

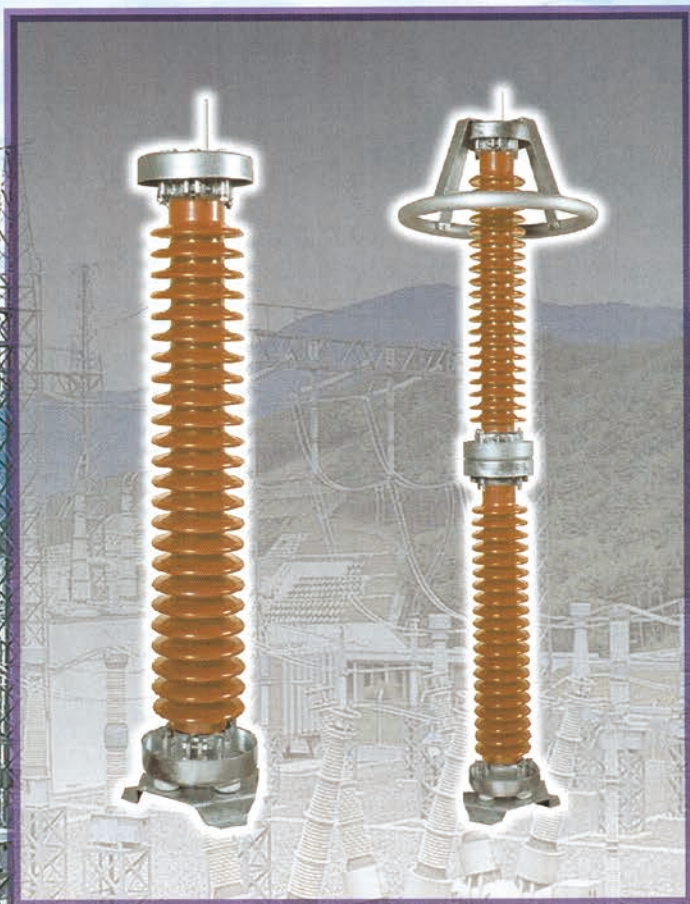
## ZSE-E Series

# MEIDEN

Quality connecting the next

# SORESTER

Metal Oxide Surge Arrester

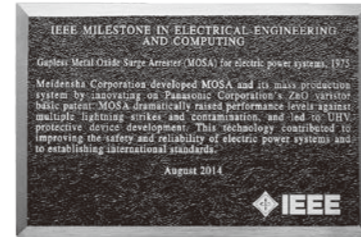


Applicable to a Variety of Voltage Classes,  
from 3kV to 500kV.



Meidensha Corporation was the first company in the world to pioneer the development and commercialization of metal oxide gapless surge arresters (MOSA). As a result of our efforts, the world's first MOSA was delivered to Kyushu Electric Power Co., Inc., in 1975 and since then about 300,000 gapless surge arresters (AS of 2017) for 3 to 500kV power systems have been delivered to many electric power companies and utilities in Japan and overseas. This MOSA was awarded an IEEE Milestone in 2014 by the Institute of Electrical and Electronics Engineers Inc.

We have named this gapless surge arrester the SORESTER (SOLID-STATE SURGE ARRESTER). The SORESTER (ZSE-E Series) is a pure gapless surge arrester which operates without series or by-pass (shunt) gaps. This is possible in large part due to the fact that the SORESTER incorporates ZnO blocks with extremely outstanding voltage-current non-linear characteristics and an ample discharge current withstand capability.



## Principle

The silicon carbide (SiC) elements which are employed as the characteristic element for conventional arresters are obtained by sintering solid contact SiC particles of about 200 microns using clay or other porcelain bonding agent, and its voltage-current non-linear characteristic is obtained by the properties of SiC particles contact. On the contrary, the sintered element (ZnO) using zinc oxide as the main component is composed of fine ZnO crystalline particles of about 5-10 microns, surrounded by very thin high-resistance layer, in such a manner that the sintered ZnO particles make contact with each other through this thin layer. Its non-linear characteristic exists at the boundaries between these sintered particles, and these boundary layers are laminated innumerable. (Fig. 1)

The resistivity of the sintered ZnO particles is far lower than that of the boundary layer. Accordingly, when a high voltage is applied across ZnO element, almost all of this voltage is applied to the boundary layer to produce a current multiplication phenomenon, making an ideal non-linear characteristic between voltage and current.

As shown in Fig. 2, follow current flows at normal line-to-ground voltage in the case of SiC element while it scarcely flows in the case of ZnO element excepting capacitive current. As a result, ZnO element substantially serves as an insulator at the normal operating voltage and does not require any series gap.

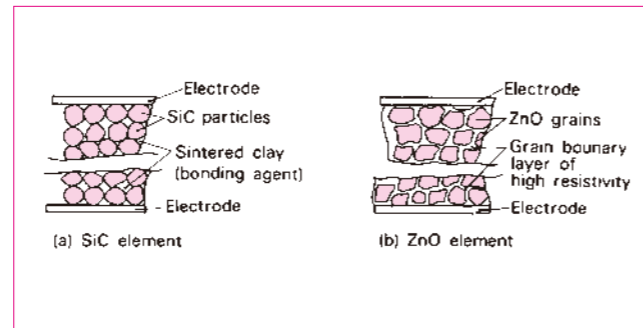


Fig. 1 Structure of Element

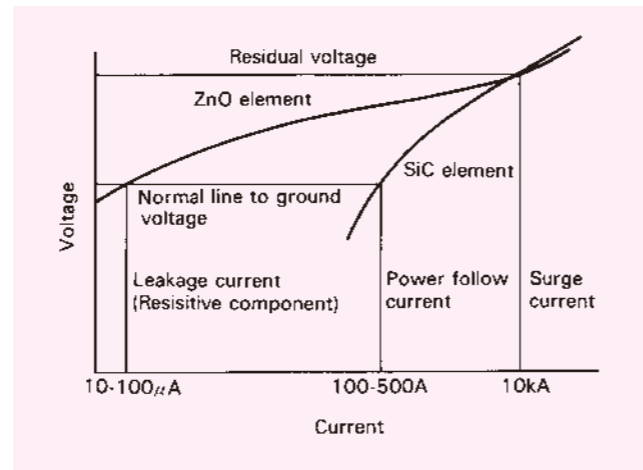


Fig. 2 Voltage-Current Characteristics of SiC Element and ZnO Element

## Features

### 1. Stabilized protective performance

Since the SORESTER operates without series gaps, its protective performance is stable. Also, the SORESTER has an excellent response against a steep wave front voltage. Compared with conventional arresters, therefore, the SORESTER has excellent protective characteristics.

### 2. Improved operating duty characteristic

Since the ZnO blocks have high non-linear voltage-current characteristics, they do not permit the flow of follow current caused by AC voltages. The amount of energy absorption is smaller than that for any other conventional arresters. Thus the operating duty characteristic against multiple lightning and multiple switching surges is greatly improved.

### 3. Improved capability to withstand discharge current

Compared with conventional SiC blocks, the ZnO blocks have a high capability to withstand energy. In addition, the SORESTER enables the use of ZnO blocks in parallel arrangement. This makes it possible to manufacture arresters for ultra-high-voltage systems and HVDC systems where extremely heavy operating duty capability is required.

### 4. Compact and light

The volume of internal element blocks is only 1/5 to 1/10 that of conventional types. This feature is highly effective in the reduction of overall size and mass of the unit. In particular, the SORESTER is extremely suitable for use with compact substation or integration with other equipment units.

### 5. Improved reliability

High reliability is assured since the SORESTER has a simpler construction and fewer constitutive components than conventional types.

## Performance

### 1. Applicable standard

SORESTERS of the ZSE-E Series are manufactured in accordance with IEC 99-4 (1991). Table 1 shows the major ratings of the ZSE-E Series, and Table 2 shows its protective characteristics.

### 2. Continuous operating voltage

Continuous operating voltage (COV or MCOV in abbreviation) is a permissible rms value of power frequency voltage that can be continuously applied between arrester terminals. This value is specified in Table 2. When applying SORESTERS to a new system, it is essential to confirm that the highest system voltage does not exceed the SORESTER's MCOV multiplied by  $\sqrt{3}$ .

### 3. Temporary overvoltage capability

Fig. 3 shows the power-frequency-voltage-versus time characteristics specified for SORESTERS of the ZSE-E Series. The temporary overvoltage curve indicates the capability available after surge energy specified by IEC has been absorbed. Fig. 3 shows the time range from 0.1 to 2000 seconds. If an overvoltage continues for more than 2000 seconds, however, queries should be made to Meidensha Corporation or the arrester rated voltage should be selected so that its overvoltage is identical with MCOV.

### 4. Energy absorption capability

The energy absorption capability determines the amount of energy to be absorbed during operating duty test for the IEC Standard. ZSE-E1, ZSE-E2 and ZSE-E3 types belong to Classes 2, 3 and 4 respectively. Their energy is the total of long-term current impulse absorbed twice. It is always the absorption energy measured after preheating at 60°C.

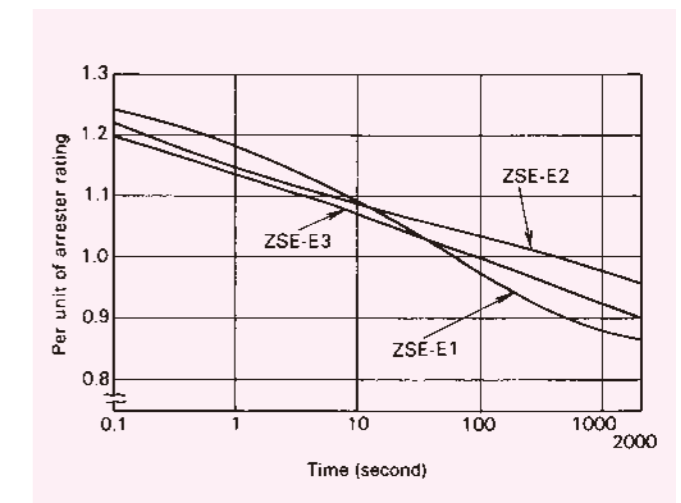


Fig. 3 Power Frequency Voltage versus Time Characteristics

Table 1 Major Ratings

Type of SORESTER	ZSE-E1	ZSE-E2	ZSE-E3
Rated voltage:Er (kV)	3~198	18~444	240~444
Max. continuous operating voltage (kV)	0.78Er	0.78Er	0.78Er
Nominal discharge current (kA)	10	10	20
Line discharge class	2	3	4
Discharge current withstand capability (4/10 $\mu$ s, 2 shots) (kA)	100	100	100
Energy absorption capability (kJ/kV-arrester rating, within one minute)	4.5	7.5	9.5
Pressure relief current (kA)	40	40	40
Residual voltage level at nominal discharge current (per unit of kV rating)	2.74	2.45	2.53

\* Data other than shown above will be provided upon request.

### 5. Pollution characteristics

SORESTERS of the ZSE-E Series are designed so that their creepage distance is suitable for 16mm/kV—the highest system voltage. They are, therefore, not a pollution-resistant type. Salt deposit density must be for use below 0.01mg/cm<sup>2</sup>.

The creepage distances of the ZSE-E Series are specified in a separate table. If a SORESTER is to be installed in a high-pollution area where it calls for a longer creepage distance than mentioned above, queries should be made to Meidensha Corporation.

Table 2 Protective Characteristics

(a) Type ZSE-E1

Rated voltage (kV rms)	Max. continuous operating voltage (kV rms)	Max. residual voltage with current wave						
		Switching surge		8/20μs				1/2μs
		125A (kV crest)	500A (kV crest)	1kA (kV crest)	5kA (kV crest)	10kA (kV crest)	20kA (kV crest)	10kA (kV crest)
3	2.3	6.1	6.5	6.8	7.8	8.3	9.2	9.2
4.5	3.5	9.1	9.7	10.2	11.6	12.4	13.7	13.7
6	4.6	12.1	12.9	13.5	15.4	16.5	18.2	18.2
7.5	5.8	15.1	16.0	16.8	19.3	20.6	22.7	22.7
9	7.0	18.1	19.2	20.2	23.1	24.7	27.2	27.2
10.5	8.1	21.1	22.4	23.5	26.9	28.8	31.7	31.7
12	9.3	24.1	25.6	26.9	30.7	32.9	36.2	36.2
15	11.7	30.1	32.0	33.6	38.4	41.1	45.3	45.3
18	14.0	36.2	38.4	40.3	46.1	49.4	54.4	54.4
21	16.3	42.5	45.1	47.4	55	58	64	64
24	18.7	48.3	52	54	62	66	73	73
27	21.0	55	58	61	69	74	82	82
30	23.4	61	65	68	78	83	92	92
33	25.7	67	71	75	85	91	101	101
36	28.0	73	77	81	93	99	109	109
39	30.4	79	84	88	100	107	118	118
42	32.7	85	90	95	109	116	128	128
48	37.4	97	103	108	124	132	146	146
54	42.1	109	115	121	139	148	163	163
60	46.8	121	129	135	154	165	182	182
72	56.1	145	154	162	185	198	218	218
75	58.5	151	160	168	193	206	227	227
84	65.5	169	180	189	216	231	255	255
90	70.2	181	192	202	231	247	272	272
96	74.8	194	205	216	247	264	291	291
102	79.5	205	218	229	262	280	308	308
108	84.2	217	230	242	277	296	326	326
120	93.6	241	256	269	307	329	362	362
132	102	265	282	296	338	362	399	399
138	107	278	295	310	354	379	417	417
144	112	289	307	323	369	395	435	435
150	117	301	320	336	384	411	453	453
168	131	338	358	376	431	461	508	508
180	140	362	384	403	461	494	544	544
186	145	374	396	416	476	510	561	561
192	149	386	410	430	492	527	580	580
198	154	398	422	443	507	543	598	598

(b) Type ZSE-E2

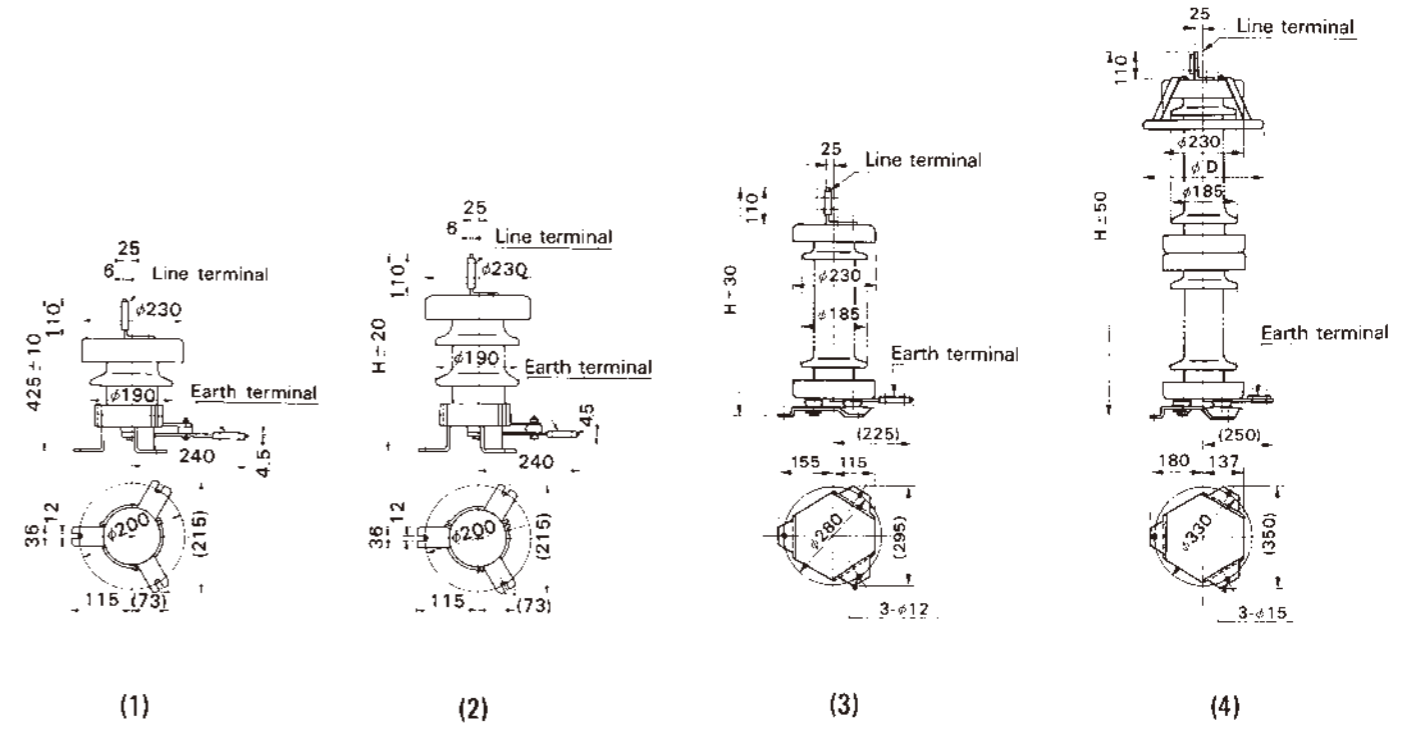
Rated voltage (kV rms)	Max. continuous operating voltage (kV rms)	Max. residual voltage with current wave						
		Switching surge		8/20μs				1/2μs
		250A (kV crest)	1000A (kV crest)	1kA (kV crest)	5kA (kV crest)	10kA (kV crest)	20kA (kV crest)	10kA (kV crest)
18	14.0	34.6	36.7	37.1	41.3	44.1	47.8	48.6
21	16.3	40.8	43.3	43.7	48.6	52	57	58
24	18.7	46.3	49.1	49.6	56	59	64	65
27	21.0	53	56	57	63	67	73	74
30	23.4	58	62	63	70	74	81	82
33	25.7	64	67	68	76	81	88	90
36	28.0	70	74	75	84	89	97	98
39	30.4	76	80	81	90	96	104	106
42	32.7	81	86	87	97	103	112	114
48	37.4	93	99	100	111	118	128	130
54	42.1	105	111	112	125	133	144	147
60	46.8	116	123	124	138	147	160	162
72	56.1	139	148	149	166	177	192	195
75	58.5	145	153	155	172	184	200	203
84	65.5	162	172	173	193	206	223	227
90	70.2	174	184	186	207	221	240	244
96	74.8	185	197	199	221	236	256	260
102	79.5	196	208	210	234	250	271	275
108	84.2	208	221	223	248	265	287	292
120	93.6	231	245	247	275	294	319	324
132	102	254	270	273	303	324	351	357
138	107	266	282	285	317	339	367	373
144	112	277	294	297	330	353	383	389
150	117	289	306	310	344	368	399	405
168	131	323	343	347	386	412	447	454
180	140	346	367	371	413	441	478	486
186	145	358	380	384	427	456	494	502
192	149	370	392	396	441	471	510	519
198	154	381	404	408	454	485	526	534
216	168	416	441	446	496	530	574	583
240	187	461	489	494	550	588	637	647
246	191	473	501	507	564	603	653	664
258	201	496	526	531	591	632	685	696
264	205	507	538	544	605	647	701	712
276	215	530	562	568	632	676	733	745
288	224	553	587	593	660	706	764	777
294	229	565	599	605	674	720	780	793
300	234	576	611	618	687	735	796	809
312	243	599	636	642	715	765	828	842
336	262	646	685	692	770	823	891	906
360	280	692	733	741	825	882	955	971
372	290	715	758	766	852	911	987	1005
396	308	761	807	815	907	970	1050	1070
420	327	807	855	865	962	1030	1115	1135
444	346	853	904	914	1020	1090	1180	1200

(c) Type ZSE-E3

Rated voltage (kV rms)	Max. continuous operating voltage (kV rms)	Max. residual voltage with current wave						
		Switching surge		8/20 $\mu$ s				1/2 $\mu$ s
		500A (kV crest)	2000A (kV crest)	1kA (kV crest)	10kA (kV crest)	20kA (kV crest)	40kA (kV crest)	20kA (kV crest)
240	187	461	492	480	562	606	665	668
246	191	472	504	492	576	622	681	685
258	201	495	529	516	604	652	714	718
264	205	507	541	528	618	667	731	735
276	215	530	565	552	646	697	764	768
288	224	553	590	576	674	728	797	802
294	229	565	602	588	688	743	814	818
300	234	576	615	600	702	758	831	835
312	243	599	639	624	730	788	864	868
336	262	645	688	671	786	849	930	935
360	280	691	737	719	843	909	997	1000
372	290	714	762	743	871	940	1030	1035
396	308	760	811	791	927	1000	1095	1100
420	327	806	860	839	983	1060	1165	1170
444	346	852	909	887	1040	1120	1230	1235



Type ZSE-E3 420kV

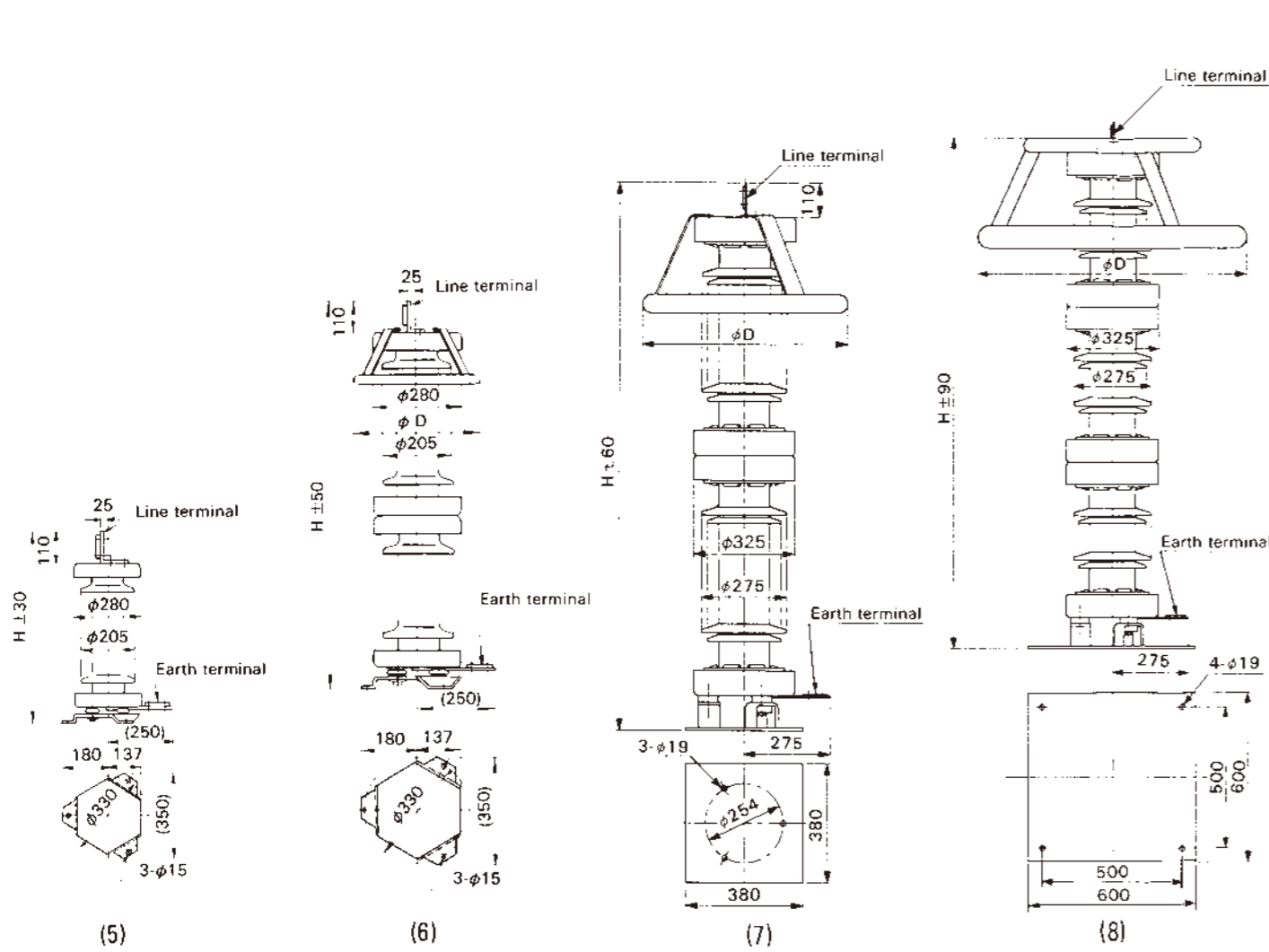


● Type ZSE-E1

Rated voltage (kV)	Dimension diagram	Terminal dimension diagram	Approx. height: H (mm)	Approx. mass (kg)	Grading ring: D (mm)	Creepage distance (mm)	Installation plan		Insulation withstand voltage*1	
							LP (mm)	LE (mm)	Power frequency (Wet) (kV rms)	Impulse (kV crest)
3~10.5	(1)	(a)	425	11	—	205	320	185	18	38
12~18	(2)	(a)	450	13	—	289	370	230	29	65
21~24	(2)	(a)	530	15	—	492	415	275	39	86
27~36	(3)	(a)	710	27	—	877	510	365	58	129
39~48	(3)	(a)	800	30	—	1096	610	465	78	172
54~75	(3)	(a)	1010	37	—	1628	820	660	120	268
84~102	(3)	(a)	1220	44	—	2160	1060	890	164	364
108~120	(3)	(a)	1360	49	—	2563	1200	1025	192	428
132~150	(4)	(b)	1850	72	500	3256	1730	1390	240	535
168	(4)	(b)	2060	79	500	3788	1870	1520	269	600
180~198	(4)	(b)	2270	87	650	4320	2280	1830	317	706

Note: \*1 The listed values are equal to minimum requirements according to the proposed IEC standard.

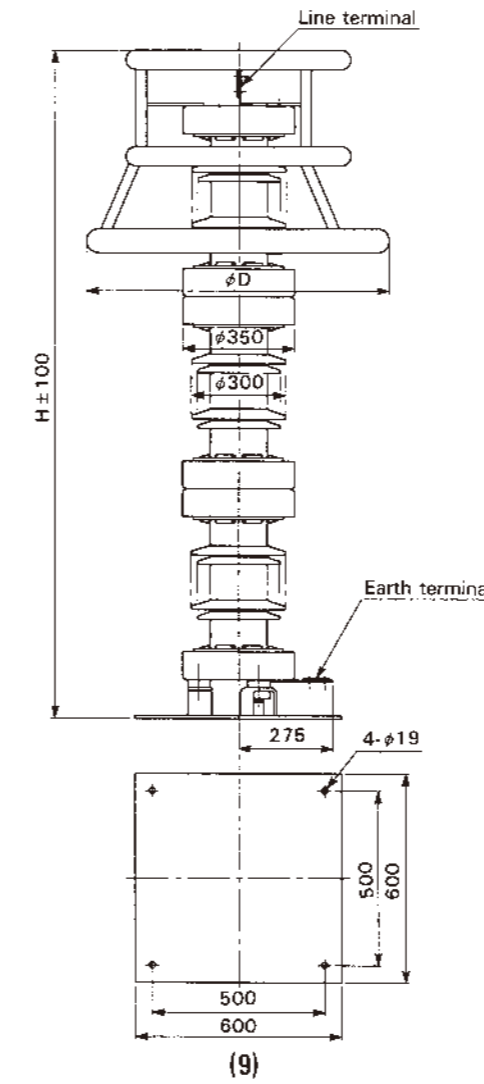




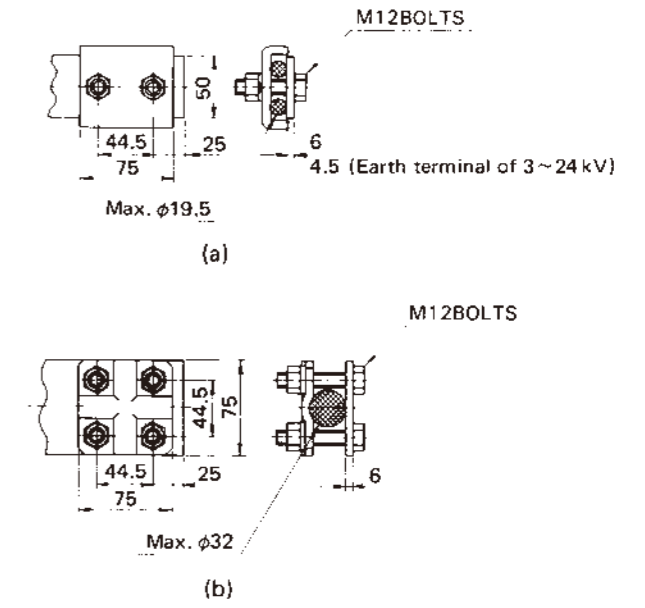
● Type ZSE-E2

Rated voltage (kV)	Dimension diagram	Terminal dimension diagram	Approx. height: H (mm)	Approx. mass (kg)	Grading ring: D (mm)	Creepage distance (mm)	Installation plan		Insulation withstand voltage*1	
							LP (mm)	LE (mm)	Power frequency (Wet) (kV rms)	Impulse (kV crest)
18~24	(5)	(b)	630	35	—	656	445	280	33	77
27~36	(5)	(b)	720	39	—	877	535	365	56	116
39~48	(5)	(b)	810	43	—	1096	625	450	75	154
54~75	(5)	(b)	1020	52	—	1628	815	630	115	240
84~102	(5)	(b)	1210	60	—	2140	1000	850	156	325
108~120	(5)	(b)	1370	67	—	2563	1150	950	184	383
132~150	(6)	(b)	1870	95	500	3256	1600	1270	230	479
168	(6)	(b)	2060	103	500	3768	1730	1390	258	536
180~186	(6)	(b)	2250	112	650	4280	1880	1600	285	593
192~198	(6)	(b)	2410	120	650	4703	2100	1670	303	631
216	(6)	(b)	2570	127	650	5126	2230	1790	331	689
240~276	(7)	(b)	2980	250	750	7085	2760	2240	—	879
288~300	(7)	(b)	3240	270	960	7950	3160	2520	—	956
312~360	(8)	(b)	3960	370	1400	9330	4070	3150	—	1147
372~396	(9)	(b)	4540	450	1400	10625	4320	3390	—	1261
420~444	(9)	(b)	4930	480	1400	11925	4660	3720	—	1417

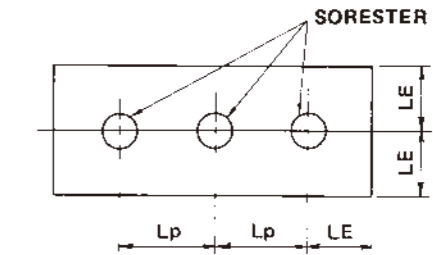
Note: \*1 The listed values are equal to minimum requirements according to the proposed IEC standard.



● Line and Earth Terminals



● Installation



● Type ZSE-E3

Rated voltage (kV)	Dimension diagram	Terminal dimension diagram	Approx. height: H (mm)	Approx. mass (kg)	Grading ring: D (mm)	Creepage distance (mm)	Installation plan		Insulation withstand voltage*1	
							LP (mm)	LE (mm)	Power frequency (Wet) (kV rms)	Impulse (kV crest)
240~276	(7)	(b)	2980	260	750	7085	2830	2300	—	907
288~300	(7)	(b)	3240	280	960	7950	3230	2580	—	986
312~360	(8)	(b)	3960	380	1400	9330	4150	3220	—	1182
372~396	(9)	(b)	4540	470	1400	10625	4400	3470	—	1300
420~444	(9)	(b)	4930	500	1400	11925	4750	3800	—	1456

Note: \*1 The listed values are equal to minimum requirements according to the proposed IEC standard.

## Construction

1. SORESTER accommodates ZnO blocks inside an insulator housing and seals ZnO blocks by a suitable clamping system using quality synthetic rubber based on the gasket system of an angular sectional ring which has been proved from its long term experiences in service conditions. Containing a desiccating agent, SORESTER is free from any fear of moisture absorption, deterioration, etc. for a long time.
2. The pressure-relief structure is designed with a thin pressure-relief plate provided at the top and bottom of each stack in such a manner that these plates shall break at low internal pressure. Accordingly, even if SORESTER should burn out due to an unexpected duty, the insulator housing is protected from being broken and flown asunder to prevent injuries and damages to surrounding equipment.
3. The internal structure is very simple, that is, composed of stacked ZnO elements only, thus giving features of high reliability in assembling transportation. Figs. 4 and 5 show the inner view of SORESTER.

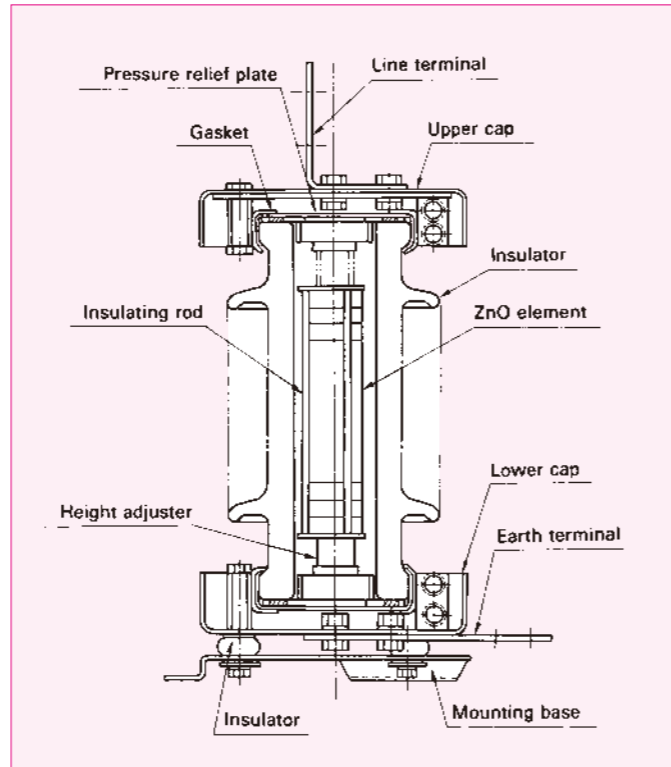


Fig. 4 Construction Drawing of Type ZSE-E Series (216kV below) SORESTER

## Accessories

1. Standard Accessories
  - (1) Clamp type line terminal
  - (2) Clamp type earth terminal
  - (3) Insulation base
  - (4) Grading ring (above 132kV rating)
  - (5) Mounting bolts and nuts

2. Special Accessories

The following special accessories can be furnished to order with extra charge.

- (1) Surge counter
- (2) Surge counter with leakage current meter
- (3) Surge recorder
- (4) Special terminal

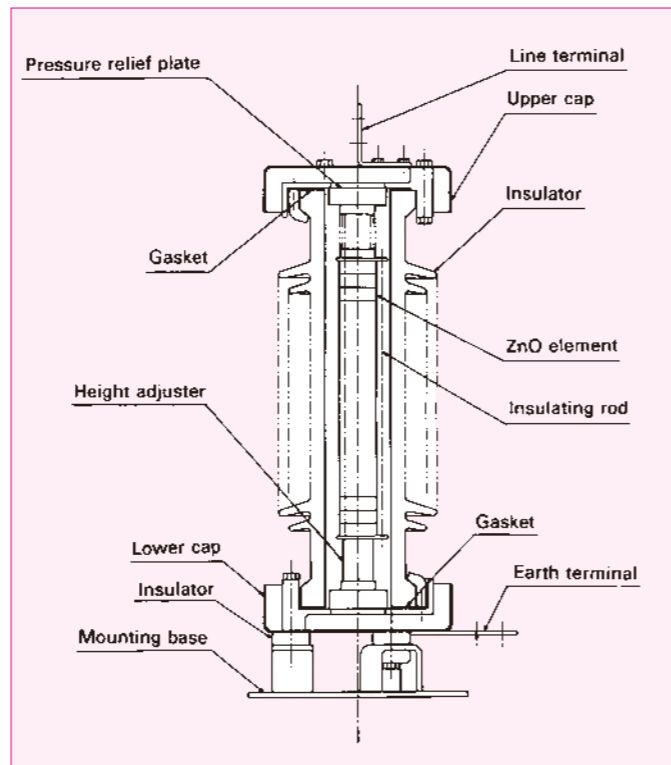


Fig. 5 Construction Drawing of Type ZSE-E Series (240kV above) SORESTER

## Notes for Installation

1. Keep vertical position during the period of removal or storage of SORESTER.
2. SORESTER must be handled with special care so as not to give strong impact.
3. To prevent contamination or mechanical damage of other important equipments from gas or arc as the result of the operation of pressure relief device, at the time of SORESTER installation keep appropriate distance from other equipments.

## Information Required When Ordering

The following information for inquiries and ordering:

1. Type of SORESTER
2. Rated voltage
3. Nominal system voltage, highest system voltage and neutral earthing conditions
4. Long duration discharge class (Arrester classification)
5. Pressure-relief current
6. Color of porcelain (for color other than brown)
7. Creepage distance (when used in contamination area)
8. Special accessories
9. Other special requirement

Since the information in this brochure is described only for standard type arrester (porcelain housing) of Meidensha Corporation, some of data are not applicable to special application. In such case, please contact Meidensha Corporation. Moreover, all data are subject to change without notice.