,0	36,3	93,2	65,9	70,3	81,5	87,5	93,5
36	29	41,4	39,6	101,6	69,5	74,0	89,8	96,9	107,0
42	34	48,3	46,2	118,6	81,4	88,8	95,1	103,0	114,0
45	36	51,8	49,5	127,1	87,4	93,1	110,0	118,0	131,0

> 3-45kV/SL serisi (10kA,Sınıf 2)

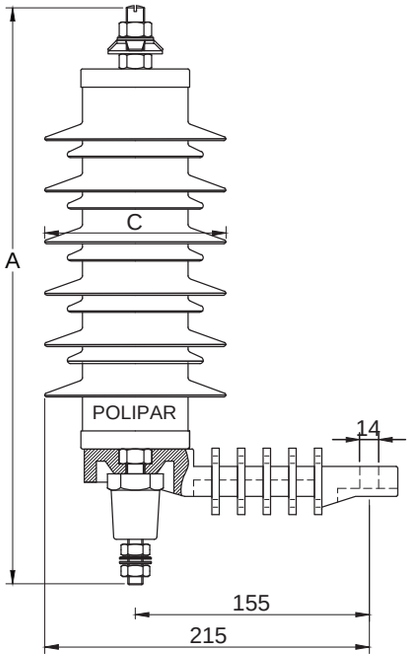
HP tipi polimer gövdeli parafudrların fiziksel özellikleri

> 3-45kV/SL series (10kA,Class 2)

Physical dates of HP type polymer housing arresters



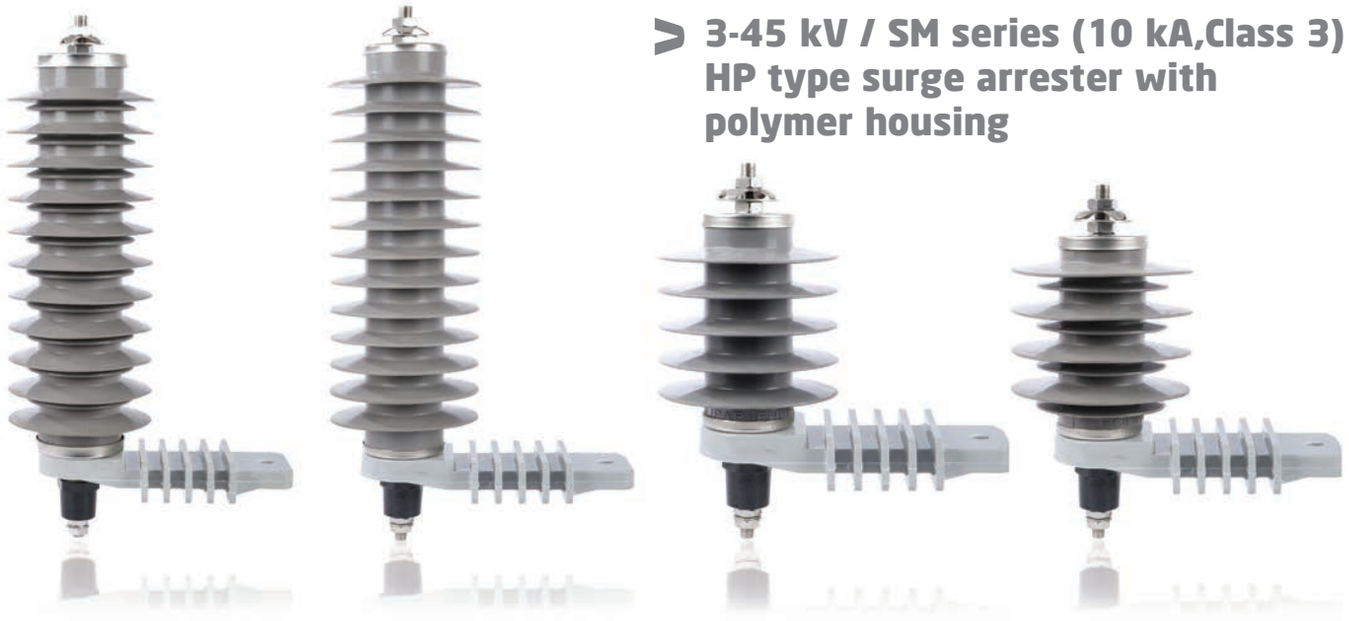
TİP 1 / TYPE 1



TİP 2 / TYPE 2

Beyan Gerilimi Rated Voltage	Amax		Cmax		Maks. Ağırlık Max. Weight		Min. Kaçak Yolu Uzunluğu Min. Creepage Distance		Parafudr Mahfaza Izolasyon Dayanımı Housing Basic Insulation Level (BIL)	
kV	Tip 1 Type 1 mm	Tip 2 Type 2 mm	Tip 1 Type 1 mm	Tip 2 Type 2 mm	Tip 1 Type 1 kg	Tip 2 Type 2 kg	Tip 1 Type 1 mm	Tip 2 Type 2 mm	Yaşta şebeke frekanslı Wet Power Frequency 1 dakika-minute (kVp)	Kuruda Yıldırım Darbesi Dry lihtning Imulse 1,2/50 µs (kVp)
3	240	210	115	120	1,7	1,6	195	130	30	85
6	270	240	115	120	2	2,4	274	225	35	95
9	300	270	115	120	2,4	2,8	349	320	40	105
12	330	300	115	120	2,8	3	424	415	45	115
15	360	340	115	120	3,2	3,4	499	510	50	125
18	390	370	115	120	3,6	3,8	574	605	60	145
21	420	370	115	120	4	4,2	649	605	95	175
24	450	410	115	120	4,4	4,6	724	700	105	180
27	480	450	115	120	4,8	5	798	795	110	190
30	510	480	115	120	5,1	5,3	874	890	125	210
33	540	510	115	120	5,4	5,6	949	985	130	230
36	570	550	115	120	5,7	6	1090	1115	135	240
42	570	550	115	120	6,1	6,4	1090	1115	145	250
45	570	550	115	120	6,5	6,8	1090	1115	150	255

> 3-45 kV / SM serisi (10 kA,Sınıf 3) HP tipi polimer gövdeli



> 3-45 kV / SM series (10 kA,Class 3) HP type surge arrester with polymer housing

GENEL TEKNİK DEĞERLER / GENERAL TECHNICAL PARAMETERS

En Yüksek Sistem Gerilimi Max. System Voltages	3-45 kV	En Küçük Mahfaza Kaçak Yolu Uzunluğu Min. Creepage Distance of Housing	Tip 1 / Type 1 : 25 mm/kV Tip 2 / Type 2 : 31 mm/kV
Anma Gerilimleri Rated Voltages	3-45 kV	Ortam Sıcaklığında Referans Akım Reference Current in Ambiance Temperature	1mA,peak
Anma Boşalma Akımları Nominal Discharge Current	10 kA	Ortam Sıcaklığında Referans Gerilim Reference Voltages in Ambiance Temperature	> Beyan Gerilimi (Ur)
Basınç Sınırlama Akımı Pressure Limiting Current	65 kA	Uzun Süreli Akım Dayanım Kapasitesi Long Duration Current Impulse Temperature	1000 A / 2000µs
Enerji Yeteneği Energy Capability	7.8 kj/kV	Yüksek Akım Darbesi Dayanımı High Current Impulse Withstand	100 kA (4/10 µs)

GARANTİLİ TEKNİK DEĞERLER / GUARANTEED TECHNICAL PARAMETERS

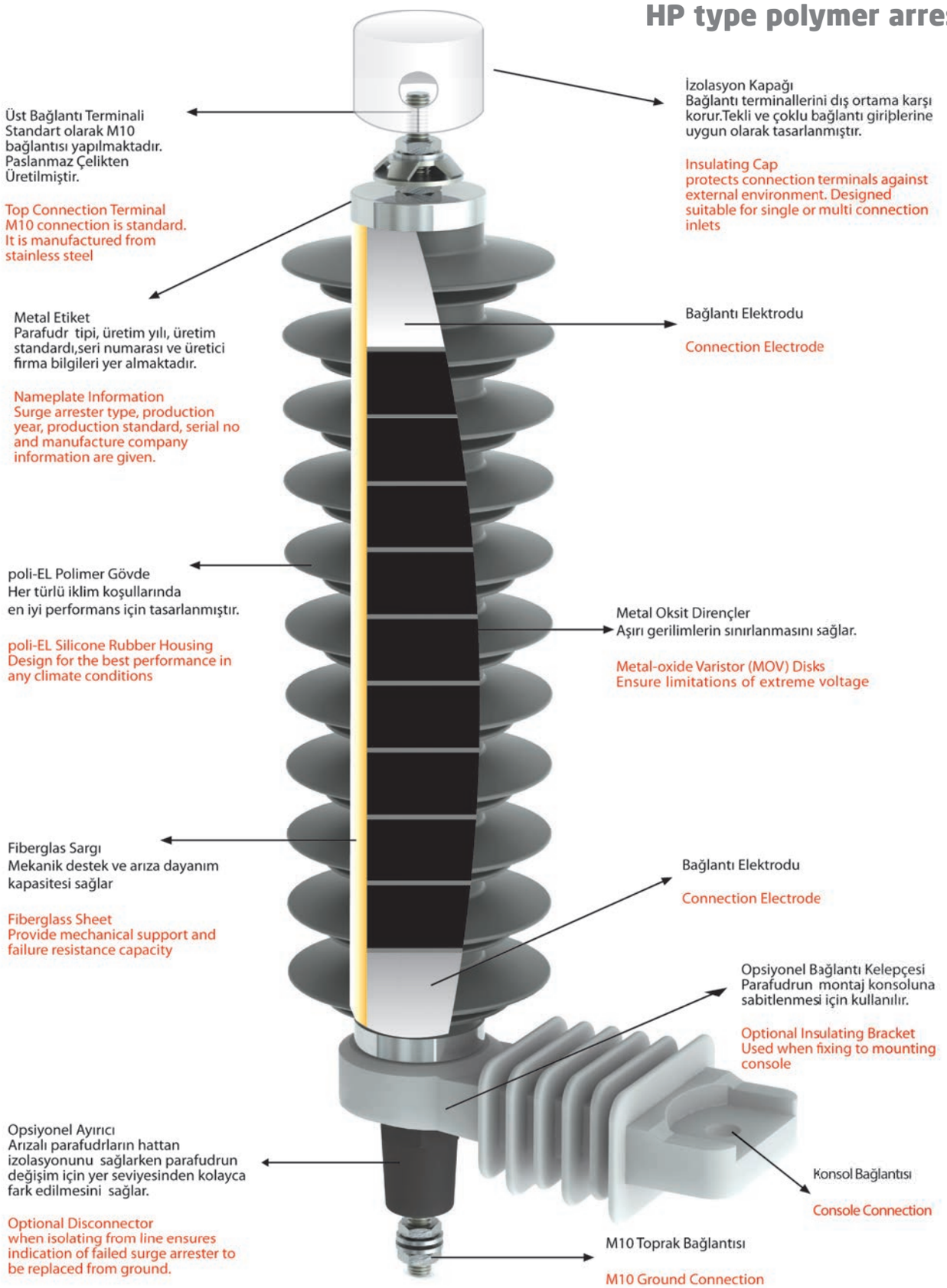
Anma Gerilimi Rated Voltage	Sürekli İşletme Gerilimi Continuous Operating Voltage	Geçici Aşırı Gerilimler TOV Capability For		Maksimum Artık Gerilimler (kVpeak) Maximum Residual Voltage (kVpeak)					
		1sn	10sn	1/20 µs Dik Akım Darbesi Steep Current Impulse	30/60 µs Anahtarlama Darbesi Switching Impulse With Current Wave		8/20 µs Yıldırım Akım Darbesi Lightning Impulse With Current Wave		
kVrms	kVrms	kVrms	kVrms	10kApeak	125Apeak	500Apeak	5kApeak	10kApeak	20kApeak
3	2,5	3,6	3,4	8,2	5,7	6,1	7,2	7,8	8,4
6	5,1	7,3	7,0	16,3	11,4	12,1	14,3	15,6	16,8
9	7,5	11,1	10,6	24,5	17,1	18,1	21,5	23,3	25,2
10	8,4	12,2	11,7	26,9	18,8	19,8	23,6	25,6	27,7
12	10,2	13,8	13,2	32,6	22,8	24,1	28,6	31,1	33,6
15	12	18,2	17,4	40,6	28,4	30,0	35,6	38,7	41,9
18	15,3	21,7	20,8	48,9	34,2	36,2	42,9	46,6	50,4
21	17	25,5	24,4	54,4	38,0	40,2	47,7	51,7	56,0
24	19,5	29,4	28,2	62,4	43,6	46,1	54,7	59,3	64,2
27	22	33,1	31,7	70,3	49,1	52,0	61,7	66,9	72,5
30	24,4	36,5	35,0	78,0	54,5	57,7	68,4	74,2	80,4
33	27	40,0	38,3	87,9	61,4	65,0	77,1	83,6	90,6
36	29	43,4	41,6	92,7	64,8	68,6	81,3	88,2	95,5
42	34	50,3	48,2	109,0	75,9	80,4	95,3	104,0	112,0
45	36	53,8	51,5	117,0	81,5	86,3	103,0	111,0	121,0

> 3-45kV/5-10kA serisi

HP tipi polimer gövdeli parafudrların detay görünümü

> 3-45kV/5-10kA series

View of inner design of HP type polymer arresters

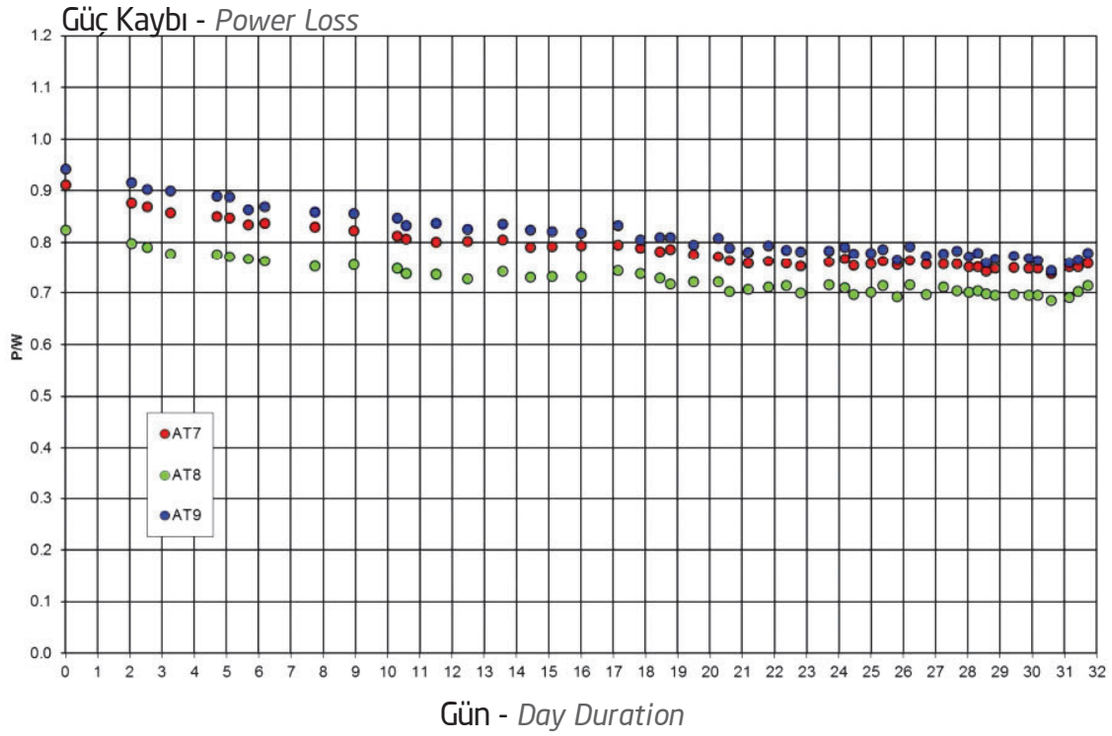


Madrid İspanya'da iletim hattında kullanılan POLİPAR HP Serisi Orta Gerilim Parafudrları

POLIPAR HP Series Medium Voltage Surge Arrester used in transmission line in Madrid Spain

HP Serisi Parafudrlarla Enerji Sistemlerinde Minimal Güç Kaybı

Minimal Power Loss in Energy Systems with HP Series Surge Arrester



Prüffelder des Schaltwerks Berlin Almanya laboratuvarlarındaki POLiPAR Parafudr segmentinin 17-058-HA-1 nolu yaşlandırma deneyinden alınmıştır.

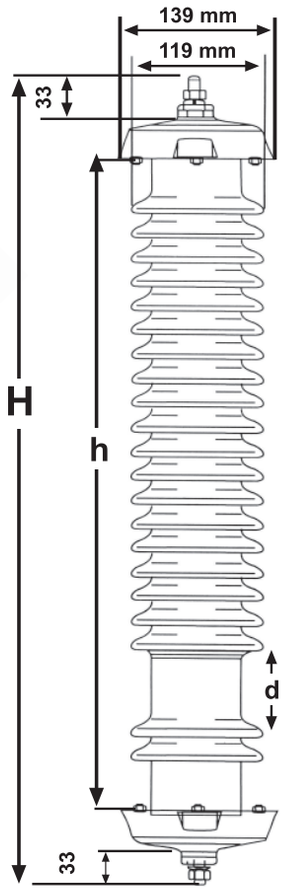
The graphic taken by 17-058-HA-1 numbered long term stability under COV test of Surge Arrester test segment images in Prüffelder des Schaltwerks Berlin Germany laboratories

> Prüffelder des Schaltwerks Berlin Almanya laboratuvarlarındaki Parafdur test segment görüntüleri

> *Surge Arrester test segment images in Prüffelder des Schaltwerks Berlin Germany laboratories*

> 3-45kV/5-10kA serisi
HD tipi porselen gövdeli parafudrlar

> 3-45kV/5-10kA series
HD type porcelain housing arrester



FİZİKSEL ÖZELLİKLERİ
PHYSICAL DATES

		HD 45/10	HD 42/10	HD 36/10	HD 36 /05	HD 30/10	HD 30/05	HD 15/10	HD 15/05	HD 6,3/05
Parafudr Yükseklik(H) Height of Arrester	mm	760	760	760	760	620	620	400	400	400
İzolator Yüksekliği (h) Height of Insulator	mm	650	650	650	650	510	510	28	28	28
Bağlantı Konsol Uzunluğu (d) Height of Connection field	mm	55	55	55	55	55	55	25	25	25
Min. Kaçak Yolu Uzunluğu Min. Creepage Distance	mm	900	900	990	990	750	750	375	375	260
Maks. Ağırlık Max. Weight	kg	10,65	10,3	9,5	8,3	8,7	8,1	4,5	4,3	4,0

> Parafudr Ayırıcıları

Parafudrlarda nadiren meydana gelen arızalar sonucunda enerji hatlarında kısa devreler olabilir. Kısa devre olan parafudrların arızaya rağmen hatta bağlı kalması durumunda, sisteme yeniden enerji verilmesinde problemlerle karşılaşılabilir.

Bu nedenle Polipar Parafudrlarda opsiyonel olarak bulunan parafudr ayırıcıları sayesinde arızalı parafudrlar sistemden ayrılırken hattın kısa zamanda yeniden işletime alınması da sağlanır.

Ayrıca parafudr gövdesinden farklı renkteki tasarımı sayesinde arızalı parafdrun yer seviyesinden kolayca fark edilmesini de sağlar.

> Disconnectors

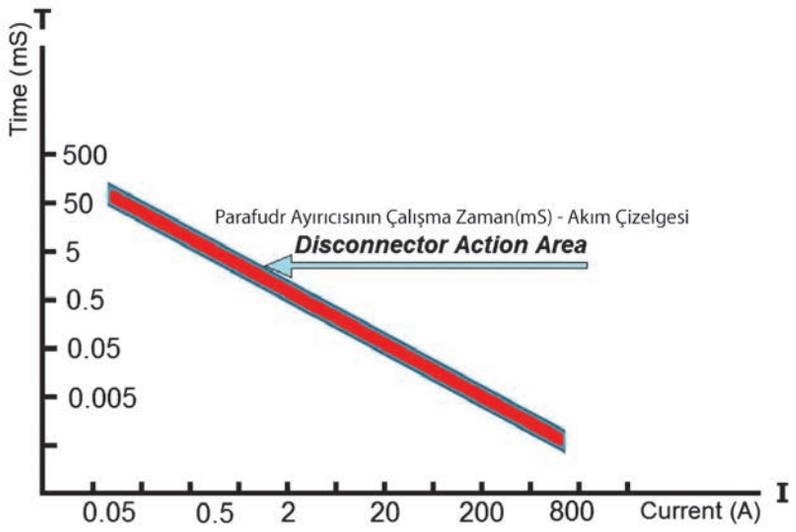
As a result of rare failures in surge arresters, short circuits might happen in energy lines. Problems may arise if surge arresters that failed due to short circuit are still connected to line when the system is loaded again.

Therefore failed surge arresters are disconnected and line is ensured to be operational in a short time by means of optional surge arrester separators.

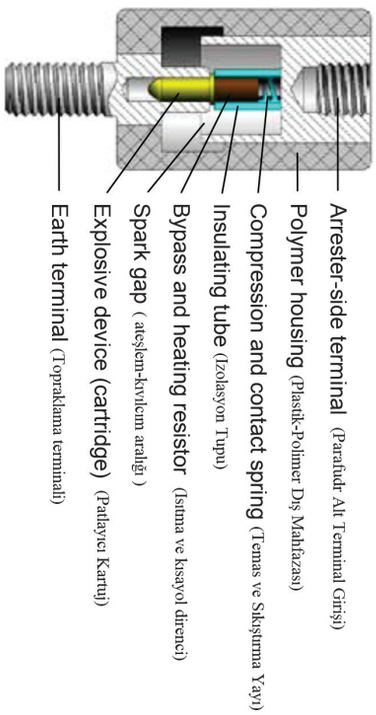
Additionally, the failed surge arresters are distinguished easily from ground due to different color design.

E / CİVATALI AYIRICI | E / DISCONNECTORS WITH SCREWS

D / CİVATASIZ AYIRICI | D / DISCONNECTORS WITHOUT SCREWS



0.05	0.5	2	20	200	800	Operating Current (A)
300~400	50~70	4~6	0.4~0.5	0.03~0.04	0.008~0.015	Action Time (mS)



> Polipar Kodlama Sistemi > Catalogue Numbering System

1	2	3	4	5	6	7	
HP	3kV-45kV	5 kA	48H -60Hz	P-01	T-01	L-01	N-01
				P-02	T-02	L-02	N-02
HD		10 kA		P-03	T-03	L-03	N-03

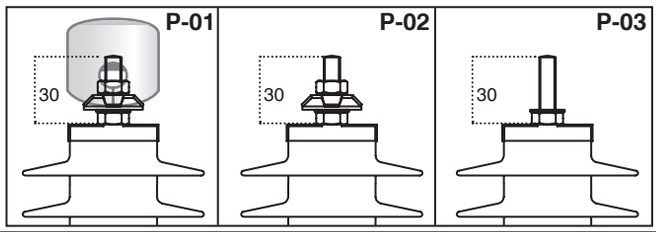
1. Parafudr Gövde İzolasyon Şekli
Type of Housing Material
HP: Polimer Gövde HD :Porselen Gövde
Polymer Housing Porcelain Housing

2. Anma Gerilimleri
Rated Voltage
3kV ile 45kV arası
3kV to 45kV

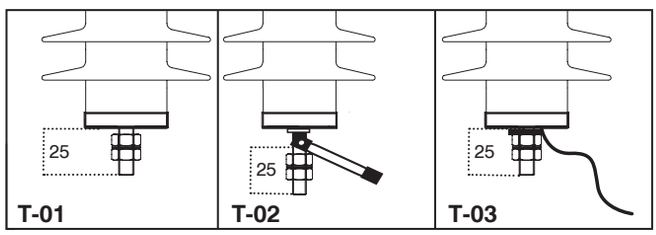
3. Anma Boşalma Akımları
Nominal Discharge Current
5kA:Normal Görev, 10kA:Ağır Görev, 10kA:İstasyon Tipi
Normal Duty (DM) Heavy Duty (DH) Station Type (SL&SM)

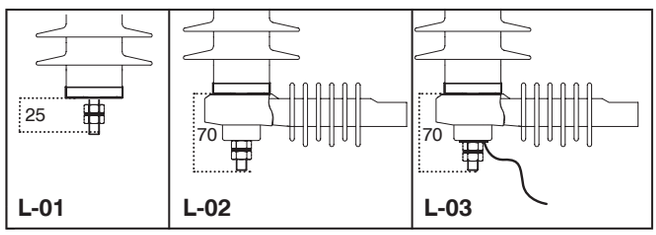
4. Anma Frekansı
Rated Frequency
48Hz ile 60Hz arası
48Hz to 60Hz

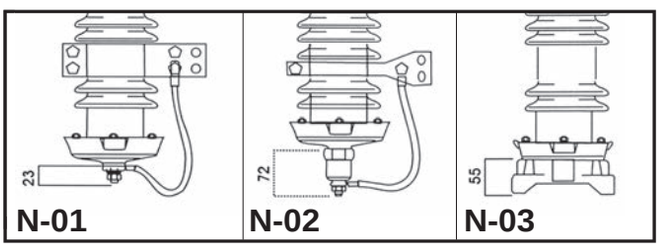
5.Hat Bağlantı Şekli
Line Terminal Options



6.Toprak - Montaj Bağlantı Şekli
Ground - Base Terminal Options







Etiket Tasarımı / *Ticket Design*

Tip deneyleri Uluslararası Akredite Laboratuvarlarda yapılmıştır.
Type tests were conducted in International Accredited Laboratories.

HY SERİSİ SL (SINIF 2) YÜKSEK GERİLİM PARAFUDRLAR

HY Series SL (Class 2) High Voltage Surge Arresters

> POLİPAR Metal Oksit parafudrların kullanım alanları

>>> Aşırı gerilmlerden dolayı sistemde meydana gelen voltaj çökmeleri sonucu güç kaynaklarında yük kayıpları oluşur ve bu aşırı gerilimler sistemde ciddi problemler yaşanmasına neden olur.

>>> Sistemde oluşan bu voltaj dalgalanmaları, modern endüstride voltaj salınımlarına hassas olan ekipmanlar için son derece tehlikeli bir durumdur.

>>> Atmosferik ve anahtarlama aşırı gerilimlerine karşı; kontrol mekanizmalarına ve transformatörlere koruma sağlar.

>>> Parafudrlar kullanılacağı sistemin kurulumuna göre harici ve dahili olarak kullanılabilmekte ve hassas ekipmanlara yüksek güvenlik sunmaktadır.

> Application of POLIPAR Metal-Oxide type arresters

>>> *As a result of over dose voltage and voltage collapse in the system, there exist a load loss on power supply therefore these overvoltage's causes serious damages I the system.*

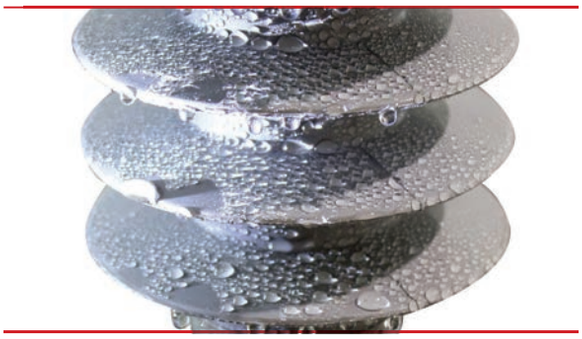
>>> *This voltage wave which exist in the system is a dangerous situation for modern industry in terms of delicate products in voltage oscillations.*

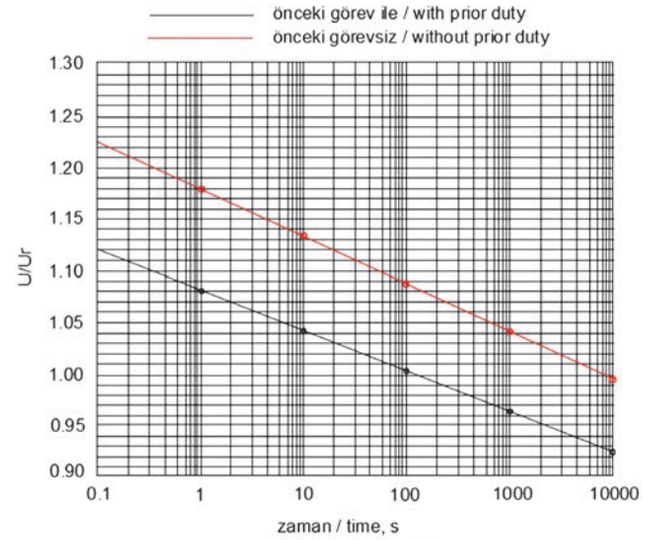
>>> *It provides protection for control mechanism and transformers against to atmospheric and over switching voltages.*

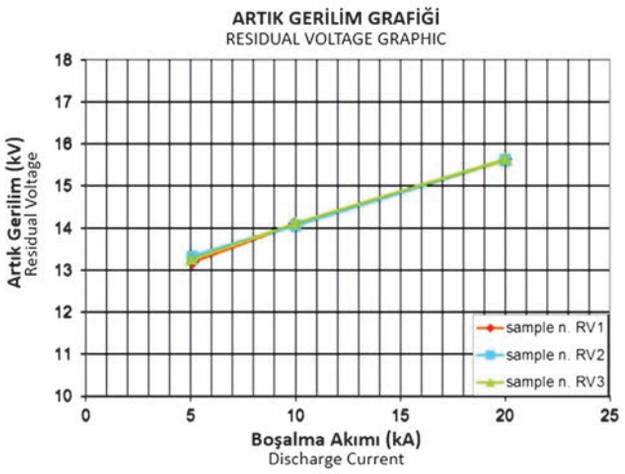
>>> *It provides high protection for delicate products and equipment according to surge arresters' usage of system's installation.*

*SL parafudrlarının TOV karakteristikleri IEC 60099-4'e göre "önceden görevli" ve "önceden görevsiz" dir.

**The TOV characteristics of SL surge arresters 'with prior duty' and 'without prior duty' as per IEC 60099-4.*







Genel Teknik Değerler General Technical Parameters

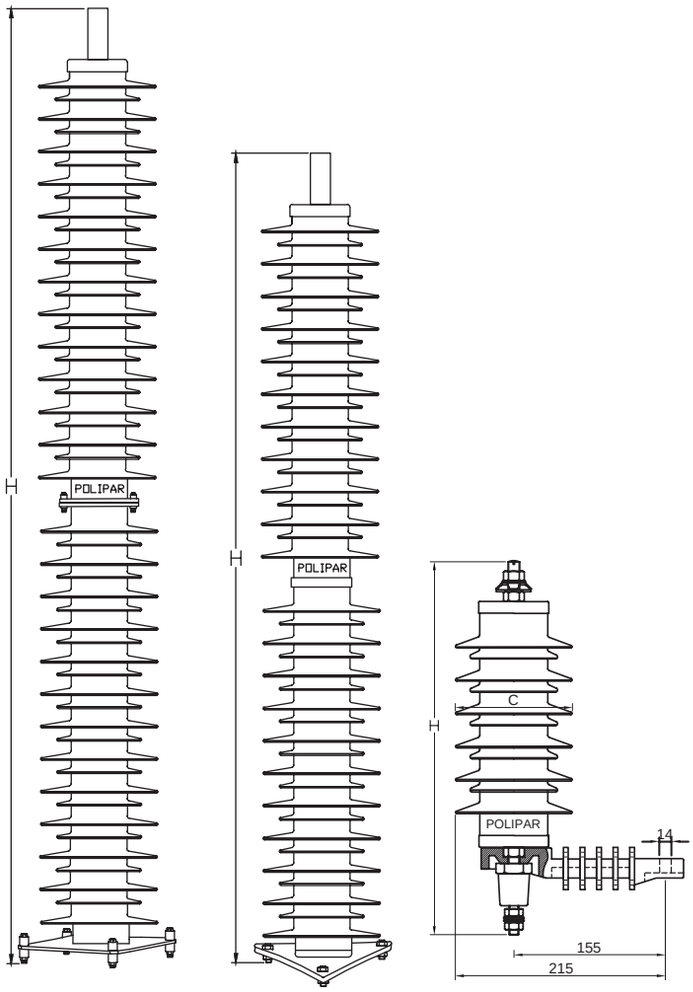
STANDART Standart	IEC 99-4 TS EN 60099-4
ANMA BOŞALMA AKIMI Nominal Discharge Current	10 kA peak
BEYAN GERİLİMİ Rated Voltage	3 - 144 kV
YÜKSEK AKIM DAYANIM KAPASİTESİ High Voltage Impulse Capability	100 kA (4/10 µs)
HAT BOŞALMA SINIFI Line Discharge Class	2
KISA DEVRE DAYANIM KAPASİTESİ Short Circuit Capability	40-50 kA
MİNİMUM ENERJİ KAPASİTESİ Minimum Energy Capability	5.5 kj/kV (Ur)
KANTİLEVER DAYANIM High Cantilever Strenght	1600
A.C. SİSTEM FREKANSI AC System Frequency	50Hz – 60Hz
YÜKSEKLİK SEVİYESİ The Altitude Above Sea	2500+ m
ORTAM SICAKLIĞI Ambient Temperatures	-55 °C , +65 °C

> Garantili Teknik Değerler > Guaranteed Protective Parameters

Anma Gerilimi **Rated Voltage** Ur kV(rms)	**Maks. Devamlı İşletme Gerilimi** **Max. Continuous Operating Voltage** Uc kV(rms)	**Geçici Aşırı Gerilim Yeteneği(1sn)** **Temporary Over voltage Capability** kV(rms)	**Dik Akım Darbesi Artık Gerilimi (10kA)** **Max. Steep Current Protective level at 10kA** kV(peak)	**Maks. Anahtarlama Aşırı Gerilimi** **Max. Switching protective level** kV(peak)		**Yıldırım Darbe Aşırı Gerilimi (8/20 µs)** **Max. lightning discharge voltage at 8/20 µs** kV(peak)		
				250 A	**1000 A**	**5 kA**	**10 kA**	**20 kA**
3	2,5	3,4	8,6	6,3	6,7	7,5	8,1	9,0
6	5,1	6,9	17,7	12,6	13,5	15,0	16,2	17,9
9	7,5	10,4	25,4	18,9	20,2	22,6	24,4	27,0
10	8,4	11,5	28,2	20,7	22,2	24,9	26,9	29,8
12	10,2	13,8	33,9	25,2	26,9	29,9	32,3	35,8
15	12	17,3	42,4	31,3	33,5	37,6	40,6	44,9
18	15,3	20,7	50,8	37,7	40,4	45,2	48,8	54,0
21	17	24,2	59,3	41,9	44,9	49,9	53,8	59,6
24	19,5	27,6	67,8	48,1	51,5	58,5	64,6	71,5
27	22	31,1	76,2	54,3	58,1	67,9	73,2	81,0
30	24,4	34,5	84,7	60	64,4	74,8	80,7	89,3
33	27	38,0	93,2	67	72,6	81,5	87,5	93,5
36	29	41,4	101,6	71	75	89	96	107
42	34	48,3	118,6	83	89	95	103	114
45	36	51,8	127,1	90	96	110	118	131
54	44	59	150	100	105	127	137	151
60	49	68	171	110	115	145	156	173
66	54	73	186	120	130	160	173	191
72	59	83	205	130	140	172	186	205
90	73	102	225	165	175	217	234	258
96	78	111	245	175	187	229	247	274
108	88	122	304	200	210	253	273	302
120	98	138	342	225	235	295	318	353
132	107	152	373	245	255	320	345	382
144	117	165	398	265	280	347	374	472

> Fiziksel Özellikleri > Dimensions

Parafudr Tipi Type of Arrester	H mm	Birim Sayısı No. of Unit	Min. Kaçak Yolu Uzunluğu Min. Creepage Distance mm	Yaklaşık Ağırlık Approximately Weight kg (+-1)
HP-SL 3	210	1	130	1,6
HP-SL 6	240	1	225	2,4
HP-SL 9	270	1	320	2,8
HP-SL 10	300	1	415	2,9
HP-SL 12	300	1	415	3,0
HP-SL 15	340	1	510	3,4
HP-SL 18	370	1	605	3,8
HP-SL 21	370	1	605	4,2
HP-SL 24	410	1	700	4,6
HP-SL 27	450	1	795	5,0
HP-SL 30	480	1	890	5,3
HP-SL 33	510	1	985	5,6
HP-SL 36	550	1	1115	6,0
HP-SL 42	550	1	1115	6,4
HP-SL 45	550	1	1115	6,8
HP-SL 54	1020	2	2230	15,0
HP-SL 60	1020	2	2230	15,5
HP-SL 66	1020	2	2230	16,0
HP-SL 72	1020	2	2230	16,5
HP-SL 90	1800	2	4620	35,5
HP-SL 96	1800	2	4620	36,0
HP-SL 108	1800	2	4620	37,0
HP-SL 120	1800	2	4620	38,0
HP-SL 132	1800	2	4620	38,5
HP-SL 144	1800	2	4620	39,0



IEC standartlarına uygun olarak üretim ve testleri yapılmaktadır.

Production and testing are carried out in accordance with IEC Standards.

HY SERİSİ SM (SINIF 3) YÜKSEK GERİLİM PARAFUDRLAR

HY Series SM (Class 3) High Voltage Surge Arresters

> POLİPAR Metal Oksit parafudrların kullanım alanları

>>> Aşırı gerilmlerden dolayı sistemde meydana gelen voltaj çökmeleri sonucu güç kaynaklarında yük kayıpları oluşur ve bu aşırı gerilimler sistemde ciddi problemler yaşanmasına neden olur.

>>> Sistemde oluşan bu voltaj dalgalanmaları, modern endüstride voltaj salınımlarına hassas olan ekipmanlar için son derece tehlikeli bir durumdur.

>>> Atmosferik ve anahtarlama aşırı gerilimlerine karşı; kontrol mekanizmalarına ve transformatörlere koruma sağlar.

>>> Parafudrlar kullanılacağı sistemin kurulumuna göre harici ve dahili olarak kullanılabilmekte ve hassas ekipmanlara yüksek güvenlik sunmaktadır.

> Application of POLIPAR Metal-Oxide type arresters

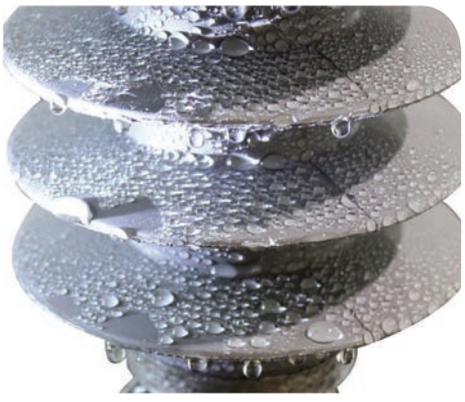
>>> *As a result of over dose voltage and voltage collapse in the system, there exist a load loss on power supply therefore these overvoltage's causes serious damages I the system.*

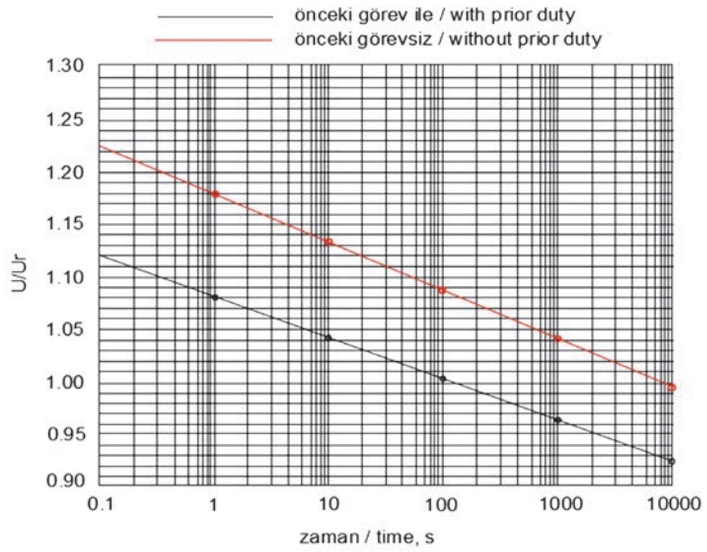
>>> *This voltage wave which exist in the system is a dangerous situation for modern industry in terms of delicate products in voltage oscillations.*

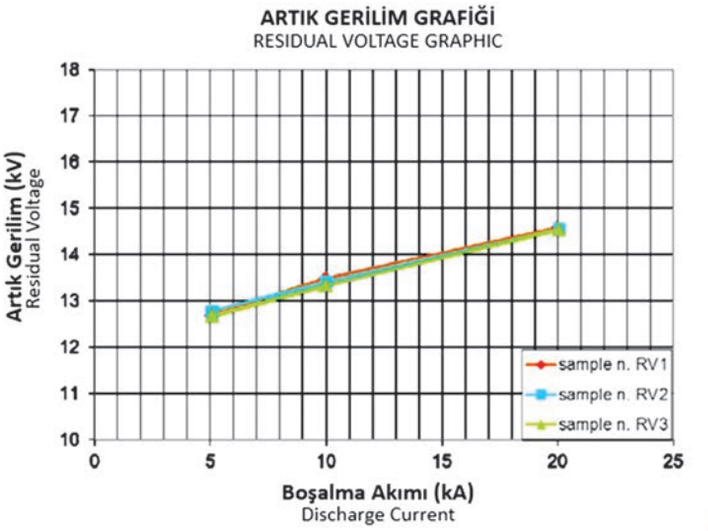
>>> *It provides protection for control mechanism and transformers against to atmospheric and over switching voltages.*

>>> *It provides high protection for delicate products and equipment according to surge arresters' usage of system's installation.*

*SM parafudrlarının TOV karakteristikleri IEC 60099-4'e göre "önceki görev ile" ve "önceki görevsiz" dir.
**The TOV characteristics of SM surge arresters 'with prior duty' and 'without prior duty' as per IEC 60099-4.*





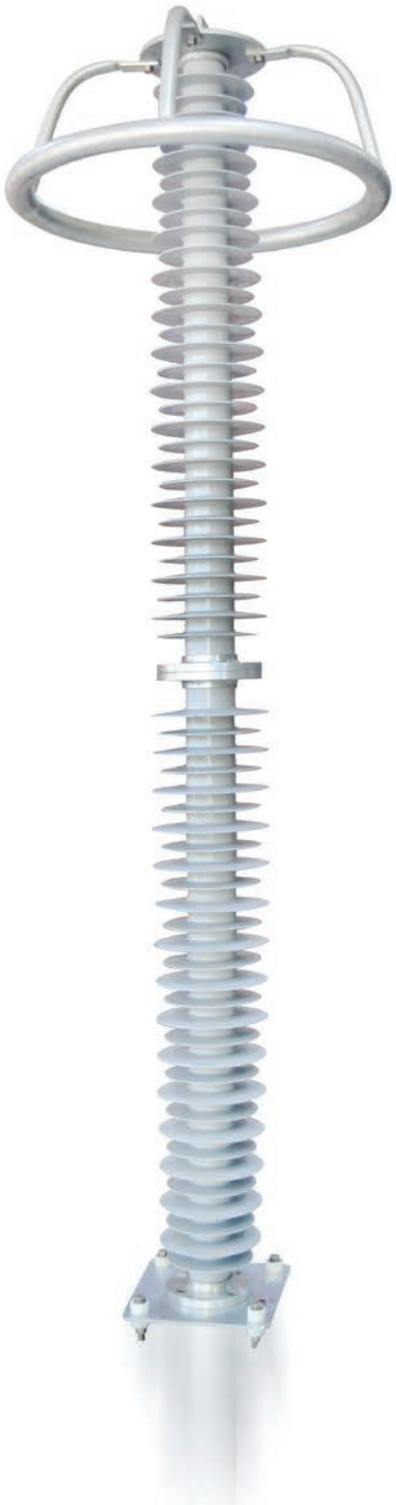


> HY Serisi SM (Sınıf 3) Yüksek Gerilim Parafudrlar

> HY Series SM (Class 3) High Voltage Surge Arresters

Genel Teknik Değerler General Technical Parameters

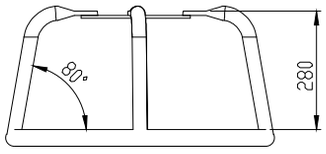
STANDART Standart	IEC 99-4 TS EN 60099-4
ANMA BOŞALMA AKIMI Nominal Discharge Current	10 kA peak
BEYAN GERİLİMİ Rated Voltage	36 - 420 kV
YÜKSEK AKIM DAYANIM KAPASİTESİ High Voltage Impulse Capability	100 kA (4/10 µs)
HAT BOŞALMA SINIFI Line Discharge Class	3
KISA DEVRE DAYANIM KAPASİTESİ Short Circuit Capability	65 kA
MİNİMUM ENERJİ KAPASİTESİ Minimum Energy Capability	7.8 kj/kV (Ur)
KANTİLEVER DAYANIM High Cantilever Strenght	2300
A.C. SİSTEM FREKANSI AC System Frequency	50Hz – 60Hz
YÜKSEKLİK SEVİYESİ The Altitude Above Sea	3000+ m
ORTAM SICAKLIĞI Ambient Temperatures	-55 °C , +65 °C

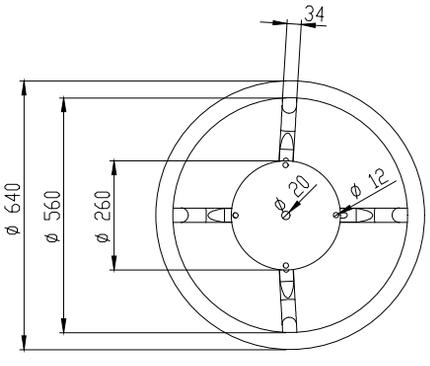


> Garantili Teknik Değerler > Guaranteed Protective Parameters

Tip / Type	Anma Gerilimi / Rated Voltage Ur kV(rms)	Maks. Devamlı İşletme Gerilimi / Max. Continuous Operating Voltage Uc kV(rms)	Geçici Aşırı Gerilim Yeteneği(1sn) / Temporary Over voltage Capability kV(rms)	Dik Akım Darbesi Artık Gerilimi (10kA) / Max. Steep Current Protective level at 10kA kV(peak)	Maks. Anahtarlama Aşırı Gerilimi / Max. Switching protective level kV(peak)		Yıldırım Darbe Aşırı Gerilimi (8/20 µs) / Max. lightning discharge voltage at 8/20 µs kV(peak)		
					250 A	1000 A	5 kA	10 kA	20 kA
HY 36	36	29	43	92	66	71	81	88	95
HY 42	42	34	50	109	78	83	95	104	112
HY 45	45	36	53	117	84	89	103	111	121
HY 54	54	44	60	140	104	108	122	130	141
HY 60	60	49	70	160	116	119	136	144	166
HY 66	66	54	75	175	126	131	148	158	171
HY 72	72	59	85	190	138	143	162	173	188
HY 90	90	73	105	225	172	179	202	216	234
HY 96	96	78	115	240	183	190	216	230	249
HY 108	108	88	125	287	206	214	242	269	280
HY 120	120	98	142	320	228	238	268	287	311
HY 132	132	107	155	355	251	262	296	316	342
HY 144	144	117	170	380	274	286	322	345	373
HY 168	168	137	195	445	319	333	376	402	435
HY 172	172	140	200	455	326	352	385	415	451
HY 180	180	146	210	477	342	367	402	431	466
HY 192	192	156	226	509	365	380	429	460	498
HY 228	228	185	270	605	433	461	509	546	591
HY 240	240	194	283	635	456	476	535	574	621
HY 258	258	210	300	680	490	510	576	617	667
HY 264	264	215	310	695	502	523	590	632	684
HY 276	276	224	325	730	524	546	616	660	714
HY 288	288	233	340	760	547	570	643	689	746
HY 294	294	238	345	775	562	586	662	702	762
HY 300	300	243	355	795	578	602	681	715	785
HY 312	312	253	365	825	592	617	696	746	807
HY 336	336	272	395	890	638	665	750	804	870
HY 360	360	292	420	950	683	712	803	861	931
HY 372	372	297	433	980	692	736	830	890	963
HY 378	378	302	439	1000	703	747	843	901	978
HY 390	390	312	452	1022	725	771	870	933	1009
HY 396	396	316	459	1043	736	783	883	947	1024
HY 420	420	336	480	1082	781	831	937	1005	1087

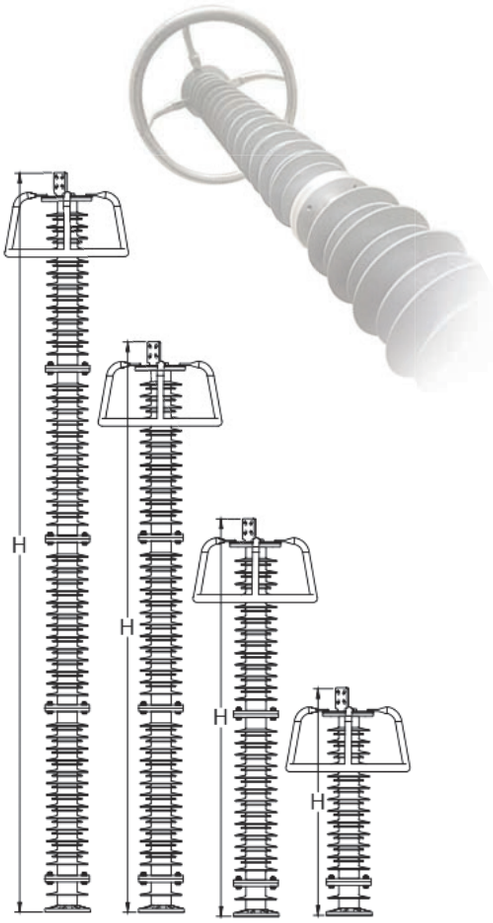
Korona Halkası / Grading Ring

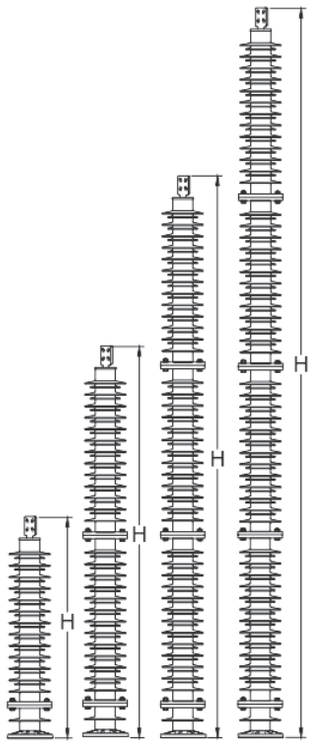




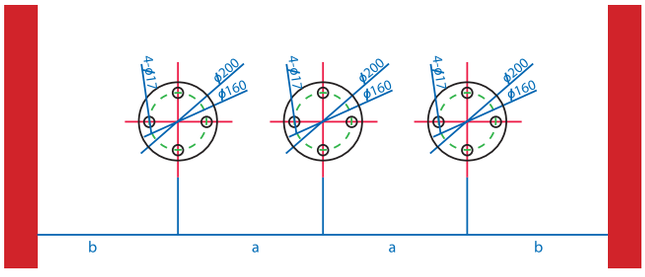
> HY Serisi SM TY1 Fiziksel Özellikleri > Dimensions

Parafudr Tipi Type of Arrester	H mm	Birim Sayısı No. of Unit	Min. Kaçak Yolu Uzunluğu Min. Creepage Distance mm	Korona Halkası Grading Ring	Kurulum Açıklığı Clearances		Yaklaşık Ağırlık Approximately Weight kg (+-1)
					a mm	b mm	
HY 36	700	1	1220	-	575	490	16.0
HY 42	700	1	1220	-	590	505	17.0
HY 45	700	1	1220	-	605	520	17.5
HY 54	950	1	2485	-	620	530	20.0
HY 60	950	1	2485	-	625	540	21.0
HY 66	950	1	2485	-	730	645	21.5
HY 72	950	1	2485	-	730	650	22.0
HY 90	950	1	2485	-	825	750	23.0
HY 96	1990	2	4785	-	875	790	37.5
HY 108	1990	2	4785	-	950	865	38.0
HY 120	1990	2	4785	-	1035	965	39.0
HY 132	1990	2	4785	-	1120	1030	39.5
HY 144	1990	2	4785	-	1225	1135	40.0
HY 168	1990	2	4785	x	1690	1465	41.0
HY 172	1990	2	4785	x	1840	1545	42.5
HY 180	1990	2	4785	x	1840	1545	44.0
HY 192	2830	3	7085	x	1945	1645	57.0
HY 228	2830	3	7085	x	2225	1925	60.0
HY 240	2830	3	7085	x	2300	2015	62.0
HY 258	2830	3	7085	x	2830	2350	64.5
HY 264	2830	3	7085	x	2885	2400	65.0
HY 276	2830	3	7085	x	2990	2510	66.5
HY 288	3680	4	9385	x	3100	2610	80.0
HY 294	3680	4	9385	x	3135	2655	80.5
HY 300	3680	4	9385	x	3160	2685	81.0
HY 312	3680	4	9385	x	3265	2800	82.0
HY 330	3680	4	9385	x	3440	2975	85.0
HY 360	3680	4	9385	x	3645	3500	90.0
HY 372	3680	4	9385	x	3755	3615	91.5
HY 378	3680	4	9385	x	3790	3645	92.0
HY 390	3680	4	9385	x	3895	3760	93.0
HY 396	3680	4	9385	x	3930	3795	93.5
HY 420	3680	4	9385	x	4105	3975	95.0



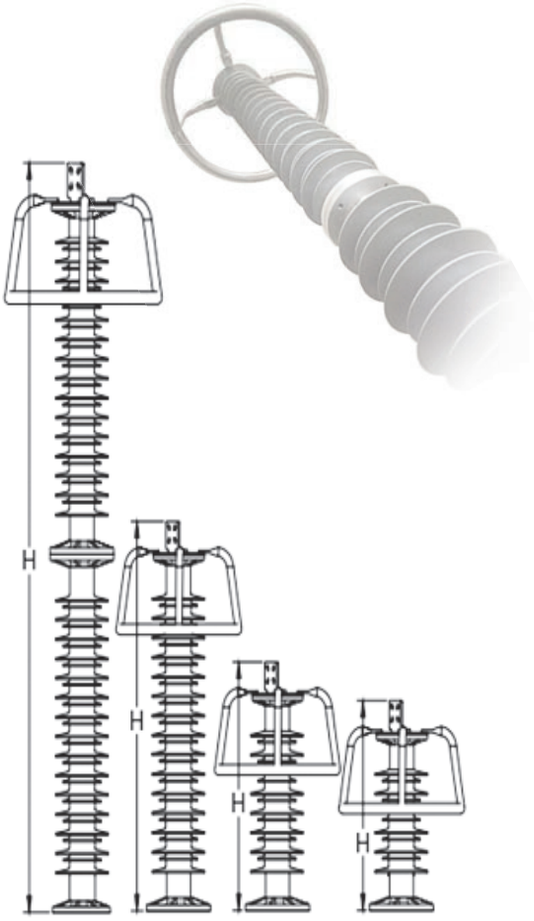


> Kurulum Açıklığı > Clearances

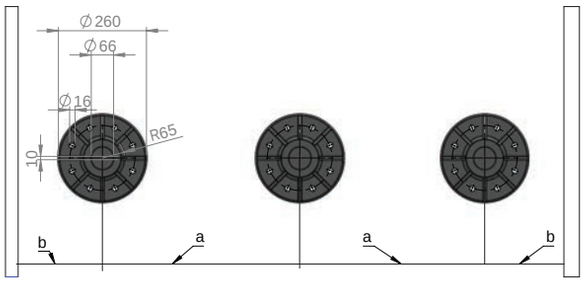


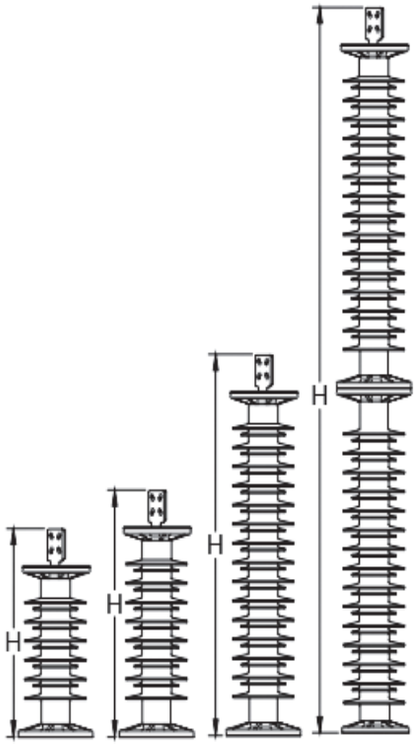
> HY Serisi SM TY2 Fiziksel Özellikleri > Dimensions

Parafudr Tipi Type of Arrester	H mm	Birim Sayısı No. of Unit	Min. Kaçak Yolu Uzunluğu Min. Creepage Distance mm	Korona Halkası Grading Ring	Kurulum Açıklığı Clearances		Yaklaşık Ağırlık Approximately Weight kg (+-1)
					a mm	b mm	
HY 36	650	1	1150	-	575	490	15.0
HY 42	650	1	1150	-	590	505	16.5
HY 45	650	1	1150	-	605	520	17.0
HY 54	900	1	2550	-	620	530	19.5
HY 60	900	1	2550	-	625	540	20.0
HY 66	900	1	2550	-	730	645	20.5
HY 72	900	1	2550	-	730	650	21.0
HY 90	900	1	2550	-	825	750	23.0
HY 96	900	1	2550	-	875	790	25.0
HY 108	1670	1	4780	-	950	865	43.0
HY 120	1670	1	4780	-	1035	965	44.0
HY 132	1670	1	4780	-	1120	1030	45.0
HY 144	1670	1	4780	-	1225	1135	46.0
HY 168	1670	1	4780	x	1690	1465	51.0
HY 172	1670	1	4780	x	1840	1545	51.5
HY 180	1670	1	4780	x	1840	1545	52.0
HY 192	3200	2	9560	x	1945	1645	80.0
HY 228	3200	2	9560	x	2225	1925	82.0
HY 240	3200	2	9560	x	2300	2015	83.0
HY 258	3200	2	9560	x	2830	2350	84.5
HY 264	3200	2	9560	x	2885	2400	85.0
HY 276	3200	2	9560	x	2990	2510	86.0
HY 288	3200	2	9560	x	3100	2610	87.0
HY 294	3200	2	9560	x	3135	2655	87.5
HY 300	3200	2	9560	x	3160	2685	88.0
HY 312	3200	2	9560	x	3265	2800	89.0
HY 330	3200	2	9560	x	3440	2975	91.0
HY 360	3200	2	9560	x	3645	3500	93.5
HY 372	3200	2	9560	x	3755	3615	94.5
HY 378	3200	2	9560	x	3790	3645	95.0
HY 390	3200	2	9560	x	3895	3760	96.0
HY 396	3200	2	9560	x	3930	3795	96.5
HY 420	3200	2	9560	x	4105	3975	98.0



> Kurulum Açıklığı > Clearances





> Polipar HY Serisi SM (Class 3) 154 kV 10 kA Parafudr

> Polipar HY Series SM (Class 3) 154 kV 10 kA Surge Arrester

*Test görüntüsü EGU10665/C/17 nolu RIV deneyinden alınmıştır.
Test picture taken by EGU 10665/C/17 numbered RIV test.

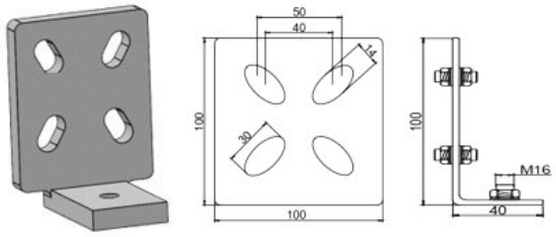
> Polipar HY Serisi SM (Class 3) 220 kV 10 kA Parafudr

> Polipar HY Series SM (Class 3) 220 kV 10 kA Surge Arrester

*Avusturya Güç Istasyon Projesinde kullanılan POLIPAR® HY 220 kV SM (Class 3) parafudr kurulumu referans olarak alınmıştır.

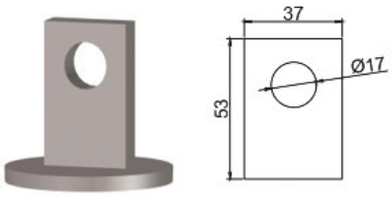
**The picture taken by Austrian Power Station Project that installed POLIPAR® HY 220 kV SM type surge arrester*

Hat Terminalleri / Line Terminals

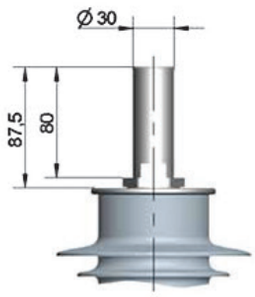


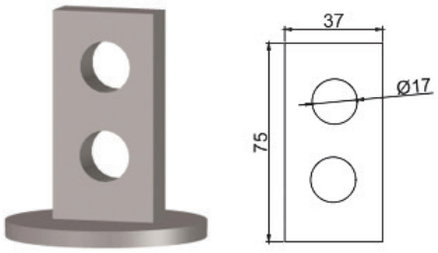
Paslanmaz Çelik / Stainless Steel

NEMA® Four-Hole Pad



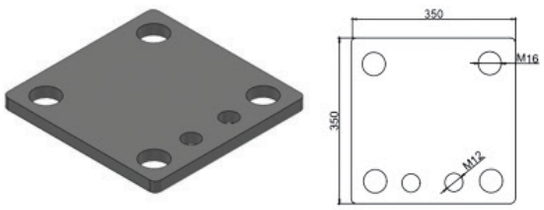
Sıcak Daldırma Galvanizli / Paslanmaz Çelik
Hot-dip Galvanized / Stainless Steel



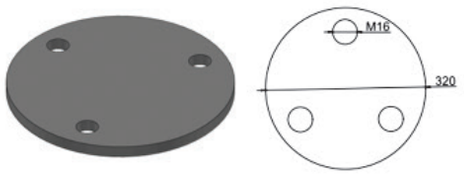


Sıcak Daldırma Galvanizli / Paslanmaz Çelik
Hot-dip Galvanized / Stainless Steel

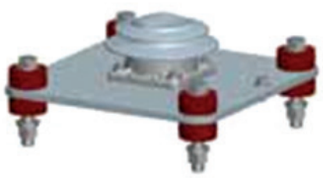
Yalıtımlı Taban / Mounting Base

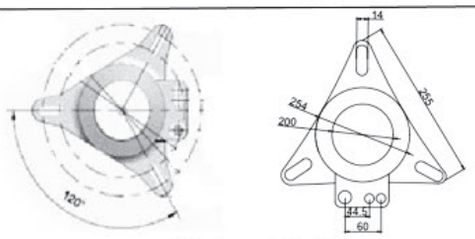


Sıcak Daldırma Galvanizli /Hot-dip Galvanized



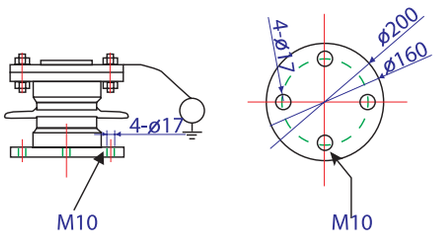
Sıcak Daldırma Galvanizli /Hot-dip Galvanized



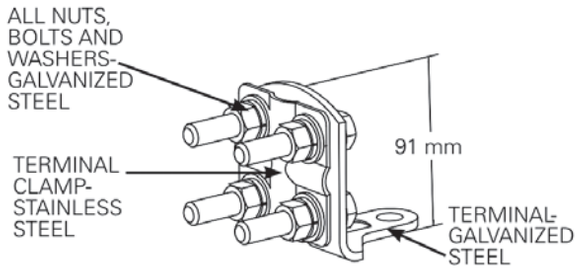


Alüminyum / Alüminium

Toprak Terminali
Grounding Terminal



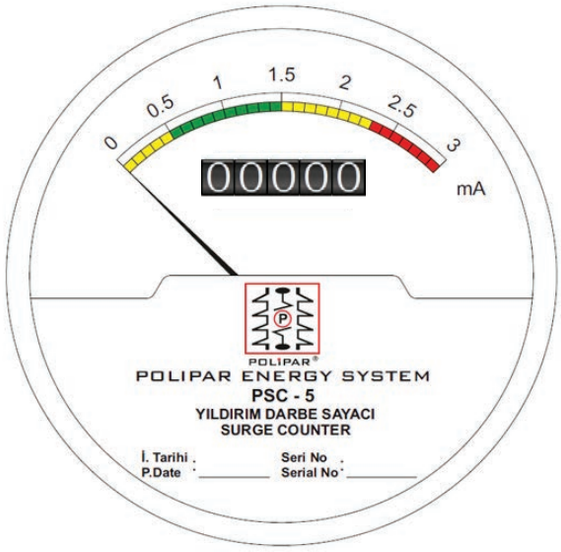
Opsiyonel Topraklama Bağlantı Klemensi / Optional Grounding Connection Terminal



NEMA Four-hole Pad
Accepts Copper or Aluminum Conductors up to 20 mm Ø

> PSC-5 UZAKTAN KUMANDALI DARBE SAYACI

> PSC-5 REMOTE SURGE PROCESSOR



PSC 5 tipi darbe sayaçları, IEC hat sınıfı 1,2 ve 3 orta ve yüksek gerilim parafudrlarında yıldırım darbe sayısını ölçmek amacıyla kullanılmaktadır.

Surge counter type PSC 5 is intended to count the number of operations of HV and MV surge arresters for IEC line discharge class 1,2 and 3

Ölçme Karekteristliği / Rated Characteristics

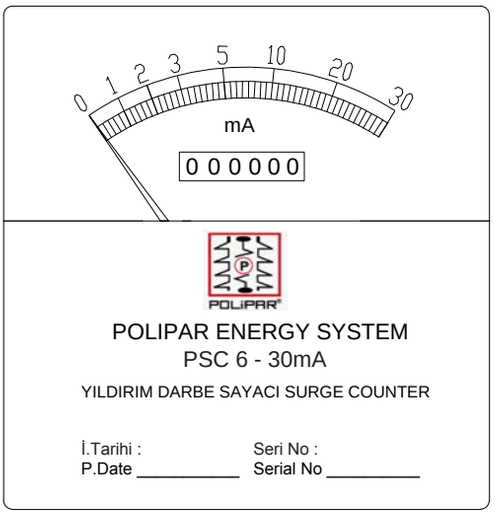
Anma Başalma Akımı *Nominal Discharge Current*	10kA (8/20μs dalga) *10kA (8/20μs wave)*
Artık Gerilim *Residual Voltage*	0,8kV tepe *0,8kV peak*
Uzun Süreli Akım Dayanım Kapasitesi *Long Duration Current Impulse Withstand*	800A(2 ms dalga) *800A(2 ms wave)*
En Yüksek Akım Dayanım Kapasitesi *Maximum High Current Withstand*	100kA (4/10μs dalga) *100kA (4/10μs wave)*
En Düşük Sayma Akımı *Minimum Count Current*	20A (8/20μs dalga) *20A (8/20μs wave)*
Aşırı Akım Dayanım Kapasitesi *Over Current Withstand Capacity*	800mA (48~62 Hz) *800mA (48~62 Hz)*
Ölçme Skala Aralığı *Meter Scale*	0~3 mA *0~3 mA*
Sayıcı *Counter*	5 hane *5 digit cyclometer*
Devamlı İşletim Gerilimi Altında *Under Continuous Operating Voltage*	<3V *<3V*

PSC tipi darbe sayacı -40°C (233K) ile +60°C(333K) iklim koşulları altında kullanım için tasarlanmıştır. Kullanım rakım yüksekliği 2000 metrenin üzerinde olmamalıdır. İşletim Frekansı 48Hz ile 62 Hz.

Surge counters type PSC 5 are designed for operation at the ambient temperature from -40°C (233K) to +60°C (333K), at the altitudes not exceeding 2000m above level sea and at the rated frequency of the power voltage from 48 Hz to 62 Hz.

> PSC 6 Tipi Yüksek Gerilim Parafudr Darbe Sayacı

> PSC 6 Type Surge Counter For High Voltage Surge Arresters



PSC 6 tipi darbe sayaçları, IEC hat sınıfı 1,2 ve 3 orta ve yüksek gerilim parafudrlarında yıldırım darbe sayısını ölçmek amacıyla kullanılmaktadır.

Surge counter type PSC 6 is intended to count the number of operations of HV and MV surge arresters for IEC line discharge class 1,2 and 3

Ölçme Karekteristliği / Rated Characteristics

Anma Başalma Akımı *Nominal Discharge Current*	10kA (8/20μs dalga) *10kA (8/20μs wave)*
Artık Gerilim *Residual Voltage*	0,8kV tepe *0,8kV peak*
Uzun Süreli Akım Dayanım Kapasitesi *Long Duration Current Impulse Withstand*	800A(2 ms dalga) *800A(2 ms wave)*
En Yüksek Akım Dayanım Kapasitesi *Maximum High Current Withstand*	100kA (4/10μs dalga) *100kA (4/10μs wave)*
En Düşük Sayma Akımı *Minimum Count Current*	20A (8/20μs dalga) *20A (8/20μs wave)*
Aşırı Akım Dayanım Kapasitesi *Over Current Withstand Capacity*	800mA (48~62 Hz) *800mA (48~62 Hz)*
Ölçme Skala Aralığı *Meter Scale*	0~30 mA *0~30 mA*
Sayıcı *Counter*	6 hane *6 digit cyclometer*
Devamlı İşletim Gerilimi Altında *Under Continuous Operating Voltage*	<3V *<3V*

PSC tipi darbe sayacı -40°C (233K) ile +60°C(333K) iklim koşulları altında kullanım için tasarlanmıştır.

Surge counters type PSC 6 are designed for operation at the ambient temperature from -40°C (233K) to +60°C (333K),.

> PSC-7 UZAKTAN KUMANDALI DARBE SAYACI

> PSC-7 REMOTE SURGE PROCESSOR

Cihaz PSC-7, metal oksit parafudrun işletme gerilimi altında boşluksuz (MOSA) entegre şekilde izlenmesi için tasarlanmıştır. İzleme, veri toplama konsolu kullanılarak uzaktan gerçekleştirilir. Cihaz, parafudr topraklama devresine monte edilmiştir.

Device PSC-7 is designed for integrated monitoring of metal oxide surge arrester without gaps (MOSA) under operating voltage. Monitoring is carried out remotely using data collection console. The device is installed in earth circuit of surge arrester.

Ayırt Edici Özellikler / Distinctive Features

>> Seçim ile darbelerin kaydı;

>> 1, 3 ve 5 kaçak akım harmoniğinin genliğinin ölçülmesi;

>> Sıcaklık ölçümü;

>> Parafudrun durumu hakkındaki verilerin toplanması tamamen otomatiktir, okumalar günde bir kez radyo üzerinden veri toplama konsoluna iletilir;

>> Yüksek stabilite - 100 kA'ya kadar olan darbeleri, maksimum genlik darbelerinin miktarını kaydeder - sınırlı değildir;

>> Yüksek seviyede toz ve nem koruması;

>> Cihazın arızalanması parafudr çalışmasını etkilemez.

>> Registration of pulses with selection;

>> Measurement of an amplitude of 1, 3 and 5 leakage current harmonics;

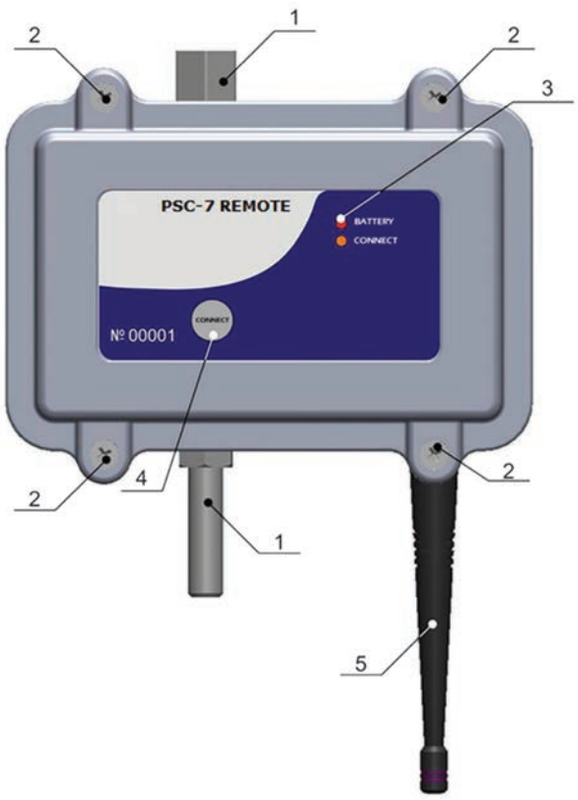
>> Measurement of temperature;

>> The collection of data on the status of the surge arrester is fully automated: readings are transmitted once a day to the data acquisition console via radio;

>> High stability – registers pulses up to 100 kA, amount of maximum amplitude pulses – not limited;

>> High level of dust and moisture protection;

>> Failure of device does not affect operation of surge arrester.



1 - Akım Taşıyan Çubuk,
2 - Muhafaza Kapağını Tutan Vidalar,
3 - Düşük Pil Göstergesi,
4 - Bağlantı Düğmesi,
5 - Harici Anten.

1 – Current-Carrying Rod,
2 – Screws Securing The Housing Cover,
3 – Low Battery Indicator,
4 – Connect Button,
5 – External Antenna.

> Kalite POLIPAR ® garantisi altındadır.

> Quality guaranteed by POLIPAR®

*Prüffelder des Schaltwerks Berlin Almanya laboratuvarlarındaki POLiPAR Parafudr segmentinin 16-013-HA nolu deneyinden alınmıştır.

**The graphic taken by 16-013-HA numbered test of POLIPAR Surge Arrester images in Prüffelder desSchaltwerks Berlin Germany laboratories*

> Polimer Gövde Teknik Özellikleri

> Technical Parameters Of Polymer Housing

Yüzeysel Direnç Oranı Rate of resistance on surface (ohm)	Delinme Dayanımı Puncture strenght (kV/mm)	Gerilme Dayanımı Tensile strenght (Mpa)	Yırtılma Dayanımı Tearing strenght (N/mm)	Genişleme Oranı Rate of expansion (%)	Ortam Kaybı Loss of medium (tgd/%)
$\geq 10^{13}$	≥15	≥4	≥9	≥150	≥10

Siz hala porselen mi kullanıyorsunuz?

Are you still using porcelain?

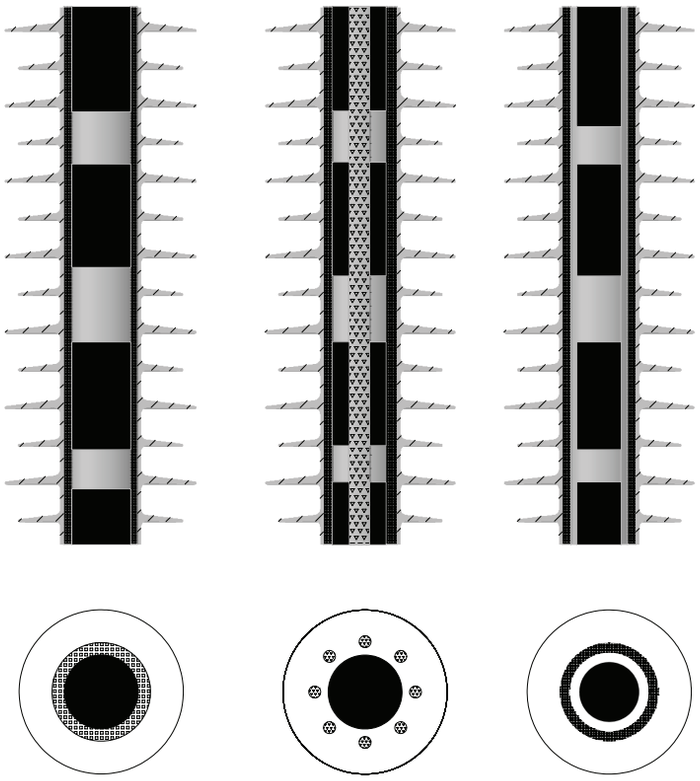
	Y.G PORSELEN PARAFUDR H. V. Porcelain Arrester	Y.G POLİMER PARAFUDR H.V. Polyrner Arrester
Ağırlık Weight	**144 kV 204 kg (örnek)** 204 kg for 144 kV (example)	**144 kV 40 kg (örnek)** 40 kg for 144 kV (example)
Kırılma Refraction	**Çok sık** Very often	**Kırılmaz, son derece esnektir** Not refraction
Montaj Mounting	**Zor,pahalı** Hard and expensive	**Son derece kolay, elle taşınını** The easiest, can move by hand and cheap
Kirlenme Pollution	**Etkilenir** Affected	**Etkilenmez** Not affected
Bakım Maintenance	**Yıkama, silme ve yağlama gibi bakım gerektirir** Need maintenance as washing, cleaning and greasing	**Bakım gerektirmez** Maintenance free
Hidrofobik özellik Hydrophobic specialty	**Yok** Not	**Eşsiz hidrofobik özellik** Perfect hydrophobic ensures
Yaşta elektriksel özellik Electrical characteristic in wet	**Düşük** Low	**Yüksek** High
Kullanım ömrü Using life	**Kısa-orta** Short-medium time	**Uzun** Long time
Ülkeye maliyeti ve kaçak akım Cost and residual current	**Pahalı-yüksek kaçak akım** Expensive, the high residual current	**Ucuz-düşük kaçak akım** Cheap, the low residual current
Kirli havada erozyona direnç Resistance against erosion in pollution weather	**Düşük** Low	**Yüksek** High
Bütünlük Completeness	**Uyumsuz alt ünite birleşimi** Maladjusted subunit	**Uyumlu alt ünite birleşimi** Well-adjusted subunit
Kantilever dayanım Cantilever strength	**Düşük (Sert- rijid yapıdan ötürü)** Low cause rigid Housing	**Yüksek (Esnek yapıdan ötürü)** High cause elastic housing
Enerji hat görünümü View at energy lines	**Çirkin** Looking bad	**Estetik** Looking good
Ambalajlama, depolama ve nakliyat Package, storage and shipping	**Tahta ambalajlarda, , pahalı nakliyat ve nakliyat zaafı** At board package, need large store, and expensive shipping.	**Karton kutularda, ucuz nakliyat ve düşük nakliyat zaafı** At cardboard, need small store, and cheap shipping

> POLİPAR PARAFUDR TASARIM ŞEKİLLERİ
> POLIPAR SURGE ARRESTER DESIGNS

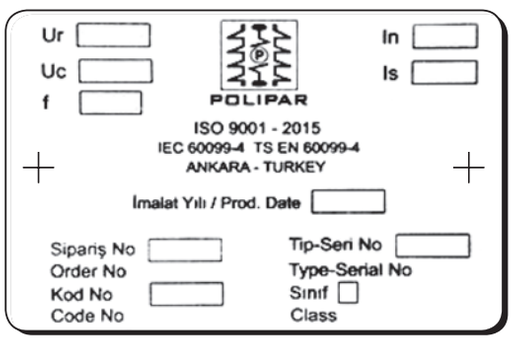
Çekirdek Tasarım
Solid Core Design

Kafes Tasarım
Cage Design

Tüp Tasarım
Tube Design



> POLİPAR HY SERİSİ SİPARİŞ KODLAMASI VE ÜRÜN ETİKETİ
> POLIPAR HY SERIES ORDERING CODES AND TICKET DESIGN



HY - SM - TY1/TY2 - 144/154 - R/N - C/Y

- **Paratudr Tipi** / Arrester Type
- **Hat Boşalma Sınıfı** / Line Discharge Class
- **Tip 1** / Type 1
- **Tip 2** / Type 2
- **Beyan Gerilimi** / Rated Voltage
- **Sistem Voltajı** / System Voltage
- **Korona Halkası** / Grading Ring (R:Var/Yes N:Yok/No)
- **Darbe Sayacı** / Surge Counter (C:Var/Yes Y:Yok/No)

> İLETİM HATTI PARAFUDR

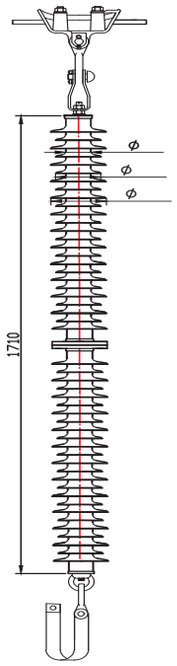
> TRANSMISSION LINE ARRESTER (TLA)

Silikon mahfazadaki HS-TLA tipi parafudrlar, AC elektrik mühendisliği şebekelerini HV trafo merkezlerinde, kablolarda ve transformatörlerde çoklu yıldırım ve aşırı gerilimlere karşı koruma amaçlıdır. Bu parafudr, tüm özel teknik gereksinimlere de sahiptir. Dış ve iç mekan kurulumları için uyarlanmış parafudrlardır ve deniz seviyesinden 1200 metreye kadar ılıman ve tropik iklimde kullanılabilirler.

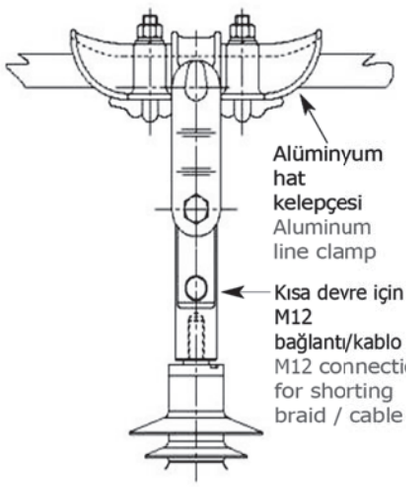
Surge arresters type HS-TLA in silicone housing are intended for protection AC power engineering networks against multiple lightning and switching overvoltages in HV substations, cables and transformers. This surge arrester is destined to all special technical requirements as well. Surge arresters adapted for outdoor and indoor installation and temperate and tropical climate up to 1200 m over the sea level.

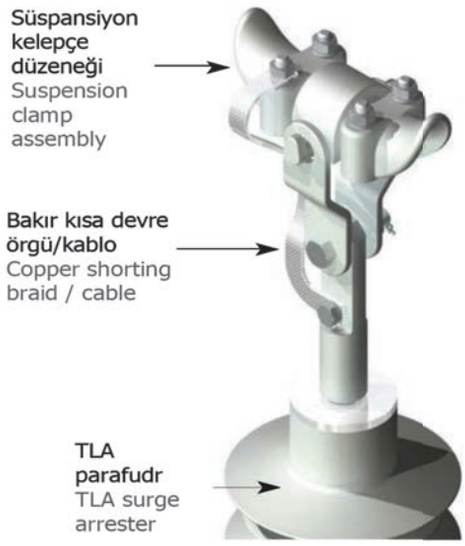
> Garantili Teknik Değerler > Guaranteed Protective Parameters

Anma Gerilimi **Rated Voltage** Ur kV(rms)	**Maks. Devamlı** İşletme **Gerilimi** **Max. Continuous Operating Voltage** Uc kV(rms)	**Geçici Aşırı Gerilim Yeteneği(1sn)** **Temporary Over voltage Capability** kV(rms)	**Dik Akım Darbesi Artık Gerilimi (10kA)** **Max. Steep Current Protective level at 10kA** kV(peak)	**Maks. Anahtarlama Aşırı Gerilimi** **Max. Switching protective level** kV(peak)		**Yıldırım Darbe Aşırı Gerilimi (8/20 µs)** **Max. lightning discharge voltage at 8/20 µs** kV(peak)		
				250 A	**1000 A**	**5 kA**	**10 kA**	**20 kA**
3	2,5	3,4	8,6	6,3	6,7	7,5	8,1	9,0
6	5,1	6,9	17,7	12,6	13,5	15,0	16,2	17,9
9	7,5	10,4	25,4	18,9	20,2	22,6	24,4	27,0
10	8,4	11,5	28,2	20,7	22,2	24,9	26,9	29,8
12	10,2	13,8	33,9	25,2	26,9	29,9	32,3	35,8
15	12	17,3	42,4	31,3	33,5	37,6	40,6	44,9
18	15,3	20,7	50,8	37,7	40,4	45,2	48,8	54,0
21	17	24,2	59,3	41,9	44,9	49,9	53,8	59,6
24	19,5	27,6	67,8	48,1	51,5	58,5	64,6	71,5
27	22	31,1	76,2	54,3	58,1	67,9	73,2	81,0
30	24,4	34,5	84,7	60	64,4	74,8	80,7	89,3
33	27	38,0	93,2	67	72,6	81,5	87,5	93,5
36	29	41,4	101,6	71	75	89	96	107
42	34	48,3	118,6	83	89	95	103	114
45	36	51,8	127,1	90	96	110	118	131
54	44	59	150	100	105	127	137	151
60	49	68	171	110	115	145	156	173
66	54	73	186	120	130	160	173	191
72	59	83	205	130	140	172	186	205
90	73	102	225	165	175	217	234	258
96	78	111	245	175	187	229	247	274
108	88	122	304	200	210	253	273	302
120	98	138	342	225	235	295	318	353
132	107	152	373	245	255	320	345	382
144	117	165	398	265	280	347	374	472

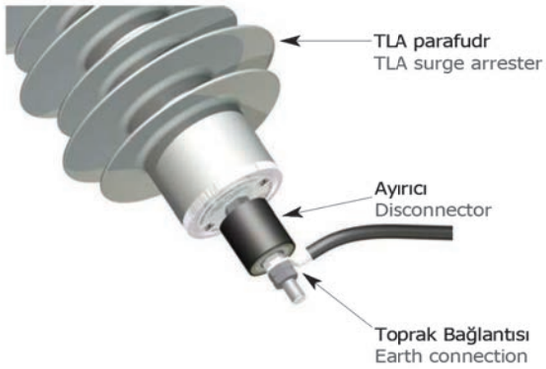


> Hat Terminalleri / Line Terminals

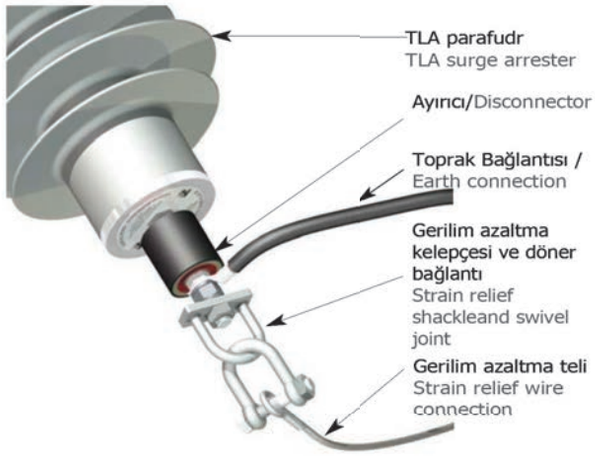




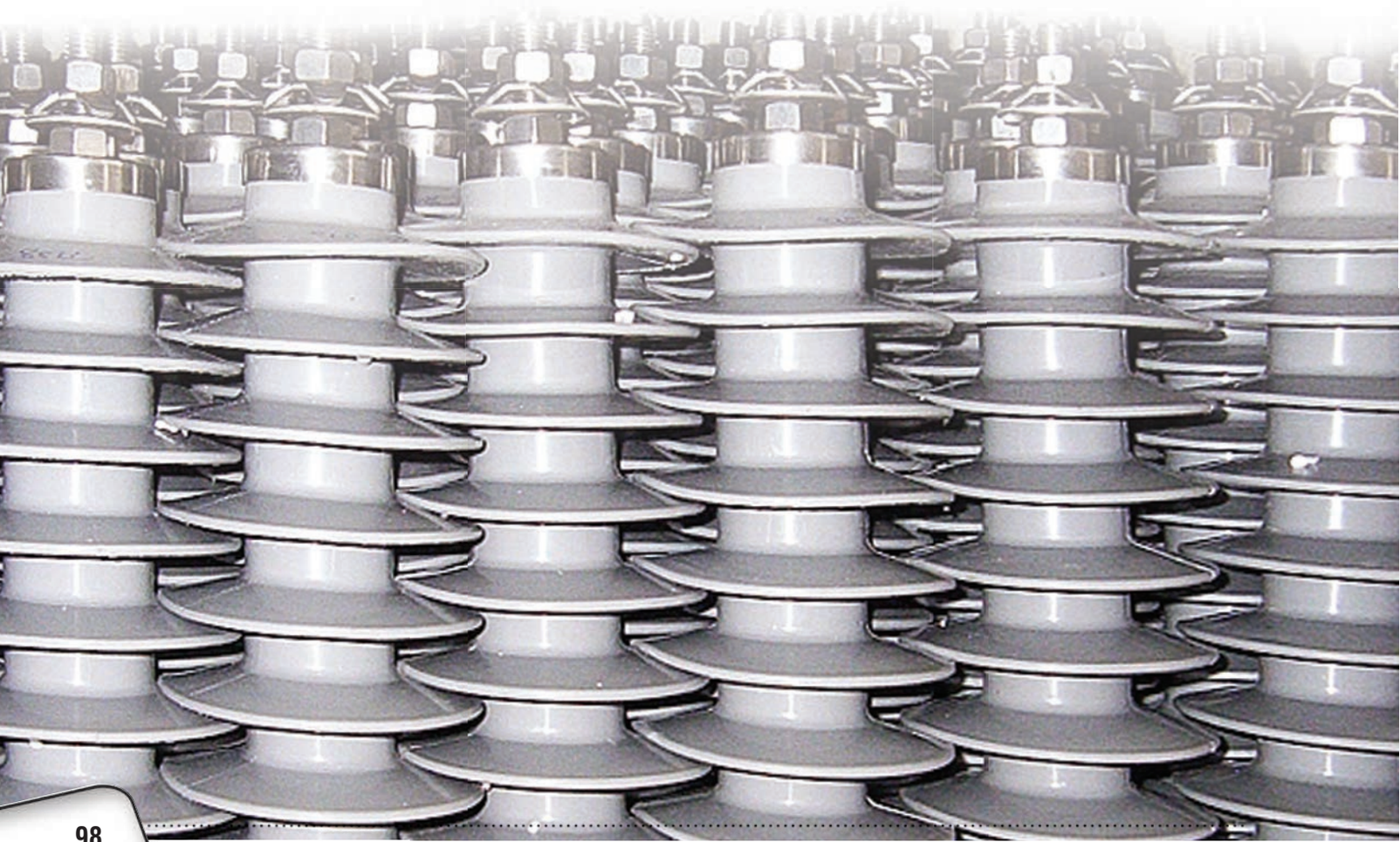
> Toprak Terminali
Grounding Terminal



> Gerilim Azaltma Sistemi
Strain Relief System



Notlar / Notes



Turkey

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