

**VKYM3200**  
**Insulator's Salt Density**  
**Measuring Instrument**

**USER Manual**

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# 1 .Brief Introduction

In general, there is no doubt that the power plant and line with high voltage class and large-capacity transportation play a vital role in the electrical network. However, on account of the weak wire tables in country's electrical power system ,we need to prevent the pollution flashover which can bring the overall system to disintegrate and cause the big- area power cut. Therefore, before design and construction, we should primarily detect the external insulation's saturated salt density to determine the contamination levels in your area. And then select the appropriate external insulation creepage distance to bring the pollution flashover to an acceptable degree in power system with safe-economical transportation (ie acceptable pollution flashover rate). So, there is a demands of Electricity Industry about the pollution flashover controlling for it can bring down the economic losses to a minimum.

Insulator's Salt Density Measuring Instrument, a dedicated instrument that can detect not only the external insulation's equivalent salt deposit density but the Conductivity, is frequently used to prevent the pollution flashover in power system. However, the defects that imported conducted apparatus can't be directly read out conductivity of salt density and the function of the instrument are seldom, so our company develop a **suitable instrument - VKYM3200**. With its easy-manipulation and diverse-function, our product has been unanimously admitted by all customers.

## Standard:

GB/T 16434—1996 《 Environment pollution classification and outside insulator selection standard in overhead line, power plant and power substation》

GB/T16434-200X 《 Filth choice under the condition of high voltage insulator and size to determine the part 1 : definition , information , and general principles》

Q/GDW152-2006 《 High voltage overhead line and power plants, substation environment classification and external insulation selection criteria》



## TERMINOLOGY EXPLANATION:

### 1、reference cap and pin insulator

ordinary disc suspension insulator (according to the GB/T 7253) ,such as XP-70、 XP-160、 LXP-70 and LXP-160 .Usually use 7 ~ 9 pieces of a string to measure the pollution degrees at the scene.

### 2、 creepage distance

divided the shortest distance along the insulator surface between two conductive parts.

### 3、 unified specific creepage distance (USCD)

divided the product of two squares of 3 and the test voltage by the insulator's creepage(L), usually represent with mm/kV.

### 4、 salt deposit density (SDD)

divided the surface area by the salt that deposited at the insulator's surface, usually represent with  $\text{mg}/\text{cm}^2$ .

### **5、equivalent salt deposit density (ESDD)**

the concentration of contaminant liquor equivalent to sodium chloride, usually represent with  $\text{mg}/\text{cm}^2$ .

### **6、non soluble deposit density (NSDD)**

insulator unit insulation surface cleaning of soluble residues divided by the total surface area, usually represent with  $\text{mg}/\text{cm}^2$ .

### **7、site equivalent salinity (SES)**

the salinity in the case of salt spray test(according to the GB/T 4585).

### **8、site pollution severity (SPS)**

the maximum of ESDD/NSDD or SES at an appropriate time.

### **9、site pollution severity class**

divided the pollution severity class according to SPS.

### **10、energy coefficient K1**

ESDD/NSDD (SES) divided by ESDD/NSDD (SES), normally K1 is between 1.1 and 1.5.

## 2. Functional Characteristics

1) Automatic range switching, improving the accuracy when salt density is low.

measuring speed (2.5 s/time).

2) Wide measurement range, the range of salt density is between  $0.0001\text{mg/cm}^2 \sim 9.9999\text{mg/cm}^2$ .

3) Can choose the language (Chinese or English).

4) Using  $480 * 272$  color LCD touch screen.

5) Direct-Reading. You can read the ESSD、Conductivity、temperature、SPS Class、USCD on the screen directly and print the result.

6) Temperature auto-compensating technology. Automatic Compensation for liquor's conductance is the values at  $20^{\circ}\text{C}$ .

7) Automatically delete the original solution salinity and reduces the requirement of the cleaning fluid.

8) Can store 100000 set of records and records can be exported to the U disk or through the printer.

9) Can consult, delete, export a single record, also can delete all the records.

10) Display screen has backlighting and backlight can be adjusted.

11) The apparatus has high power rechargeable lithium battery (5200mAh) inside and the function of battery gauge displaying. So it is convenient to use in field.

## 3. Product Parameter

### 3.1 Measurement Range:

Salt Density:  $0.0001\text{mg}/\text{cm}^2 \sim 9.9999\text{mg}/\text{cm}^2$  (typified by X - 4.5 type insulator) .

Temperature:  $0^\circ\text{C} \sim 100^\circ\text{C}$ .

Conductivity:  $0 \sim 200000\mu\text{s}/\text{cm}$ .

### 3.2 Measurement Accuracy:

Salt Density: the resolution is  $0.0001\text{ mg}/\text{cm}^2$ .

Full Range Accuracy:  $\pm 2\%$ .

Temperature: the resolution is  $0.1^\circ\text{C}$ , the precision is  $\pm 0.5^\circ\text{C}$ .

Conductivity: the resolution is  $0.01\mu\text{s}/\text{cm}$ .

### 3.3 Environment Temperature: $0^\circ\text{C} \sim 60^\circ\text{C}$ .

### 3.4 Environment Humidity: $< 90\%$ .

### 3.5 Size and Weight

Size:  $356\text{mm} \times 260\text{mm} \times 133\text{mm}$ .

Weight:  $\sim 2.5\text{Kg}$ .

## 4. Test Step

### 4.1 Select insulator

Charged insulator strings shall be taken on the number of the second piece, the middle one, a few second insulator film 3; non-charged insulator string should take any position in the three insulators.

### 4.2 Configuration solvent

Select solvent: deionized or distilled water is suggested, but pure drinking water with conductivity less than  $10\mu\text{s} / \text{cm}$  is allowed as well. The Parameter - "reference value" should be modified if pure drinking water is used, that is, the salt content of the original solution should be set as the measurement data of the reference value. (See detailed operating in function instruction - parameters)

The amount of solvent: The water consumption of ordinary - standard insulator is 300ml per unit. However when the measured surface area is not the same with the ordinary insulator, appropriate changes in proportion of water consumption can be taken according to the surface area of the insulator. Refer to the following table:

**Table of the relationship between the water consumption of salt density measurement and the surface area of the insulator**

surface area of the insulator ( $\text{cm}^2$ )	$\leq 1500$	1500~2000	2000~2500	2500~4000
water consumption (ml)	300	400	500	600

Do use a glass container such as a beaker to contain the solvent, do not use



metal containers in case the measurement result is seriously affected.

### **4.3 Wiping and Sampling**

Insulator sampling selection: select the second piece from top to bottom, one piece in the middle, and the second piece from bottom to top if it is ordinary suspension insulator string. Regard the average of the three measurements as the final result.

Wiping methods: Wear a disposable latex gloves on one hand, put a scarf into the solvent (distilled water) to be soaked. Wipe the upper and lower surfaces of the monolithic insulator with the wet scarf, stir and dissolve the waste material together with the scarf in water, avoiding the losses of moisture.

*Added: sampling waste components are divided into two categories, one for the soluble substance known as salt, and the other non-soluble substances called ash. After salt dissolving in water it becomes conductive ion, which can be measured by the instrument for ESDD. Ash which is sediment and appendage in water, not conductive, does not affect the ESDD measurements. Use this instrument to measure salt density ESDD and use insulator tester (a series of instrument) to measure the density of gray ash density NSDD.*

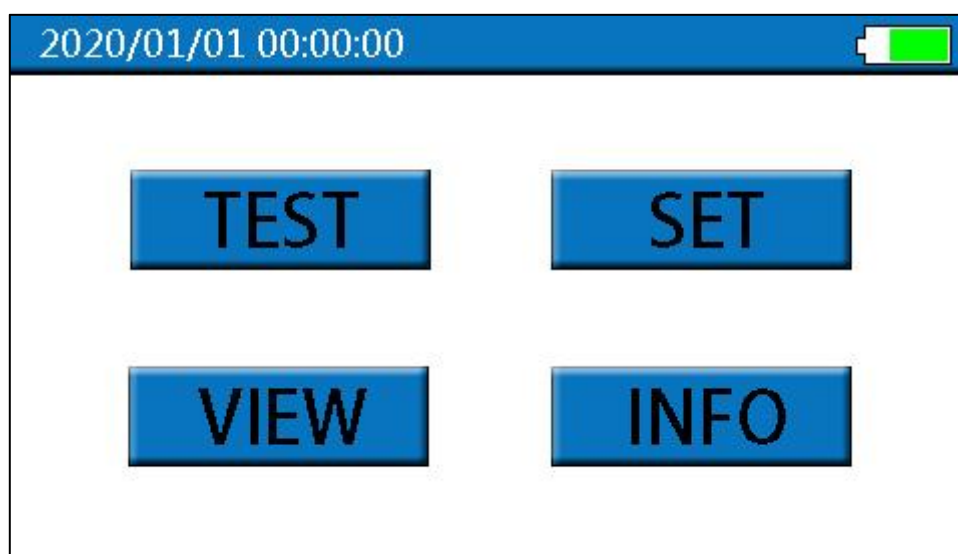
### **4.4 measurement**

Amend relevant parameter on the basis of the actual solution volume and surface area of insulator. Please put the electrode tip into the solution, and then you can read the ESDD, electrical conductivity, temperature, SPS Class and USCD directly.

*Added: Electrode with  $K=1.0$ , used for salt density measurement, is the standard configuration. It is suggested to use platinum black electrode with  $K=10$  when it is used for other purposes, such as measuring the electrical conductivity of industrial waste water with the limits of  $10000 \sim 100000 \text{ us/cm}$ . By the way, if you want to measure some Special chemical solvent with the limits of  $1 \sim 50 \text{ us/cm}$ , you shall use platinum electrode with  $K=0.1$ . However, electrode with  $K=10$  or  $K=0.1$  is not the standard configuration, you have to pay extra money if you really want.*

## 5. Function Declaration

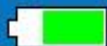
### 5.1 Main Interface






Explain keys in detail:

Test	Enter the measuring interface
Param	Enter the parameter setting interface
Record	Enter the record interface
Local	Enter the local interface

## 5.2 Test Interface

2020/01/01 00:00:00 	
ESDD :	0.0000 mg/cm <sup>2</sup>
COND :	0.13 us/cm
TMP :	26.6 °C
SPS (Q/GDW 152) :	a Class
Class (GB/T16434) :	0 Class
USCD :	22~25 mm/kV

  
  
No. :000001  


Press the measuring key and the instrument will enter measurement pattern. If you don't Insert an electrodes , the instrument will prompt you a word-“Insert Electrode! ”. When the measurement is over,you can press the “Save” key to save results or “Print” key to print it.

Explain data in detail:

Data	Result	Unit	Note
Salt Density (ESDD)	0.0000	mg/cm <sup>2</sup>	minus the benchmark automatically.
Conductivity (Cond)	0.13	us/cm	Unit : micro Siemens per cm.
Temperature (Tmp)	26.6	°C	Place 2 minutes, temperature will be stabile.
SPS Class (Q/GDW 152)	a	--	Classification: a,b,c,d,e,f (Appendix B). On the premise of ash density above 2 mg/cm <sup>2</sup> .

SPS Class (GB/T 16434)	0	--	Classification:0,1,2,3,4 (Appendix A).
USCD	22~25	mm/KV	The actual USCD need to larger than this.

Explain keys in detail:

Print	Print the results of current measurement
Save	Save the results of current measurement

### 5.3 (1) Parameters Interface (Interface A)

2020/01/01 00:00:00

WaterVOL: 300 ml

One Area: 1450 cm<sup>2</sup>

ESDD REF: 0.0000 mg/cm<sup>2</sup>

ELECT K: 1.00 cm<sup>-1</sup>

EnergyK1: 1.00

TEM&COND: Y

Date: 2020/01/01 00:00:00

AlterParameter

Reset Back

Press the item you want to amend, the item you choose will have a black background, and then press the key named “Alter param” to enter the modification Interface(**Interface B**). **Note**,if you press the key named “Reset”,all parameters will reset back to default values.


Explain parameters in detail:

Parameter	Default	range	unit	Note
Volume	300	100-9999	ml	actual water consumption $\geq$ surface area *0.2ml
Area	1450	100-9999	cm <sup>2</sup>	the total surface area of one insulator
ESDD REF	0	0- actual value	mg/c m <sup>2</sup>	the salinity of original solution
Electrode K	1.00	the actual value	cm <sup>-1</sup>	the actual value on the electrode
Energy K1	1.00	1.1~1.5	--	the charged ESDD to uncharged ESDD ratio
Tmp Compensated	Y	Y or N	--	temperature compensated or not
Set time	--	actual time	--	modify time

Explain keys in detail:

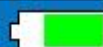
Alter param	Alter choosed item's param
Reset	Reset back to default values

## (2) Parameters Interface (Interface B)

2020/01/01 00:00:00		
WaterVOL:	<b>300</b> ml	<div><div></div><div>1234567890.←</div><div>OkClear</div><div>Max:9999 Min:100</div><div>ResetBack</div></div>
One Area:	1450 cm <sup>2</sup>	
ESDD REF:	0.0000 mg/cm <sup>2</sup>	
ELECT K:	1.00 cm <sup>-1</sup>	
EnergyK1:	1.00	
TEM&COND:	Y	
Date: 2020/01/01 00:00:00		

The currently selected item in red background, you can use the keyboard to Modify Parameters. If you press the key named “Back”, the instrument will go back to the modification Interface (Interface A).

### 5.4(1) Records Interface (Interface A)

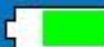
2020/01/01 00:00:00		
[2] 2020/01/01 00:00:00 0.0001mg/cm <sup>2</sup>	<div>← →</div> <div>Current</div> <div>Del. All</div> <div>Exp. All</div> <div>Back</div>	
[1] 2020/01/01 00:00:00 0.0001mg/cm <sup>2</sup>		







Press the item you want to check, the item you choose will have a black background, and then press the key named “Current” to enter the records interface (Interface B). **Note**, if you press the key named “Del.all”, all records will be delete. By the way, if you press the key named “Exp.all”, you need to insert a U disk.

Explain keys in detail:

Left and right arrows	Page up and down
[2] 2020/01/01 00:00:00 0.0001mg/cm <sup>2</sup>	The selected record
Current	Enter the records interface (Interface B)
Del.all	Delete all records
Exp.all	Export all records
Back	Go back to the last interface

## (2) Records Interface (Interface B)

2020/01/01 00:00:00 	
No. : 000002	WaterVOL: 300 ml
ESDD: 0.0001 mg/cm <sup>2</sup>	One Area: 1450 cm <sup>2</sup>
COND: 0.98 us/cm	ESDD REF: 0.0000 mg/cm <sup>2</sup>
TMP: 26.6 °C	ELECT K: 1.00 cm <sup>-1</sup>
SPSClazz: a	EnergyK1: 1.00
USCD: 22~25 mm/kV	TMP&COND: Y
DateTime: 2020/01/01 00:00:00	

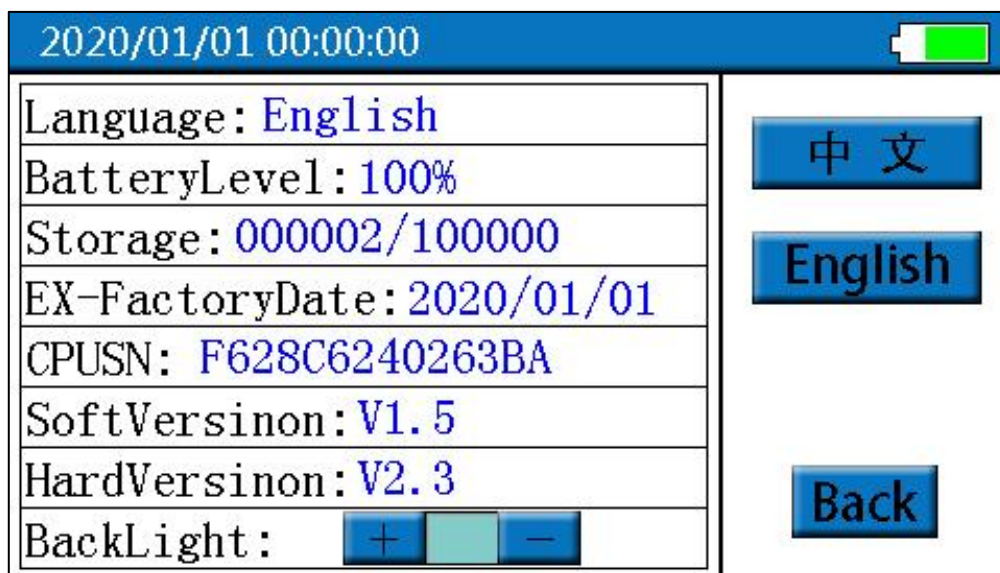
Press the key named “Print” and the instrument can print a single record.

Press the key named “Delete”, the instrument will delete the current one and show you a next record, if the current one is the last one the instrument will go back to the records interface (**Interface A**). Also, if you press the key named “Export”, the instrument can export a single record.

Explain keys in detail:

Left arrow	Last record
Right arrow	Next record
Print	Print the current record.
Delete	Delete the current record.
Export	Export the current record.
Back	Go back to the last interface

## 5.5 Local Interface



Explain items in detail:

Items	Description
Language:English	The current language
Battery Level:100%	Battery's capacity
Storage:108/100000	108 is the number of records , 100000 is the total number



EX-factory Date:2016/08/18	The EX-factory date of instrument
SN:FA-183500793	The Board number of instrument
Soft Version:V1.01	The software version number of instrument
Hard Version:V2.1	The hardware version number of instrument
English	Switch to English
中文	Switch to Chinese
Backlight	Press “+”、“-” to adjust the backlight
Back	Go back to the last interface

## 6. Maintaining

- a) The electrode need to be soaked by distilled water or deionized water to remove the dirt on the surface of the electrode before using. After using, it is suggested to clean it before storing.
- b) The electrode is the most precise enclosure in instrument, please maintain it carefully, make sure not collide with cup wall while using it.
- c) If the Instrument is idle for a long time, please store after battery full.

## 7. Stochastic Appendix

Product	Quantity
Instrument host	1
Electrode (K=1.0)	1
Charger	1
USB flash disk	1
Beaker (400ml)	1
Gauze kerchief	1
Disposable glove	1
Manual	1
Factory inspection report and certificate	1

## 8. After-sales Service

a) The instrument can be replaced if it has defects within one month from the date of delivery and it can be maintained for one year.

b) If the instrument surpasses the warranty period, our company is responsible for the long-term service, appropriate charge the cost of raw materials.

c) If the instrument appears breakdown, you can send it back to our company to fix, please do not disassemble the instrument.

d) If it is appointed in purchases and sales contract, subject to contract.

**Note: Electrode is not in maintenance scope.**

# Appendix A

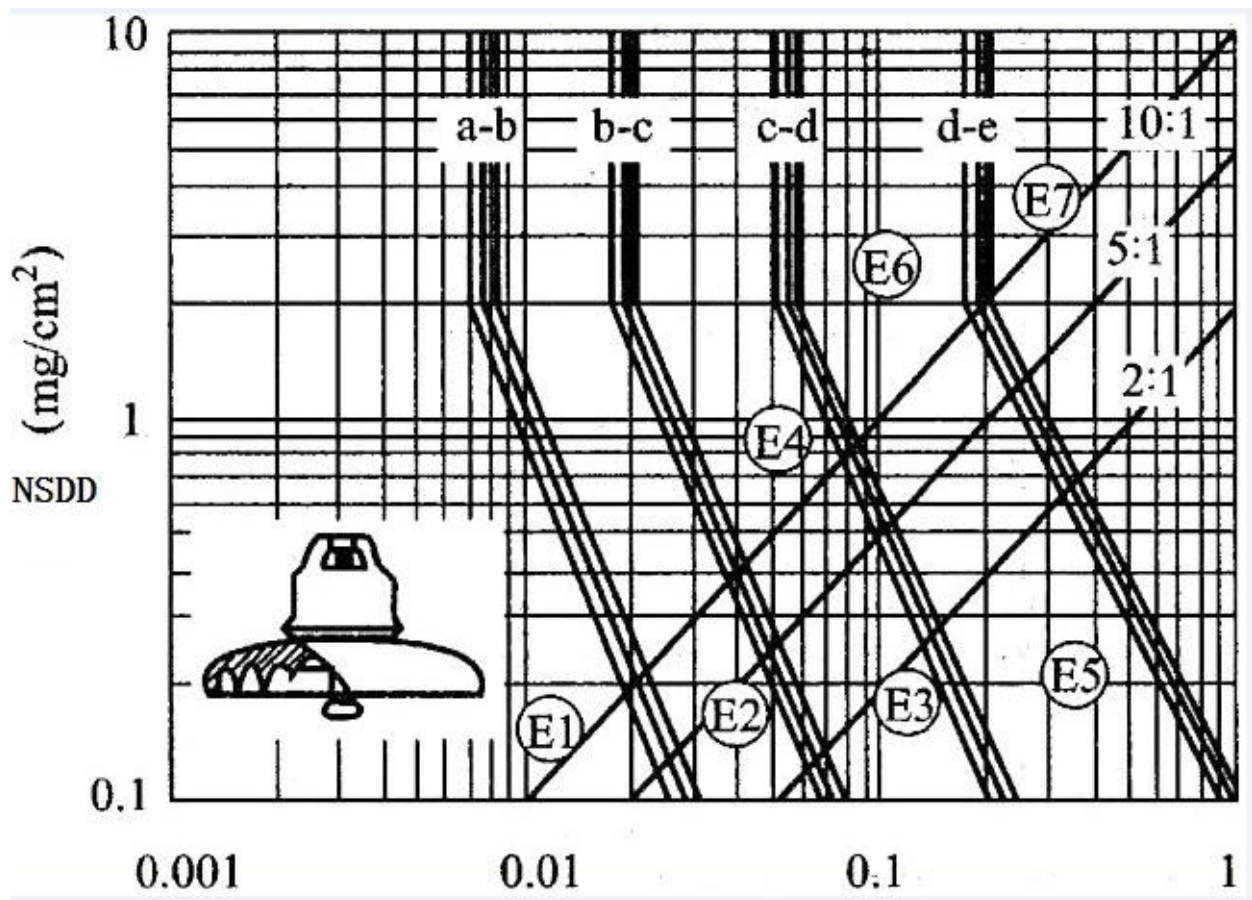
According to 《GB/T16434 – 1996》:

**Line, power plant and substation contamination class table**

Contamination class	Contamination characteristic	Salty dense, mg/cm <sup>2</sup>	
		Circuit	Power plant
0	Area where air is clean and pollution are away from seacoast saltern above 50km.	$\leq 0.03$	—
I	Light degree contaminated atmosphere area, industrial area and the low intensive population area, away from the seacoast saltern 10km~50km area .The dry few fog (including fine rain) or the rainfall are many in the dirt dodging season time.	$>0.03 \sim 0.06$	$\leq 0.06$
II	Atmosphere medium contaminated area, light salt alkaloid and stove smoke contamination area, to the seacoast saltern 3km~10km area, in dirt dodging season moist multi-fog (including fine rain), but the rainfall compares the youth.	$>0.06 \sim 0.10$	$>0.06 \sim 0.10$
III	Air pollution serious area, heavy fog and heavy salt alkaloid area, near seacoast saltern 1km~3km area, industry and population density big area, to chemistry dirt source and stove smoke contamination 300m~1500m serious contamination area.	$>0.10 \sim 0.25$	$>0.10 \sim 0.25$
IV	Air pollution especially serious area, less than 1km from the coast salt and within 300m of chemical pollution or dirty flue gas source area	$>0.25 \sim 0.35$	$>0.25 \sim 0.35$

## Appendix B

According to 《Q/GDW 152-2006》:



Equivalent Salt Deposit Density ( $\text{mg/cm}^2$ )

The link between SPS and ESDD/NSDD is in this diagram.

**Note1:** E1~E7 corresponding 7 typical filthy samples, a-b、 b-c、 c-d and d-e are all levels of the boundary;

**Note2:** 3 lines respectively are 10:1、 5:1、 2:1 ESDD/NSDD lines

# Appendix C

According to 《GB/T16434 – 1996》:

## Specific leakage distance for various contaminations class

contaminations class	Specific leakage distance, cm/kV			
	Circuit		Power plant and transformer substation	
	220kV and below	330kV and below	220 kV and below	330kV and below
0	1.39 (1.60)	1.45 (1.60)	/	/
I	1.39~1.74 (1.60~2.00)	1.45~1.82 (1.60~2.00)	1.60 (1.84)	1.60 (1.76)
II	1.74~2.17 (2.00~2.50)	1.82~2.27 (2.00~2.50)	2.00 (2.30)	2.00 (2.20)
III	2.17~2.78 (2.50~3.20)	2.27~2.91 (2.50~3.20)	2.50 (2.88)	2.50 (2.75)
IV	2.78~3.30 (3.20~3.80)	2.91~3.45 (3.20~3.80)	3.10 (3.57)	3.10 (3.14)

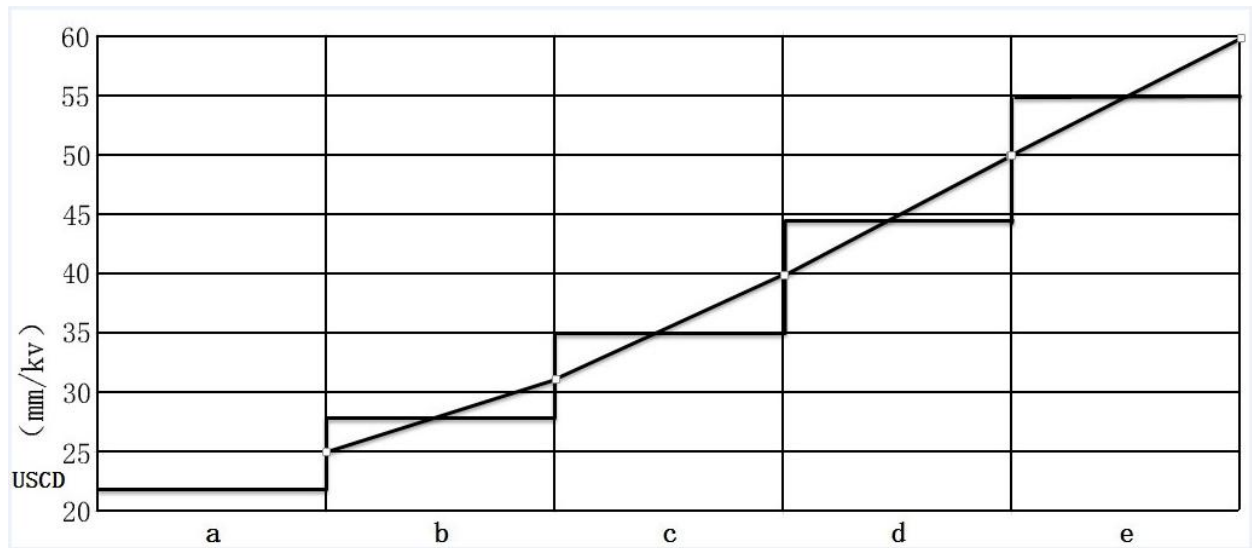
Note:

1 .Take the highest working voltage when specific leakage distance is computed for circuit, power plant and transformer substation. The digit on the table is computed with rated voltage.

2. The power station equipment class is 0 ( the creepage distance below 220kv is

8cm/kv , the creepage distance above 330kv is 1.55cm/kv ) , Keep the contaminations class as a transition period at present.

### The link between USCD and SPS according to 《Q/GDW 152-2006》



SPS Class

# Appendix D

Commonly used insulator's surface area and the leakage distance table

Ordinal number	Insulator model	Last watch area cm <sup>2</sup>	Descend watch area cm <sup>2</sup>	Total watch area cm <sup>2</sup>	Revelation distance mm	Producer
1	FC70~ FC120/146 (127)	566	1083	1649	320	Sichuan Zi gongsaidiweier armored glass insulator limited company
2	BC8~BC12/146 (127)	566	1083	1649	320	
3	FC160/155 (146, 170)	825	1492	2317	380	
4	BC160/155 (146, 170)	825	1492	2317	380	
5	FC210/170	854	1458	2312	400	
6	FC300/195	1020	2157	3177	485	
7	FC7P~ FC12P/146	611	1392	2003	400	
8	BC8P~ BC12P/146	611	1392	2003	400	
9	FC70P~ FC120P/146	881	1646	2527	450	
10	BC80P~ BC120P/146	881	1646	2527	450	
11	FC16P/155 (170)	895	1794	2689	450	
12	FC160P/170 (155)	1198	2541	3739	550	
13	FC210P/170	1183	2536	3719	550	
14	FC300P/195	1627	3718	5345	690	
15	FC70D~ FC120D/127 (146)	1184	1203	2387	365	
16	FC160D/146 (155)	1500	1769	3269	380	
17	FC210D/155 (170)	1433	1468	2901	375	

18	LXY-70 LXY4-70	648	862	1510	320	Nanjing electricity group limited company(Original Nanjing Electric porcelainous Main plant)
19	LXY-100	548	862	1410	320	
20	LXY-120	648	862	1510	320	
21	LXY-160 LXY3-160 LXY4-160	773	1325	2098	380	
22	LXY3-210	859	1459	2318	390	
23	LXY-240	859	1459	2318	390	
24	LXY-300	1097	2041	3138	485	
25	LXHY-70 LXHY4-70	870	1378	2248	400	
26	LXHY5-70	975	1601	2576	450	
27	LXHY4-100	975	1601	2576	450	
28	LXHY4-120	975	1601	2576	450	
29	LXY3-210	859	1459	2318	390	
30	LXY-240	859	1459	2318	390	
31	LXY-300	1097	2041	3138	485	
32	LXHY-70 LXHY4-70	870	1378	2248	400	
33	LXHY5-70	975	1601	2576	450	
34	LXHY4-100	975	1601	2576	450	
35	LXHY4-120	975	1601	2576	450	
36	LXHY3-160 LXHY4-160	993	1806	2799	450	
37	LXHY5-160 LXHY6-160	1256	2415	3671	545	
38	LXHY4-210	1256	2415	3671	545	
39	LXAY-120	946	784	1730	360	



40	LXZY-160	1256	2415	3671	545	
41	LXZY-210	1256	2415	3671	545	
42	LXZY-300	1811	3152	4963	635	
43	XP-70	674	917	1591	295	Dalian electric porcelainous main plant
44	XP-100	670	807	1477	295	
45	XP-160	681	891	1572	305	
46	XP-210	874	1112	1986	335	
47	XP2-210	950	1337	2287	370	
48	XP1-300	127	1994	2121	485	
49	XWP1-70	1162	861	2023	400	
50	XWP2-70	1162	861	2023	400	
51	XWP2-100	1288	1208	2496	450	
52	XWP2-160	1551	1208	2759	450	
53	XWP-210	1423	1360	2783	450	
54	XDP-70C	336	382	718	160	
55	XDP-70CN	336	382	718	160	
56	XWP-7	1210	803	2013	410	
57	X-4.5	645	805	1450	300	
58	XP-7	685	715	1400	290	
59	XP-10	645	805	1450	295	
60	LXP-7	685	715	1400	290	

### Supplementary model:

Insulator model	Disk diameter mm	Height mm	Revelation distance mm	Area cm <sup>2</sup>	Producer
XP-16	255	155	305	1630	Da Lian
XP-16	254	155	290	1530	Li Lin
XP3-16	280	155	350	2006	Da Lian
XP-16D	280	160	370	1965	Li Lin
XP-16D1	280	155	330	2019	Li Lin
XP-16D2	300	155	300	1965	Li Lin
XP-16D3	300	155	400	2275	Li Lin
XP-16D4	300	155	400	2675	Li Lin
XP-21	280	170	335	1892	Da Lian
XP-21	280	170	320	1974	Li Lin
XP-30	320	195	370	2455	Da Lian
XP-30	320	195	350	2462	Li Lin
XW-4. 5	254	180	450	2200	Xi An
XW-4. 5	254	170	440	2080	Da Lian
XW1-4. 5	254	160	410	2070	Su Zhou
XWP-6	280	146	400	2470	Li Lin
XWP-6	254	146	390	2070	Su Zhou
XWP-6	254	160	400	2070	Su Zhou
XWP-7	255	146	400	1800	Da Lian
XWP-7	280	146	400	2470	Li Lin
XWP-10	280	160	450	2492	Da Lian
XWP-16	300	155	400	2154	Da Lian
XWP1-16	280	155	400	2291	Li Lin
XWP3-16	300	155	450	2727	Da Lian
XHP-16	300	155	450	3007	Da Lian
XHP-21	300	170	470	3364	Da Lian
XHP-30	320	195	460	3194	Da Lian

**Commonly used DC insulator's surface area table**

Ordinal number	model (tonnage)	Last watch area cm <sup>2</sup>	Descend watch area cm <sup>2</sup>	Total watch area cm <sup>2</sup>	Producer
1	CA-774EZ (210)			3754	NGK
2	CA-772EZ (160)	2900	845	3745	
3	CA-776EZ (300)	3951	1268	5219	
4	CA-765EZ (300)	2055	3055	5110	
5	CA-735EZ (160)	1355	2295	3650	
6	CA-745EZ (210)	1355	2295	3650	
7	CA-765EZ (400)			3980	
8	Da Lian 160KN	1355	2185	3540	
9	Zi Gong 160KN	1355	2325	3680	