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Electronics

Energy Division

HVCE
High Voltage Creepage Extenders
A remedy for pollution flashovers of insulators

Raychem

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Raysulate

High Voltage Creepage Extenders
A remedy for pollution flashovers of insulators

Raysulate Creepage Extenders increase the flashover performance of insulators by reducing the surface electric stress, reducing the leakage current and increasing the electric strength of the insulators.
Installation of creepage extenders:

– Increases creepage length
– Improves insulator shape
– Adds high performance polymeric material to the creepage path

Pollution flashovers
Changing environments can cause increases in pollution levels which lead to excessive contamination of high voltage insulators. This may lead to unacceptably frequent flashovers if the creepage length and general design is inadequate.

A replacement insulator having greater electric strength may be installed but the costs of this are high especially when a complete assembly, like a bushing, is involved. Common palliatives include live washing which reduces the contamination level, or surface treatments, either grease or rubbery coatings which smother the dirt or make the surface less wettable, or both.
These palliatives have disadvantages in cost and effectiveness. The frequency of washing can be unacceptable and in some circumstances washing may promote flashover. Grease is a fire risk when it becomes choked with pollution and its removal is unpleasant and expensive. Coatings are difficult to apply and are also difficult to remove when eroded.

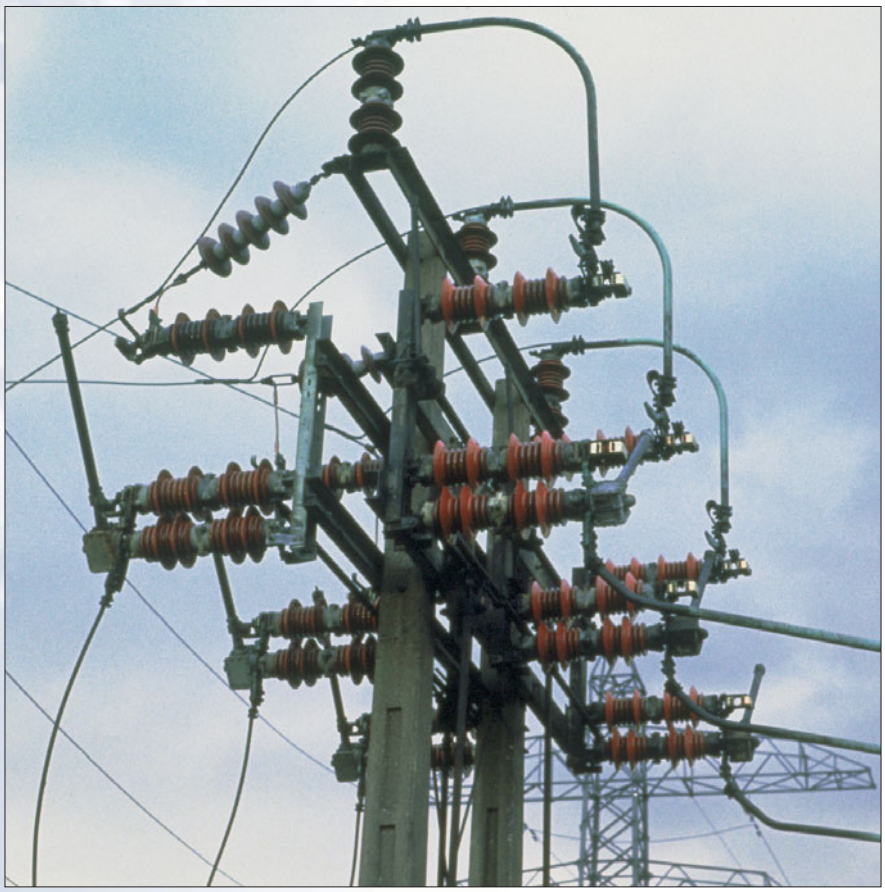
The Raysulate Creepage Extender is a polymeric skirt internally coated with a specially formulated mastic. When heated the product shrinks around and bonds onto an existing insulator shed increasing the effective diameter and creepage distance of the insulator.

Creepage extender design features

Increases creepage length
This increases electric strength by reducing leakage current and surface stress.

Improves insulator shape
The increased shed diameter improves strike distance and improves heavy wetting performance by creating an umbrella effect.

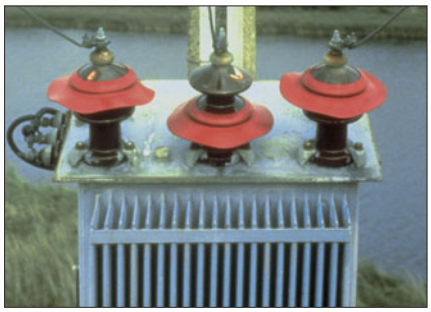
Bonds to insulator surface
The extender adhesive has been specially formulated to strongly bond to the existing porcelain or glass skirt. Thus, the assembly needs only periodic inspection and will be effective many times longer than grease.



Creepage extenders on 66 kV insulators

Rugged
Extenders are designed to be resistant to conventional spray washing techniques and will withstand all normal handling abuse and extreme weather conditions.

Proven materials
The extenders are fabricated using Raychem's unique high voltage materials technology which has over 25 years of high voltage field experience in adverse environments all over the world on cable terminations, insulators and bushings.



Creepage extenders on 24 kV bushings

Creepage extenders on 66 kV substation in a heavily polluted marine environment adjacent to a steelworks

Simple to install
Just degrease the insulator and shrink the extender with a gas torch or hot air gun. Raychem can provide installation training.

Creepage extender testing
Data from IEC 815 shows that at a fixed voltage, our typically recommanded extension of 20% to the creepage will more than double the pollution level needed to cause flashover (see figure 1). Pollution flashover tests (to IEC 507) on insulators fitted with creepage extenders show that, for a fixed salt concentration, flashover values increase in proportion to the increased creepage distance. Figure 2 shows typical results on a 66 kV post insulator.

In practice, these results show that the addition of creepage extenders can effectively change an insulator which has marginal performance in the prevailing conditions to one which has a large margin of safety against pollution flashover. Tests have been done on a variety of insulator sizes and shapes including suspension and post insulators covering a range of diameters. The results consistently show an improvement for all insulators. Where the insulators are of a particularly bad design (eg. close packed sheds of identical size) the improvement in shape adds to the effect of the longer creepage path to give exceptionally good results.

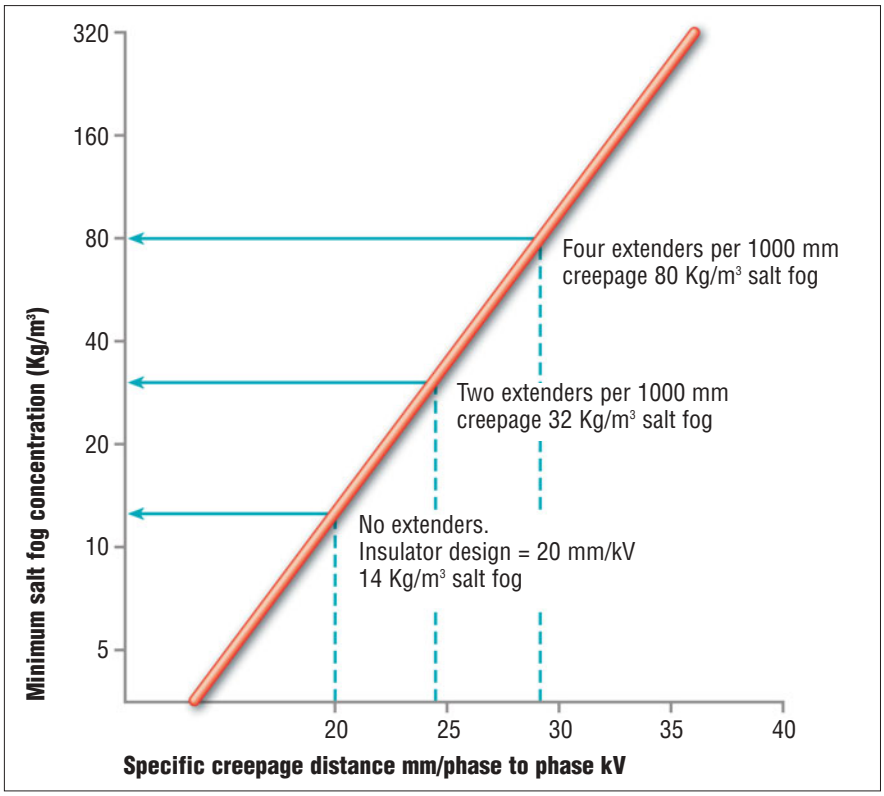
Raychem report UVR 8139 summarizes these results.

Materials properties
Raychem's high voltage insulating materials have undergone long-term field and laboratory testing to determine their suitability for use in the high voltage environment. The use of the material (eg. in several million Raychem high voltage cable terminations installed worldwide) bears out the excellent testing results and has helped establish an outstanding service record in the most severe environmental conditions.

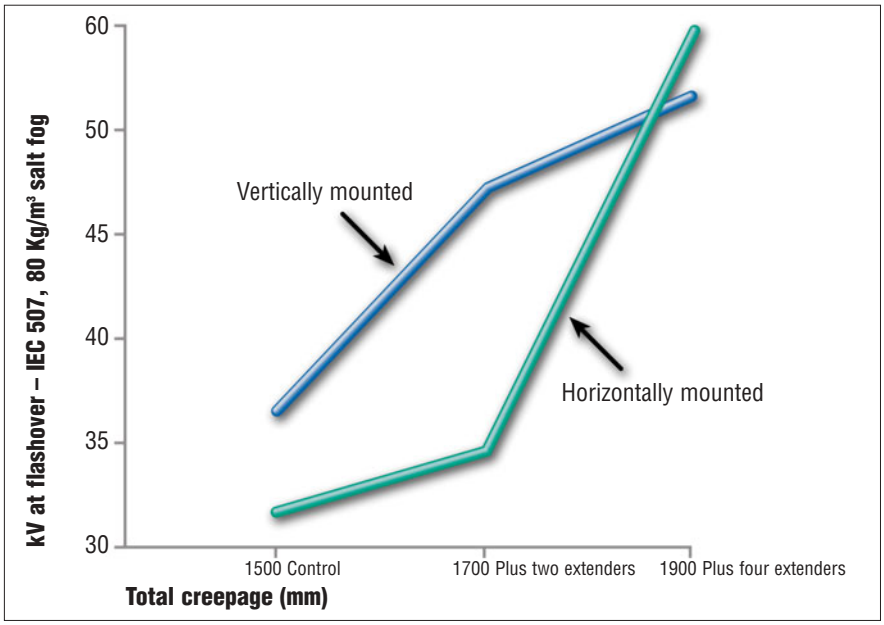
Tracking and erosion resistance testing
On the ASTM D2303 inclined planetest, the material is non-tracking under all conditions including addition of 1% sugar contaminant.

Resistance to weathering
Raychem's on-going material tests measure the retention of elongation as a method of monitoring ageing. Retention of elongation is a good measure of resistance to cracking by UV light. The material properties measured for the Raychem high voltage material demonstrate its suitability for use outdoors even in extreme desert conditions where UV light concentrations are severe. See report No. EDR 5018.

Effect of creepage distance on salt fog concentration withstand value
Figure 1



Flashover voltage versus number of extenders on 66 kV post insulator
Figure 2



General properties	Test method	Typical data*
Density	ISO/R1183 Method A	1.2 g/cm³
Tensile strength	ISO 37	10 N/mm²
Ultimate elongation	ISO 37	400%
Low temperature flexibility 4 hours at -40°C	ASTM D2671 Procedure C	no cracking
Thermal endurance	IEC 216	120°C
Electric strength	IEC 243	140 kV/cm
Dielectric constant	IEC 250	3
Volume resistivity	IEC 93	1 x 10^{14} Ω cm
Additional properties	Further details are given in Raychem Specification PPS 3011	
Note:	*Typical qualification test data. Minimum requirements are given in Raychem specification PPS 3011/1	

Selection table

Creepage extenders are usually fitted to insulators with normal or alternating shed profiles (as defined by IEC 815). This IEC specification also categorises insulators into one of four pollution classes.

Class I (ESDD* 0.03 to 0.06 mg/cm²)	Light	Creepage = 16 mm/kV system
Class II (ESDD 0.1 to 0.2 mg/cm²)	Medium	Creepage = 20 mm/kV system
Class III (ESDD 0.3 to 0.6 mg/cm²)	Heavy	Creepage = 25 mm/kV system
Class IV (ESDD > 0.6 mg/cm²)	Very heavy	Creepage = 31 mm/kV system

*ESDD equivalent salt deposit density

We recommend moving from one class to a higher pollution class for improving flash-over performance as shown in the table.

– Creepage extenders can also be used to produce extensions on insulators designed for highly polluted areas (with > 31 mm/kV as designed).

– For specific recommendation, contact your local Raychem representative. They can advise on fitting creepage extenders to non-standard shed profiles and pollution class insulators.

Insulator Voltage	Class	No. of Creepage Extenders to move to		
		II	III	IV
12/17.5	I	1	2	**
	II	–	1	2
	III	–	–	1
24	I	1	2	**
	II	–	1	3
	III	–	–	2
36	I	2	3	**
	II	–	2	4
	III	–	–	2
72	I	3	**	**
	II	–	4	**
	III	–	–	4
145	I	5	**	**
	II	–	7	**
	III	–	–	8

**Recommend new insulator fitted

Ordering information

1 XX denotes colour (01 = red)

2 On insulators close to the maximum diameter in the application range, the creepage extender will droop when installed. For further information, see the qualification report UVR 8139.

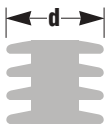
3 The ordering unit of measure is pieces.

Non standard sizes

In many cases, creepage extenders for other sizes are available or can be designed. Contact your local Raychem representative for details.

Ordering example

To order a red creepage extender for a shed of diameter 110 mm, simply order:
1 piece of HVCE–120/100-01



Dimensions in mm (inches) / Application range

Size	Min. internal dia. of the extender (as supplied)	Max. shed dia. of insulator (d)	Min. shed dia. of insulator (d)	Nominal creepage extension per extender
HVCE-100/ 80-01	115 (4.5)	100 (4.0)	80 (3.2)	100 (4.0)
HVCE-120/100-01	135 (5.3)	120 (4.7)	100 (4.0)	100 (4.0)
HVCE-140/120-01	155 (6.1)	140 (5.5)	120 (4.7)	100 (4.0)
HVCE-160/140-01	180 (7.1)	160 (6.3)	140 (5.5)	100 (4.0)
HVCE-183/161-01	205 (8.1)	183 (7.2)	161 (6.3)	100 (4.0)
HVCE-205/184-01	230 (9.0)	205 (8.1)	184 (7.2)	100 (4.0)
HVCE-226/206-11	241 (9.5)	226 (8.9)	206 (8.1)	100 (4.0)
HVCE-247/227-11	262 (10.3)	247 (9.7)	227 (8.9)	100 (4.0)
HVCE-268/248-11	283 (11.1)	268 (10.5)	248 (9.8)	100 (4.0)
HVCE-289/269-11	304 (12.0)	289 (11.4)	269 (10.6)	100 (4.0)
HVCE-310/290-11	325 (12.8)	310 (12.2)	290 (11.4)	100 (4.0)
HVCE-331/311-11	346 (13.6)	331 (13.0)	311 (12.2)	100 (4.0)
HVCE-352/332-11	367 (14.4)	352 (13.8)	332 (13.1)	100 (4.0)
HVCE-373/353-11	388 (15.3)	373 (14.7)	353 (13.9)	100 (4.0)
HVCE-394/374-11	409 (16.1)	394 (15.5)	374 (14.7)	100 (4.0)

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