CRS

Combined insulation bushing

CRS combined insulation bushing

Over 40 years have passed since COMEM began working in the electrical sector and it continues to give great importance to innovation, research and the development of new products.

COMEM takes this opportunity to present to (all transformer's OEM, Utilities and Engineering Co.) the new Combined Insulation Bushing. This project meets the latest market requirements regarding higher bushing performance, the improved safety of transformers and cost reduction.

Why is a Combined Insulation Bushing better than a conventional porcelain bushing?

A conventional bushing is composed of a conductor bolt (usually brass or copper), a porcelain insulating part, and oil.
The fixing system is usually made through a collar flange + some pressure pieces that must be used in order to fix a porcelain flange to a metallic cover.
In a Combined Insulation Bushing the conductor bolt is moulded inside an organic insulation resin block; afterwards the primary insulation layer is protected with a silicone rubber coat.

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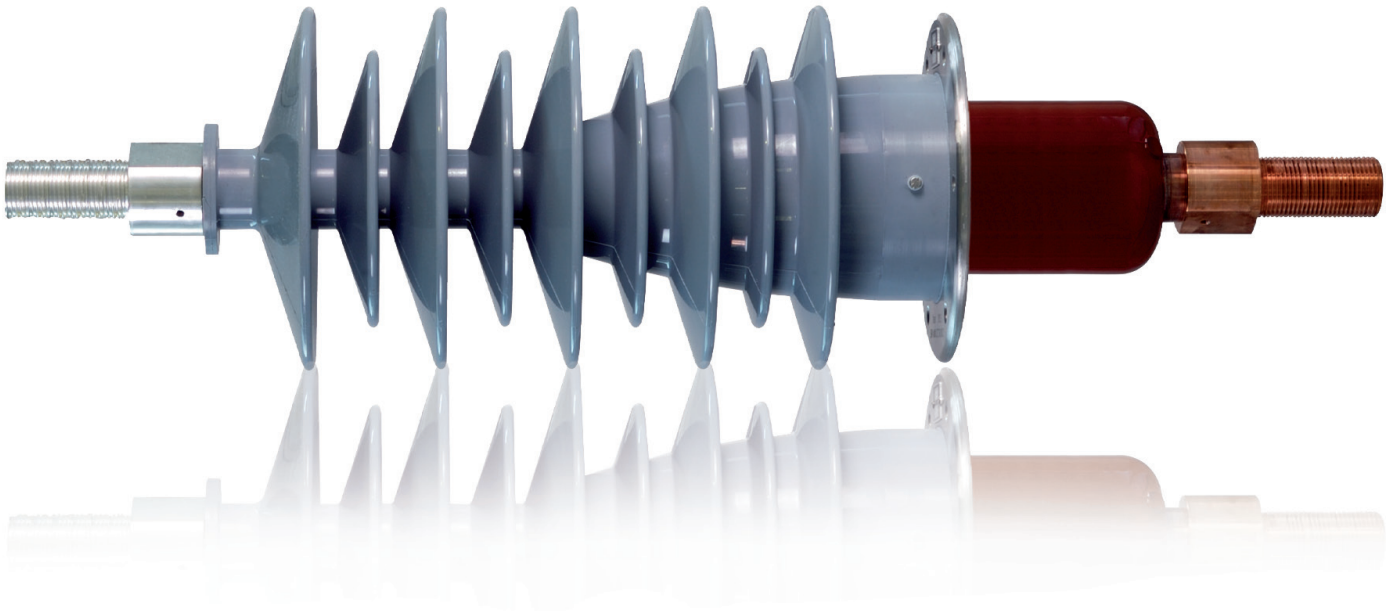
Allows you to know the partial discharge level before you actually test the transformer



Both combined and porcelain bushings must have proper mechanical, electrical and thermal characteristics to withstand, for many years, any stress related to their transformer application.

The Combined Insulation Bushing is a better choice thanks to the yield it gives for each characteristic as shown in the following summary table:

Characteristics	Porcelain bushing	Combined insulation bushing
Mechanical	Porcelain + bolt + collar + pressure pieces	Bolt + organic insulator and its moulded clamp
Thermal	Porcelain + oil	Organic insulator + silicone rubber
Dielectric	Porcelain + oil	Organic insulator + its moulded equipotential screen
Leaking	Porcelain + several gaskets	Organic insulator + one gasket

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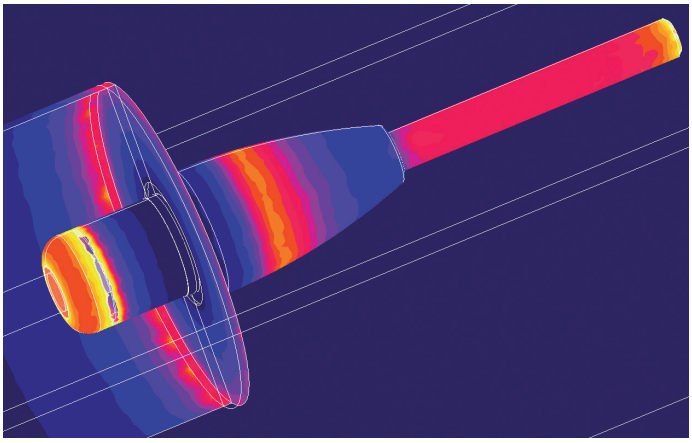
- An internal screen protects the electrical field created by the energised bushing; thanks to the Combined Insulation Bushing design, the level of partial discharges complies with IEC 60137 specifications. At the moment, partial discharges can be neither measured nor reduced in a porcelain bushing.
- In case of an accident or bushing breaking, the Combined Insulation Bushing guarantees no oil will be leaked because there is no oil inside. On the contrary, if a porcelain bushing breaks, this could cause all the oil contained in the conservator to leak (unless somebody uses an automatic cut-off valve).
- The dimensional tolerances allowed for a Combined Insulation Bushing are extremely smaller than the ones allowed for a porcelain bushing.
- The handling and transport of a Combined Insulation Bushing are easier than those one of a porcelain bushing because the insulation material is not fragile.
- The Combined Insulation Bushing is easier and faster to assemble than the porcelain bushing because there are no loose clamps and loose pressure pieces to be used. Furthermore, the Combined Insulation Bushing is interchangeable.
- The Combined Insulation Bushing does not need maintenance, as it has no sealing gaskets,except for those located between the tank cover and bushing clamp.
- The Combined Insulating Bushing has less items to be assembled.
- Furthermore, the Combined Insulation Bushing has many more advantages, for example it uses silicone rubber as its main outer insulation layer making it self-cleaning, flexibile, sturdy.
- There is an M8 thread on the top head of the bolt to lift the Combined Insulation Bushing during assembling.
- The Combined Insulation Bushing is produces in compliance with IEC 60137 and it is fully interchangeable with a conventional porcelain bushing to EN 50180.
- The exceptional quality of selected raw materials allows the Combined Insulation Bushing to be installed in an off-shore environment conforming to ISO 12944.

The project

The Combined Insulation Bushing is the result of a combination of the following key aspects: mechanical and electrical technology, the selection of superior raw materials, the interchangeability of the porcelain bushings and the improvement of general safety concerning bushing application.
In order to reach our targets, the following simulations were analysed and studied during the bushing design phase:

- FEM structure analysis, regarding the max cantilever load allowed;
- Analysis of the electrical field.



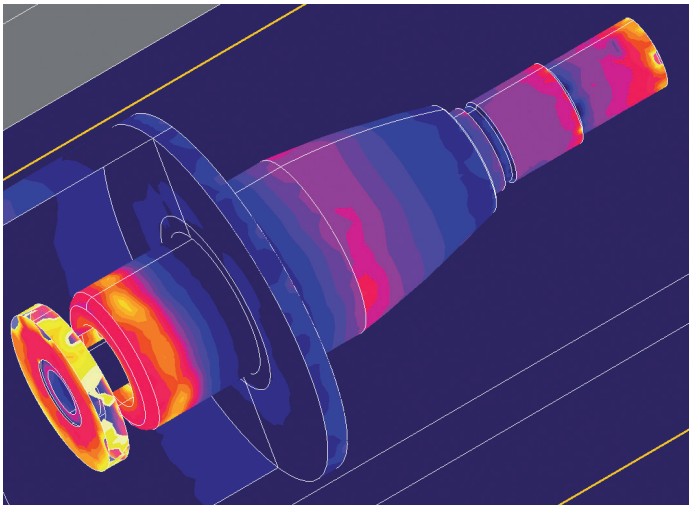
Picture no. 1 - Fem 3D electrical field

Fem structure analysis results

Description	Von Mises stress data from the simulation N/mm2	Material yielding stress by tensile load N/mm2
Copper bolt	92	190
Combined insulation	42	70 - 80
Fixing clamp	120	210

Analysis of the electrical field

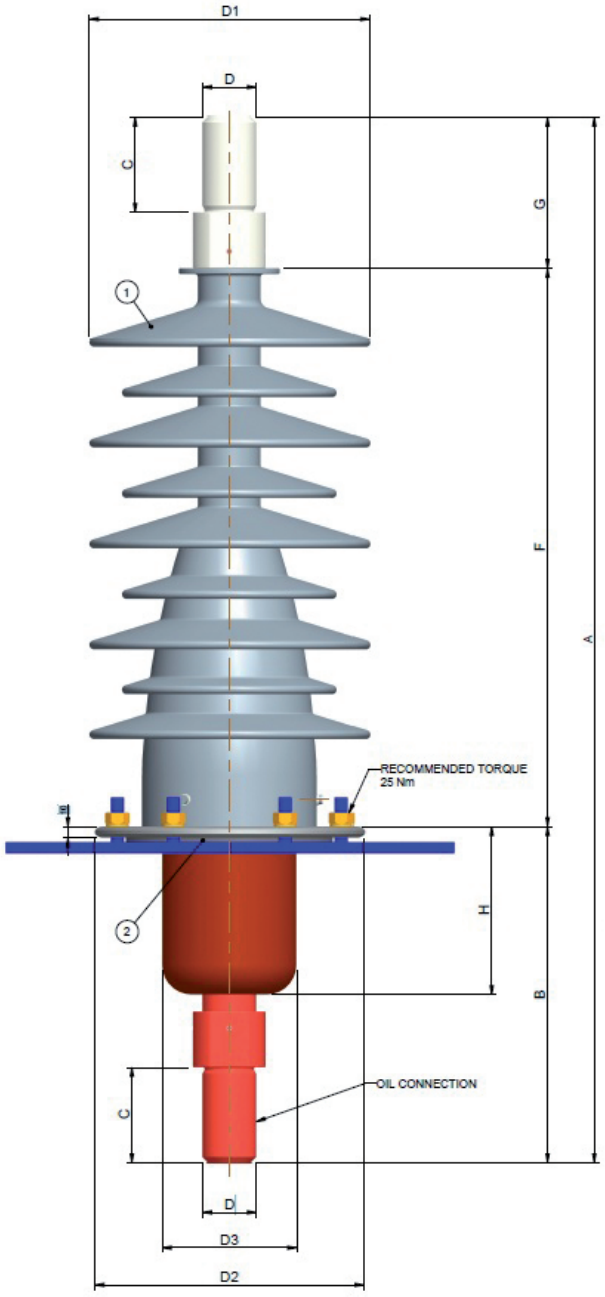
The simulation to finite elements analysis of the electrical field has been carried out by applying a 100kV continuos voltage.



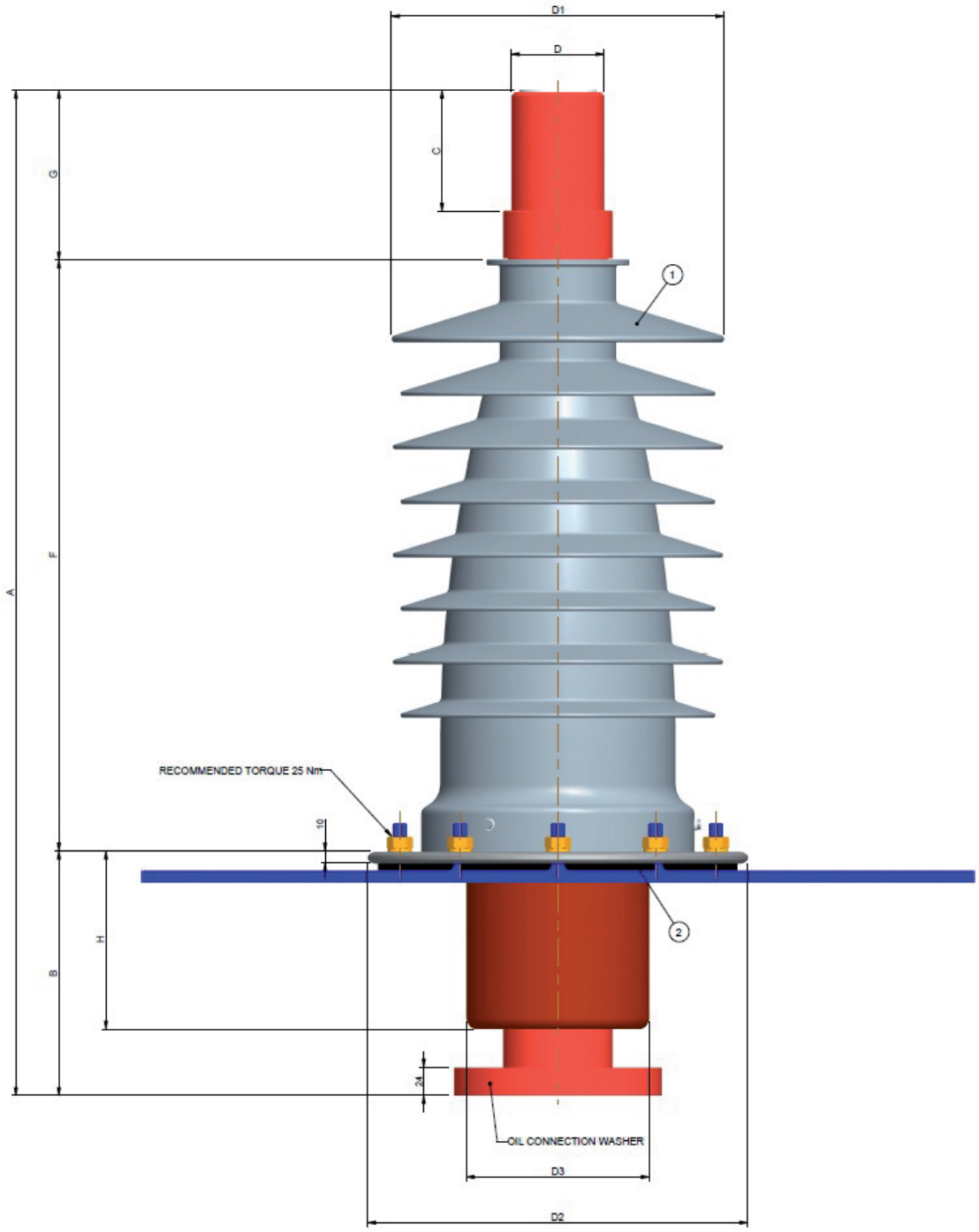
Picture no. 2 - Fem 3D electrical field


HÜBERS

Overall dimensions IEC



Type	A	B	C	D	D1	D2	D3	F	G	H	Number of sheds	Weight
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm		Kg
24-36kV/1250A	820	235	65	M30x2	Ø225	Ø225	Ø92	470	115	110	9	21.7
24-36kV/2000A	865	260	85	M42x3	Ø260	Ø240	Ø110	470	135	110	9	25,4
24-36kV/3150A	865	260	85	M48x3	Ø260	Ø240	Ø110	470	135	110	9	26,2
52kV/1250A	933	300	65	M30x2	Ø250	Ø240	Ø120	498	135	150	9	30
52kV/2000A			85	M42x3								33
52kV/3150A			85	M48x3								35
72.5kV/1250A	1163	345	65	M30x2	Ø300	Ø290	Ø130	683	135	195	12	43.5
72.5kV/2000A			85	M42x3								46.5



Type	A	B	C	D	D1	D2	D3	F	G	H	Number of sheds	Weight
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm		Kg
24-36kV/5000-6300A	846	206	102 (1)	Ø78	Ø280	Ø320	Ø154	498	142	150	8	60

(1) air side (oil side there is a washer)

Technical data IEC

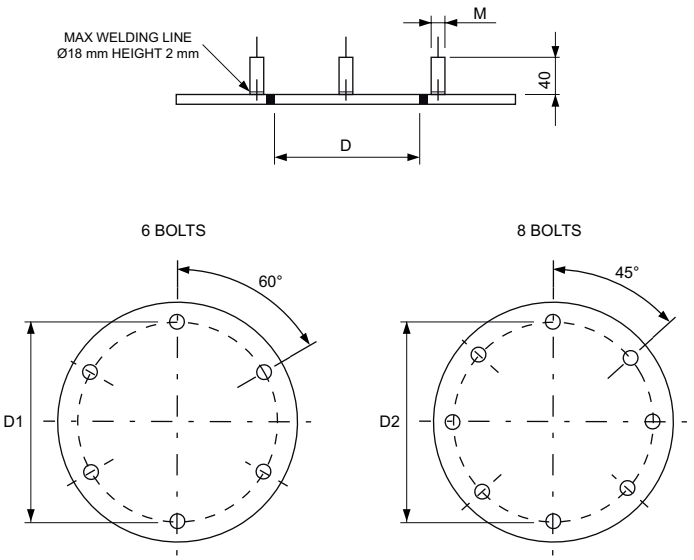
Identification	Technical characteristics									
According to the standard	**Rated voltage**	**Rated current**	**Lighting impulse**	**Dry power frequency**	**Partial discharges 1.5Um/√3**	**Creepage distance**	**Arcing distance**	**Lee protected line min.**	**Pollution level**	
	kV	A	kV	kV	pC	mm	mm	mm		
IEC 60137	24	1250	125	55	10	1360	515	435	P4	
	36	1250	170	77	10	1360	515	435	P4	
	24	2000	125	55	10	1565	515	637	P4	
		3150								
	36	2000	170	77	10	1565	515	637	P4	
		3150								
	24	5000	125	55	10	1300	490	503	P4	
		6300								
	36	5000	170	77	40	1300	490	503	P4	
		6300								
	52	1250	250	105	40	1630	563	662	P4	
		2000								
		3150								
	72.5	1250	325	140	90 [1]	2250	775	807	P4	
		2000								

* For -60°C we can deliver a special gasket upon request

[1] Lower P.D. values are available upon request

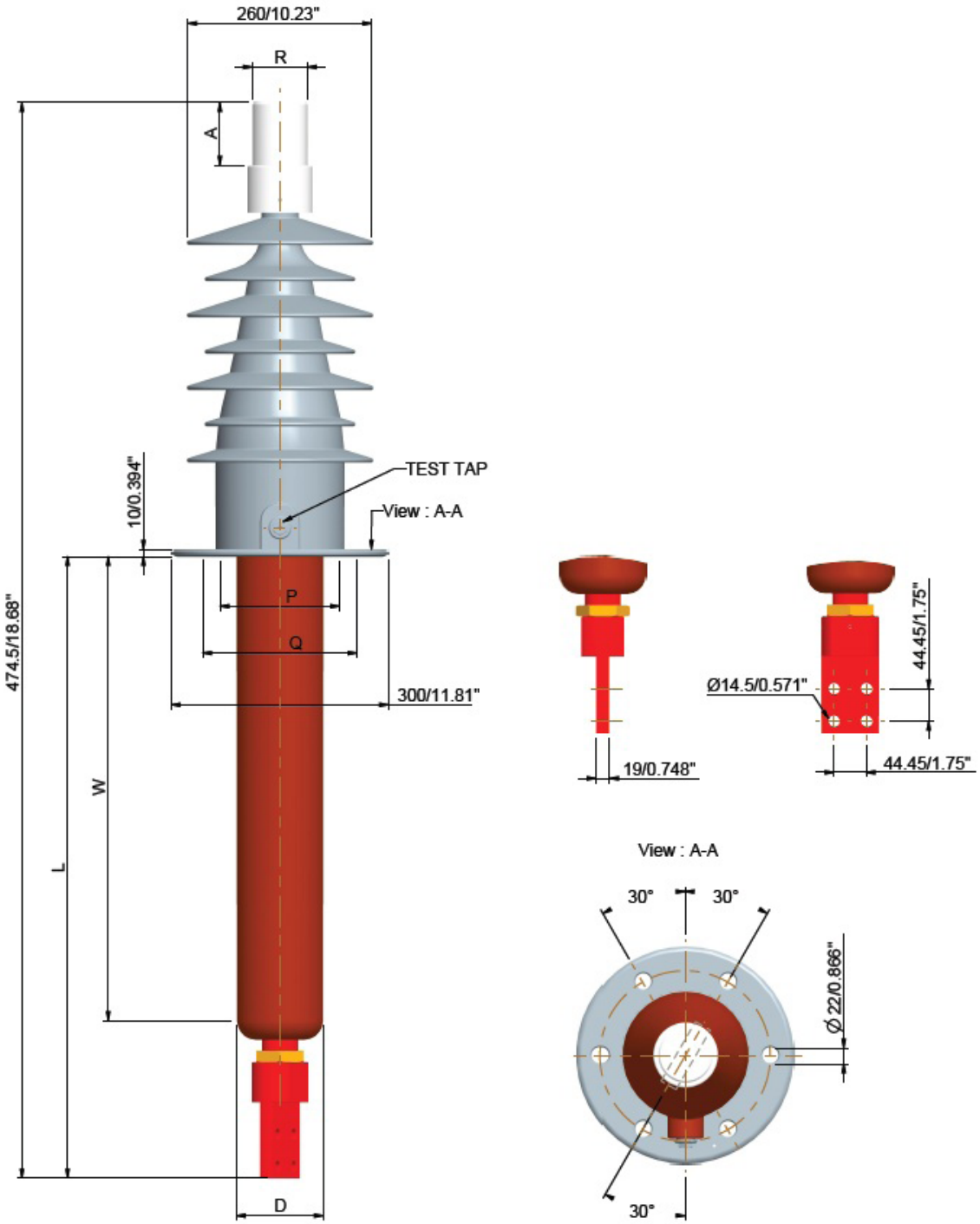
Packing	
Type	**Dimension mm**
24-36kV / 1250A	930x315x335
24-36kV / 2000-3150A	930x315x335
24-36kV / 5000-6300A	930x390x390
52-60kV / 1250-3150A	1190x365x400
72.5kV / 1250-2000A	

	Capacitance	Tanδ@20kV	Operating load	Temperature range
	pF		N	°C
	65±5	0.0065	625	-60°C/+120°C *
	65±5		1000	
	70±5	0,0065	1000	
			1575	
	70±5	0,0065	1000	
			1575	
	65±5	0,0065	1575	
	65±5	0,0065	1575	
	70±5	0.004	625	
			1000	
			1575	
	100±5	0.004	625	
			1000	



Type	D tank hole mm	D1 mm	D2 mm	D3 mm	M	No. Of bolts
24-36kV / 1250A	Ø102	Ø180-Ø185	-	-	M12	6
24-36kV / 2000-3150A	Ø115	Ø200-Ø205	-	-	M12	6
24-36kV / 5000-6300A	Ø180	-	-	Ø280	M12	10
52-60kV / 1250-3150A	Ø130	Ø200-Ø205	-	-	M12	6
72.5kV / 1250-2000A	Ø140	-	Ø250	-	M14	8

Overall dimensions IEEE



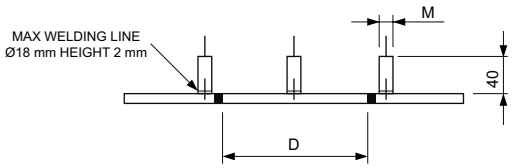
Type	A	L	R	P	Q	W	D	Number of sheds	Weight
	mm/in	mm/in		mm/in	mm/in	mm/in	mm/in		Kg/lb
25-34.5kV/2000A	86.5/3.406"	857/33.74"	2"-12UN-2A	159/6.25"	213/8.39"	620/24.4"	120/4.725"	7	46/101.4
25-34.5kV/3000A	86.5/3.406"	857/33.74"	3"-12UN-2A	159/6.25"	213/8.39"	620/24.4"	120/4.725"	7	65/143.3

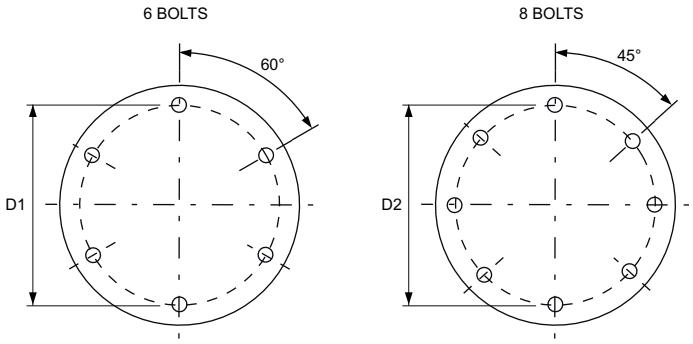
Technical data IEEE

Identification	Technical characteristics										
According to the standard	Rated voltage	Rated current	Line-to-ground voltage	Lighting impulse	Dry power frequency	Partial discharges 1.5Um/√3	Creepage distance	Arcing distance	Operating load	Temp. range	Tanδ @20kV
	kV	A		kV	kV	pC	mm/inc	mm/inc	N/lbf	°C	
IEEE C57.19.01-2000 IEEE C57.19.00-2004	25	2000	16	150	75	25	1220/48.03"	450/17.7"	890/200	-60°C/ 120°C *	0.004
		3000							1300/300		
	34.5	2000	22	200	100	25	1220/48.03"	450/17.7"	890/200		0.004
		3150							1300/300		

* For -60°C we can deliver a special gasket upon request

Identification	Capacitance and power factor				
According to the standard	Rated voltage	Rated current	Capacity C1	Capacity C2	Capacity C3
	kV	A	pF	pF	pF
IEEE C57.19.01-2000 IEEE C57.19.00-2004	25	2000	251 ±5	83 ±5	19 ±5
		3000	251 ±5	83 ±5	19 ±5
	34.5	2000	251 ±5	83 ±5	19 ±5
		3150	251 ±5	83 ±5	19 ±5





Type	D4 tank hole mm/inc	D5 mm/inc	O	No. Of bolts
25-34.5kV/2000A	Ø130/5.118"	Ø235/9.252"	M20	6
25-34.5kV/3000A	Ø130/5.118"	Ø235/9.252"	M20	6

Packing	
Type	Dimension mm
25-34.5kV/2000-3000A	1560x380x380

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