



ABB Composites

# ABB Composite Insulators

## Design for reliable performance

# ABB in Piteå

ABB Composites in Sweden develops and manufactures Power Composites - high performance insulating components made of fiber composite materials for power and high voltage applications. Our mission is to produce world-class, cost-efficient products for customers all over the world. ABB has a long history of working with composite materials dating back to 1918.

ABB Composites is located in Piteå in the northern part of Sweden. Our company was founded by pioneers in the Swedish polymer industry, and production of electrical insulating material started in 1918. The present location was established in 1967 and today there are approximately 160 employees. Our core competence resides in our knowledge of the electrical, mechanical, and physical properties of composite materials and in our ability to engineer unique insulation solutions for our customers. Our main product areas are Technical Laminates, Machined Composite Components, Filament Wound Products, Breaker Components and Composite Insulators.





# Design for reliable performance

As a part of ABB, we know the requirements of high voltage applications and the essence of being a reliable business partner with the highest quality standards. We are currently providing hollow composite insulators in the voltage range from 72 kV – 1100 kV AC / 800 kV DC and in lengths up to 11 m. All composite insulators are tested and certified according to IEC 61462.

ABB hollow composite insulators are made of glass fiber-reinforced epoxy resin tubes with silicone rubber sheds and aluminum end fittings.

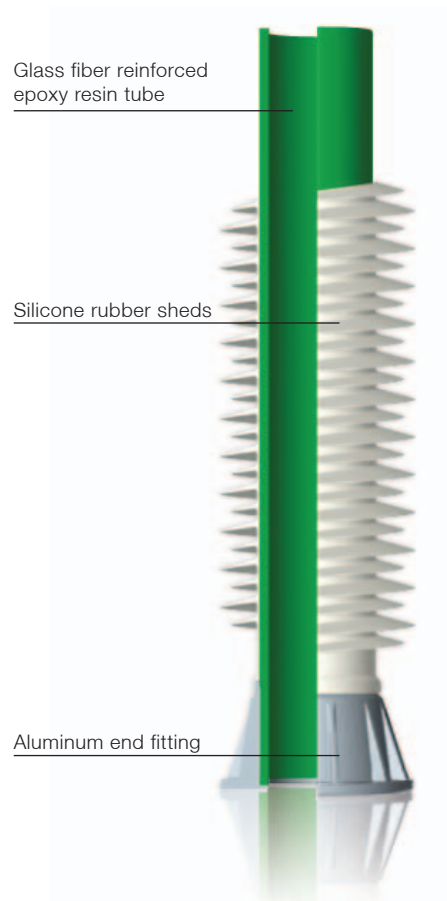
The design is adapted for high voltage applications in outdoor service. Our design, material properties and manufacturing processes ensure a lifetime of 30 years or more. Each composite insulator design is tailor-made to the customer's requirements. We currently offer a wide product range with more than 100 different composite insulators in production.

Technical support and after-sales service are always available to all our customers.

By choosing ABB composite insulators, excellent performance and reliability can be assured for the lifetime of the equipment.

## In-house production of glass fiber tubes

The insulator tubes are made of electrical-grade glass fiber reinforced epoxy resin using a wet filament winding technique. Continuous fibers are drawn through a bath of epoxy resin and then wound at a controlled pre-stress onto the mandrel. The fibers are oriented so that they will carry only tensile stress in the finished product, i.e. the design requirements determine how the fibers are wound. By alternating the structure of the layers, the tube can be tailor-made according to customer requirements.



In-house production of glass fiber reinforced epoxy tubes



The pattern in which the fibers are laid and the pre-stress on the fibers are computer controlled. The fibers can be laid at any angle from 10° to 90° to the longitudinal axis. An inner layer of polyester liner is normally used. This is a requirement for insulators used for gas-insulated circuit breaker applications to withstand decomposition products of the insulation gas SF<sub>6</sub>.

Precise and defined winding of the fiber onto the mandrel ensures uniform laminates of the highest quality. The tubes are cured on continuously rotating mandrels at high temperatures. After curing, the tubes are removed from the mandrels and machined to the required dimensions. The whole process ensures high-grade insulator tubes with low manufacturing tolerances and superb mechanical and dielectrical properties.

The composite insulators are designed according to the mechanical requirements of our customers to manage both bending forces and the inner pressure to which the insulator is subjected during its service lifetime. The composite insulator design is optimized by altering the following parameters:

- Fiber angles of the composite tube
- Wall thickness of the composite tube
- Overall dimensions (inner diameter, shape)
- Flange design

### High-strength flange design

The fiberglass tubes are fitted into high-strength aluminum alloy casted flanges using a special process which results in a combined shrink fit and adhesive bond. The result is an extremely strong, gas-tight and leak-proof joint.

### Silicone rubber sheds for best performance

The fiberglass tubes are finally coated with specially formulated high-temperature vulcanized (HTV) silicone rubber weather sheds using a void-free helical extrusion process. ABB has developed a unique patented method of extruding the sheds with a helical pattern. This method ensures the best possible interface between the silicone and the tube. The silicone rubber sheds are chemically bonded to the tube, thus allowing no moisture or contamination to enter. The result is a seamless silicone coating with no molding lines.

The flexibility of this method also ensures that any customer dimension (diameter, length or shape) can be met with even the highest creepage distance requirements. The cost of tooling is low compared to other methods, which makes our process highly suitable for optimizing the design to our customers' needs in a cost-efficient way. Even the longest insulators can be manufactured in one step.

We use only high-quality HTV silicone rubber from the best available suppliers. HTV silicone rubber ensures the highest possible durability of the sheds, as well as outstanding tracking and erosion resistance. Using only hard-wearing HTV silicone rubber ensures superior performance in sandstorm areas and minimization of damages during transportation and handling. The material has also a stable behavior under extreme climate conditions (-50°C to +105°C as standard).

Major development work has been done for our optimized shed profiles. We mainly offer shed profiles using alternating long and short sheds, which have the benefit of being self-cleaning. The bottom surface as well as the top surface of the sheds is tilted at an angle. This ensures optimal creepage distance and protected areas, resulting in the lowest possible leakage currents, even in severe environments. The tip of each shed is well-rounded to minimize the electrical field and the risk of flashover.



# Advantage of technology

ABB composite insulators with silicone rubber insulation possess unique properties. Silicone rubber is the fastest-growing, most dominant polymeric insulation material for high voltage products.

Composite insulators were first introduced more than 30 years ago, and the use of hollow composite insulators on high voltage apparatuses is now well-accepted. Composite insulators have proven themselves in the field of service experience and can directly replace porcelain insulators used for high voltage applications. They offer significant benefits compared to porcelain insulators. Increased safety, light weight, superior pollution and insulation performance are some of the reasons for customers shifting to composite insulators. The advantages are well-known and accepted. The following benefits are taken under consideration when OEMs and utilities worldwide choose composite insulators for their high voltage applications.

## Explosion proof for maximum safety

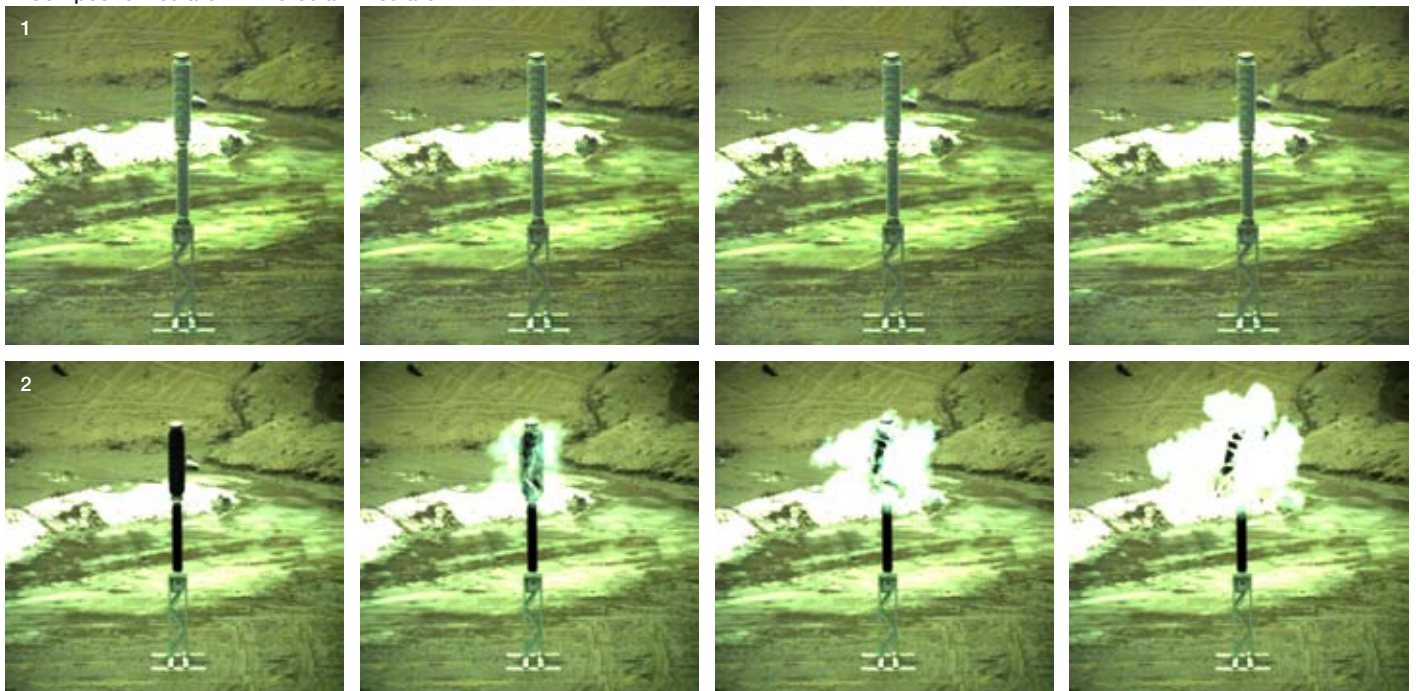
In the event of an internal fault/inner over pressure or external influence/vandalism, a porcelain insulator will show a violent failure (explosion) with dangerous fragments flying around at high speed.

The failure mode of a composite insulator is delamination/puncture without the launch of destructive fragments. There is no damage to surrounding equipment and no danger for persons in the vicinity. This ensures maximum safety for both personnel and substation equipment.

Shattering tests have been performed studying the effects of the impact of a bullet fired on a gas filled live tank circuit breaker (LTB). With composite insulators there is minimum damage to the breaker, only a small leakage but no explosion. There is no scattering of pieces and no damage to surrounding equipment. The same test on a live tank breaker with porcelain insulator results in a fatal explosion with destructive fragments.

Shatter test of live tank circuit breaker (high speed camera, 16 ms sequence)

1. Composite insulator 2. Porcelain insulator





**Composite insulator after live tank circuit breaker shatter test**

Composite insulators offer outstanding safety in events such as:

- internal fault/ inner over pressure in the equipment
- external influence e.g. during transportation, installation and maintenance
- environmental influence e.g. earthquake, landslide, tornadoes
- vandalism e.g. throwing of rocks, shooting

**Non-brittle material with reduced risk of handling damages**

As composite insulators are non-brittle with shock resistance, the risk of damage to the equipment during transport, installation and service is reduced. If, however, a minor shed damage occurs, it can be easily repaired in the field. This is not the case for porcelain insulators.

**Leakage current control due to hydrophobicity**

Composite insulators with silicone rubber sheds have the added benefit of being hydrophobic, a Greek term meaning „fears water.“ This characteristic helps break up water films and creates separate droplets, which reduces leakage current along the insulator surface, prevents flashover and elevates the voltage withstand capability during wet and highly-contaminated conditions. The low leakage current also minimizes discharge activity on the surface and erosion. In effect, the hydrophobicity acts as a self-cleaning property which extends service life and lowers substation maintenance costs.

The mechanism behind the hydrophobicity of silicone rubber is the diffusion of low molecular weight, LMW, silicones from the bulk of the material to the surface. The LMW silicone forms a layer on the surface that is hydrophobic (non-wetting).

This layer is extremely thin, only a few molecular layers, and is distributed all over the surface, thus forming the hydrophobic layer. The LMW silicones in the silicone rubber diffuse to the surface over the entire life of the insulator; however, the loss

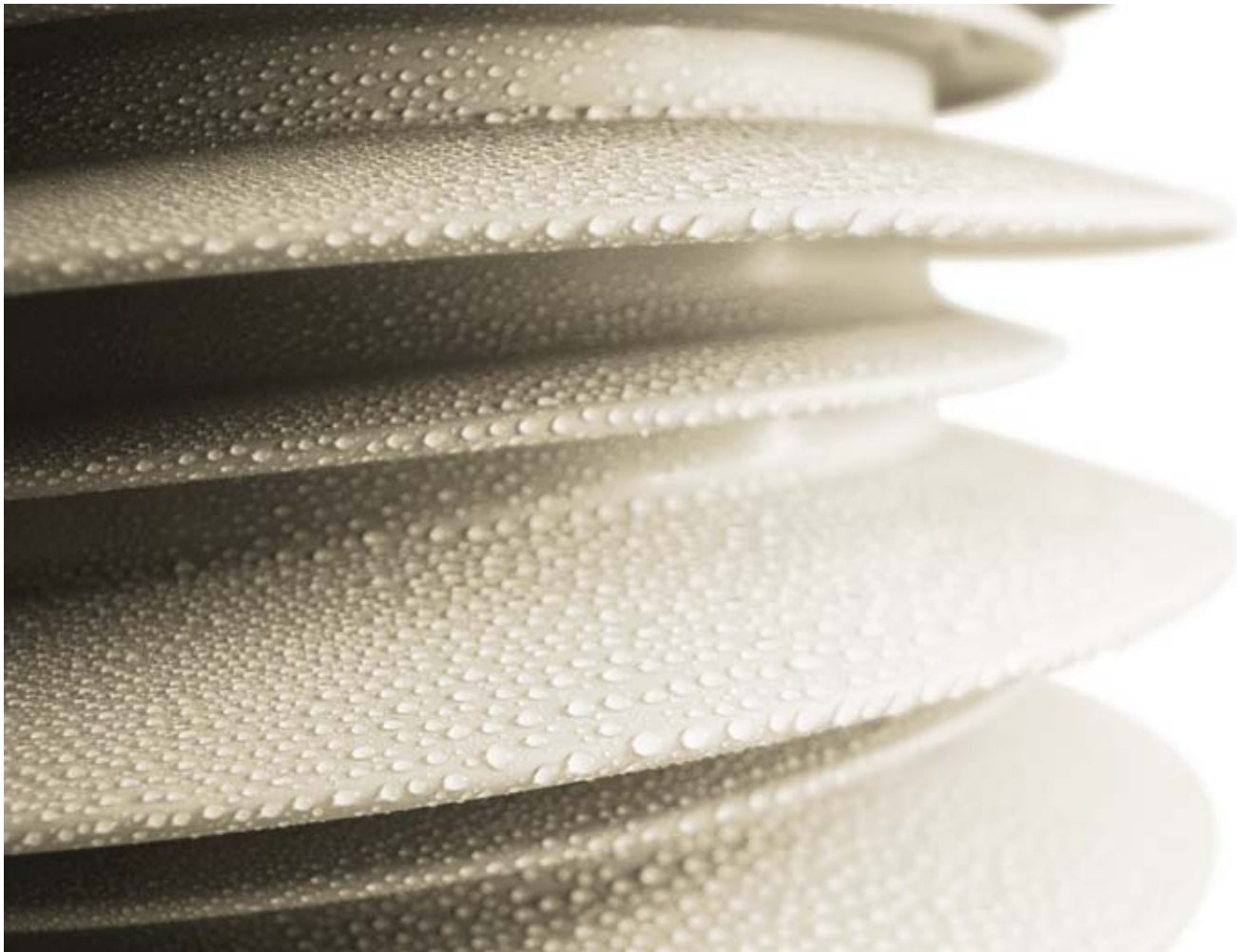


**Piece of porcelain insulator after live tank circuit breaker shatter test**

of material over the lifetime is negligible and does not impair the other insulator properties. Another ability of silicone is its ability to encapsulate contaminated particles.

Under heavy and prolonged pollution, the hydrophobic characteristic may be reduced temporarily, but it recovers quickly as soon as the conditions are normalized. Testing carried out shows loss of hydrophobicity during the extreme conditions of a 1,000 h salt fog test to the order of 200-500 h. The insulators recover within a few days if allowed to dry, faster if exposed to UV light and high temperatures.

Provided they are new, polymeric materials other than silicone rubber may also exhibit hydrophobic properties. However, these materials normally lose their hydrophobicity after a relatively short time in service.



### Excellent insulation to reduce creepage requirement

Composite insulators have excellent insulation properties and outstanding contamination performance due to the HTV silicone rubber. Published field studies show that it is possible to reduce the required creepage distance by at least one pollution level when composite insulators are chosen over porcelain.

### Flashover resistance

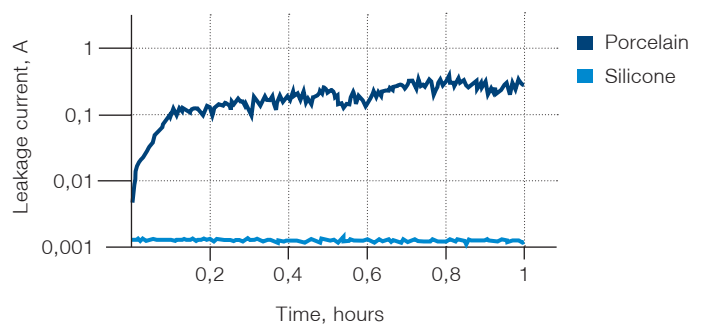
The efficient suppression of leakage currents means that the risk of flashover is reduced compared to porcelain insulators.

### Erosion resistance

It is inevitable that even silicone rubber will show some discharge activity in the event of severe pollution, though it is less than for non-hydrophobic materials such as porcelain. With proper material formulation and a suitable insulator design, such discharge activity can be minimized. The silicone rubber used for ABB composite insulators is further protected by aluminum trihydrate, ATH, which has proven arc and fire resistance capabilities.

The aging resistance of ABB composite insulators has been verified by accelerated aging tests, like the 1,000 h salt fog test and the 5,000 h cyclic test and at test stations in various climates around the world.

Leakage current over time at salt fog test



### Outstanding seismic performance provides safety and reliability

The low weight and the shock-proof design of composite insulators compared to porcelain offer advantages in terms of earthquake resistance capability. No shock absorbers or special designs are required in seismic areas.



### Low weight for cost savings

Composite insulators are much lighter and provide higher performance than porcelain insulators. This leads to a drastic reduction in the use of the other materials that make up HV electrical substations, such as foundation materials and the bearing structures. The installation phase is also easier due to the reduced need for heavy installation equipment.

### Maintenance-free and outstanding pollution performance

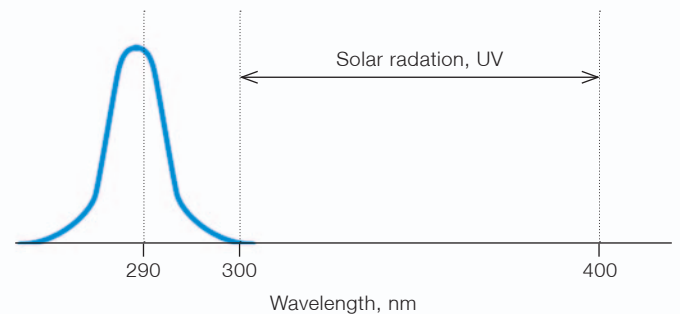
HTV silicone rubber has the ability to transfer its water-repellent properties into pollution layers which cover the surface. This eliminates the need for maintenance or cleaning of the

high voltage apparatuses in polluted environments. Expensive solutions normally used for porcelain, such as cleaning, greasing or coating, can be avoided.

### UV stability

HTV silicone rubber is UV and ozone resistant. Natural UV radiation from the sun has wavelengths of over 300 nanometers. Shorter and more energetic wavelengths are filtered out in the atmosphere. Silicone has its maximum absorption below this wavelength, which ensures superior stability against UV radiation.

Absorption max of SiO<sub>2</sub> bond



### Additional advantages

Other advantages of composite insulators are short and reliable delivery time, best possible strength-to-weight ratio, the possibility of reducing gas volume on SF<sub>6</sub> breaker bushing with conical insulators compared to cylindrical designs, proven aging resistance and high inherent fire resistance.

# Evaluating a great concept



ABB composite insulators are thoroughly tested to international standards and higher. They are installed all over the world and have been proven excellent performance under all climates and harsh conditions such as coastal, desert and industrial environments.

## Service experience

Since 1985, when the first ABB high voltage equipment with silicone rubber sheds were installed, ABB has delivered a large number of high-voltage apparatuses equipped with composite insulators. They have been installed in a wide range of environments, from marine to desert and/or areas with industrial pollution.

The performance of ABB insulators and products in installations with extreme environmental conditions has been studied in detail, and the results have been published in a number of well-known conferences and journals. The observations show excellent performance with insignificant changes in material properties.

The silicone material has proven its outstanding performance at test stations in severe climates and commercial installations all over the world.

Between 1985 and 2009, ABB has delivered a large number of HV apparatuses with hollow composite insulators:

- 7,500 dead tank circuit breakers
- 3,500 live tank circuit breakers
- 5,500 outdoor instrument transformers
- 10,000 transformer bushings
- 3,500 cable terminations
- 2,500 surge arresters

In total have over 60,000 ABB hollow composite insulators been supplied to customers worldwide. The volume is increasing year by year.

### Extensive testing

ABB composite insulators with silicone rubber sheds have been subject to extensive testing to ensure a high quality level and to verify their mechanical and electrical properties under all environmental conditions. Aging withstand, electrical and mechanical erosion resistance and UV stability have been fully verified. Natural pollution tests are continually performed at test stations in both marine and desert climates.

Testing is also performed at low ambient temperatures, down to -60°C. The composite insulators comply fully with the requirements specified by IEC. The insulators have been subject to vandalism tests in which objects have been thrown at the insulators.

A circuit breaker with composite insulators has even been subjected to gunfire to show that this kind of damage does not cause complete breakdown or explosion that may injure personnel or damage surrounding equipment.

### Examples of performed tests:

- High and low temperature
- Dielectric
- UV radiation
- Accelerated aging
- Mechanical strength
- Over-pressure
- Seismic
- Shatter

### Field test

Test installations have been made to gain information on long-term behavior with respect to optimal creepage distance of HV apparatuses in different environments. A number of surge arresters, bushings and circuit breakers with composite insulators using silicone rubber as external insulation have been installed at different sites. These have been subjected to heavy or very heavy pollution levels for a test period up to seven years. The test stations were chosen to represent all possible climates, including coastal, subtropical and desert areas.

The results, presented in a CIGRE report, verify the improved hydrophobicity and low leakage current properties of composite insulators.

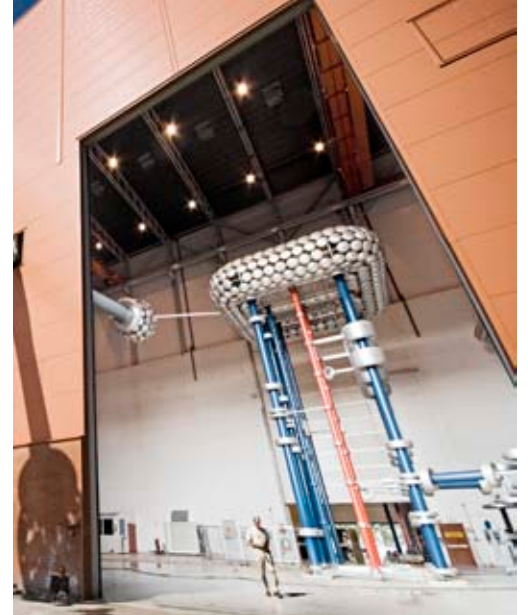
800 kV DC transformer





With regard to pollution performance, the short-term and long-term hydrophobicity characteristics of silicone rubber apparatus insulators are better than those of porcelain insulators. The number of high pulses in the leakage current, giving risk of a flashover, is much lower for silicone rubber insulators than for porcelain insulators. A large margin exists in the specific creepage distance of composite apparatus insulators in comparison to porcelain insulators.

Long-term field tests of ABB composite insulators have also been performed at very high voltage stress, 800 kV DC, together with ABB High Voltage Direct Current (HVDC) unit. The field tests and our extensive deliveries for 800 kV DC applications (wall bushings, transformer bushings, circuit breakers, instrument transformers, voltage dividers, support insulators) is a verification of the insulators' excellent insulation properties and the durability of the design.



800 kV DC test station

**Design, type and routine tests**

ABB composite insulators are design, type and routine tested in accordance with IEC 61462 and to other regional standards.

ABB has invested in sophisticated equipment for routine testing, and our routine testing goes beyond the IEC requirements. The routine testing includes cantilever bending tests, pressure tests and quantitative gas tightness measurements.

This ensures the highest quality level and long-term performance of the insulator. In addition, ABB has a fully-equipped laboratory for material analysis. Electrical, mechanical and physical properties are measured and documented on a routine basis to secure all important material properties.

**Design and type test according to IEC 61462**

Design test 7.0						Type tests 8.0		
Tests of interface and connections of end fittings 7.2				Tests of housing material 7.3		Tests for the tube material 7.4	Internal pressure test 8.4.1	Cantilever bending test 8.4.2
Reference dry power frequency flashover test 7.2.2	Thermal mechanical pre-stress test 7.2.3	Water immersion pre-stress test 7.2.4	Verification tests 7.2.5 – Visual verification 7.2.5.1 – Steep-front impulse high voltage test 7.2.5.2 – Dry power frequency voltage test 7.2.5.3 – Internal pressure test 7.2.5.4	Tracking and erosion test 7.3.1	Flammability test 7.3.2	Water diffusion test 7.4.2/7.4.3		

# Applications

Examples of applications in which ABB composite insulators are used:

- 1. Wall bushings
- 2. Compact transmission line post insulators
- 3. Cable terminations
- 4. Live tank circuit breakers
- 5. Transformer bushings



6. HVDC support insulators and voltage dividers 7. Outdoor instrument transformers  
8. Surge arresters 9. Dead tank circuit breakers



7

8

9



# Design guide

ABB Composites has a wide range of insulators in our portfolio and together with our flexible production method, we can deliver composite insulators that will meet and exceed your requirements.

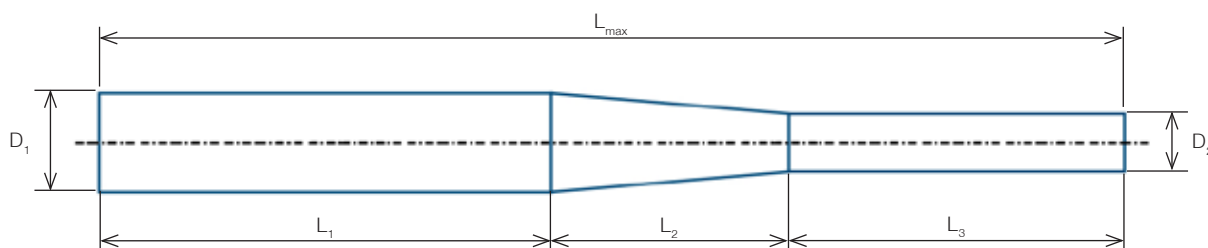
This design guide makes it is easy to choose a composite insulator that meets your requirements. If none of our standard designs match your needs, other designs can be easily developed on request.

## The easiest way to design an insulator is to decide the following:

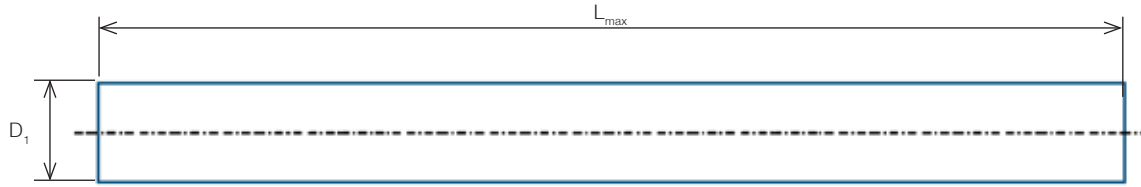
- 1: Specify inner diameter and length of the tube from the diameter set table
- 2: Choose a shed design and creepage factor
- 3: Choose flanges from the installation preferences

## Glass fiber tube dimensions

ABB Composites can offer composite insulators with cylindrical, conical, and combinations of cylindrical and conical sections. Lengths up to 11 m can be manufactured in a single tube. All of our tubes are customized (wall thickness and winding angles) to meet customers' mechanical requirements (pressure and bending).



Inner diameter 1 $D_1$ [mm]	Inner diameter 2 $D_2$ [mm]	Length 1 $L_1$ [mm]	Length 2 $L_2$ [mm]	Length 3 $L_3$ [mm]	Maximum length $L_{max}$ [mm]
200	100	300	898	100	1 298
200	100	300	1 495	150	1 945
250	219	680	855	470	2 005
270	130	265	1 100	500	1 865
270	200	1 645	1 410	1 545	4 600
296	219	770	1 595	700	3 065
326	219	780	1 965	700	3 445
330	210	150	720	190	1 060
330	210	150	1 310	680	2 140
394	286	990	2 300	990	4 280
450	210	1 500	710	1 920	4 130
486	385	1 840	1 600	2100	5 550
486	124	1 420	2 940	310	4 670
500	311	1 400	1 800	1 150	4 350
550	400	2 800	625	3 295	6 720
740	580	3 800	1 000	5 900	10 700

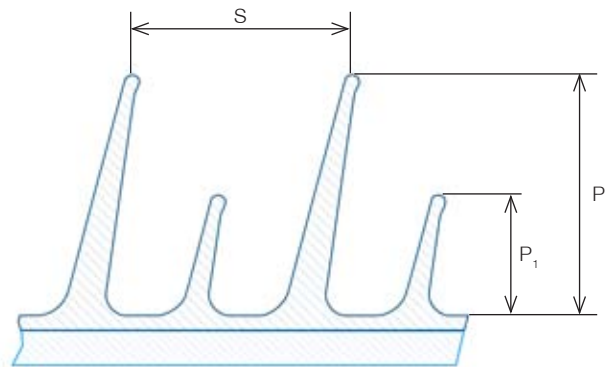


Inner diameter $D_1$ [mm]	130	150	180	210	214	260	311	335	375	406	420	450	470	486	575
Maximum length $L_{max}$ [mm]	3 200	3 200	4 570	4 570	3 300	5 150	5 200	4 570	4 570	3 600	4 600	4 570	4 570	9 500	4 570

### Shed profile

The required creepage distance for your apparatus will determine which shed form is suitable for your design and that will meet your requirements. ABB Composites has a wide range of standard shed profiles, see table below. Other shed profiles can be arranged quickly and cost-efficiently on request. Extreme creepage requirements ( $> 50$  mm/kV) can also be arranged.

S [mm]	P [mm]	$P_1$ [mm]	$C_f$ Creepage factor
55	27	27	2.65
55	55	25	3.55
55	60	30	3.87
55	60	40	4.21
70	75	55	4.25
60	70	50	4.49
55	65	48	4.61



To make an estimation of the creepage distance from the shed profiles creepage factor, the following equation may be used:

$$C_d = C_f \times (a_d - 300) + 300$$

where:

$C_d$  = Creepage distance\*

$a_d$  = Arcing distance\*\*

$C_f$  = Creepage factor

Explanatory text from IEC 61462

\*Creepage distance

Shortest distance or the sum of the shortest distances along the surface on an insulator between two conductive parts which normally have the operating voltage between them

\*\*Arcing distance

Shortest distance in the air external to the insulator between the metallic parts which normally have the operating voltage between them

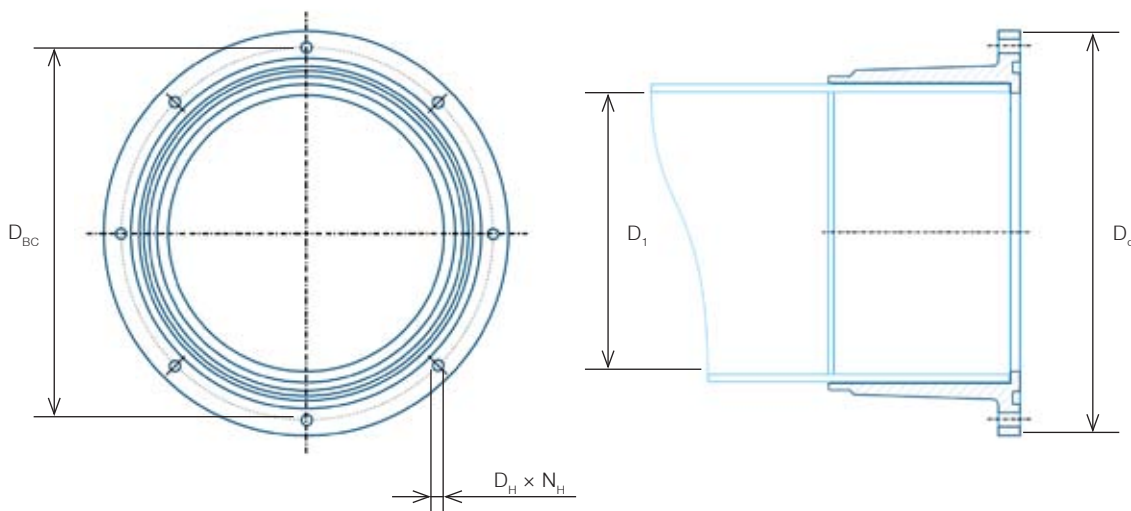
## Flanges

The flange design is critical for the fit of the insulator to the apparatus to which it will be attached. We offer a wide range of standard flange designs. If none of these flanges meet your requirements, other designs are possible.

Tube	Flange			
Tube inner diameter	Number of holes	Bolt circle diameter	Hole diameter	Outer diameter
D <sub>1</sub> [mm]	N <sub>H</sub> [pcs]	D <sub>BC</sub> [mm]	D <sub>H</sub> [mm]	D <sub>O</sub> [mm]
100	6	213	M12	254
124	8	232	M12	260
130	4	286	15	□ 255
130	4	260	15	□ 230
130	4	171.5	M8	185
130	4	225	18	270
130	4	286	15	□ 255
130	8	232	M12	260
150	6	290	14	325
150	8	280	15	310
150	4	286	19	□ 255
150	8	330	18	365
150	4	318	18	366
150	4	318	18	364
150	6	326	14	356
180	6	326	16	362
180	6	326	16	362
180	6	326	14	356
180	8	330	18	365
180	8	275	18	310
180	8	275	18	310
180	8	280	15	310
180	8	325	18	365
180	8	330	18	365
180	13	275	12	315
200	8	215	M10	258
200	4	182.5	M8	250
200	8	361	15	393
210	6 / 6	362	14 / 18	400
210	4	350	14	380
210	8	326	M10	346
210	4	360	14	390
210	10	326	14	390
210	4	296	M8	312
210	4	286	15	□ 255
210	4	244	15	□ 255
210	6	360	14	390
210	6	326	M10	346
219	6	308	M10	333
250	12	457	15	490
260	8	330	M16	365
260	4	406	14	436
270	16	450	16	480

□ = non-circular flange, square

Tube	Flange			
Tube inner diameter	Number of holes	Bolt circle diameter	Hole diameter	Outer diameter
$D_1$ [mm]	$N_H$ [pcs]	$D_{BC}$ [mm]	$D_H$ [mm]	$D_o$ [mm]
270	12	390	M12	420
286	6	389	M10	455
296	12	502	15	532
311	6	456	14	486
311	16	395	M12	430
311	8	360	M12	390
311	16	520	22	600
311	8	360	M12	380
326	12	527	15	560
335	8	360	M12	390
335	8	360	M12	380
375	16	570	14	614
375	4	425	M10	543
385	16	700	18	580
394	24	605	15	635
400	12	530	14	565
420	20	480	M12	520
420	8	360	M12	466
420	30	509	8	560
450	15	558	M10	573
486	16	555	M12	740
486	30	605	14	640
500	8	600	18	640
500	12	675	18	715
550	16	680	18	720
580	24	710	18	745
740	32	890	26	940



## Material properties

Only the highest-quality materials from well-known suppliers are used in our products.

### Material specification, glass fiber tube

Composite tube, filament wound of glass roving impregnated with epoxy resin. The inner surface is coated with polyester non-woven. The table below show typical properties for a tube with 38° winding angle.

Properties	Unit	Typical value	Test method
Winding angle	Degree	38	
Density	g/cm <sup>3</sup>	2	ISO 1183
Glass content	% weight	75	ISO 1172
Interlaminar shear strength*, ILSS	MPa		EN 2377
RT		40	
110°C		28	
140°C		12	
Flexural strength	MPa	250	ISO 178
Flexural modulus	GPa	16	ISO 178
Compressive strength, axial	MPa	200	ISO 604
Dielectric strength, tangential, oil. 90°C	kV/mm	min 3.6	IEC 60243
Dielectric strength, axial oil. 90°C	kV/mm	min 3.6	IEC 60243
Partial discharge at 3.6 kV/mm	pC	<10	ABB 309-01
Tracking index**, CTI		>600	IEC 60112
Dielectric constant, RT		5.75	IEC 60250
Dissipation factor, RT		0.0047	IEC 60250
Volume resistivity	ohm		IEC 60093
3 000 V		2x1,014	
5 000 V		3x1,014	
Surface resistivity	ohm		IEC 60093
Outside 3 000 V		2x1,016	
Outside 5 000 V		2x1,016	
Surface resistivity	ohm		IEC 60093
Inside 3 000 V		8x1,016	
Inside 5 000 V		8x1,016	
Water absorption, RT	mg	7.5	ISO R 62
Glass transition temp.	°C	min 130	ISO 11357-2
Temperature index	°C	160	IEC 60216

\*/ Interlaminar shear strength-tangential

\*\*/ Criteria 50 % reduction of flexural strength after 20,000 h, plan laminate fiber directional

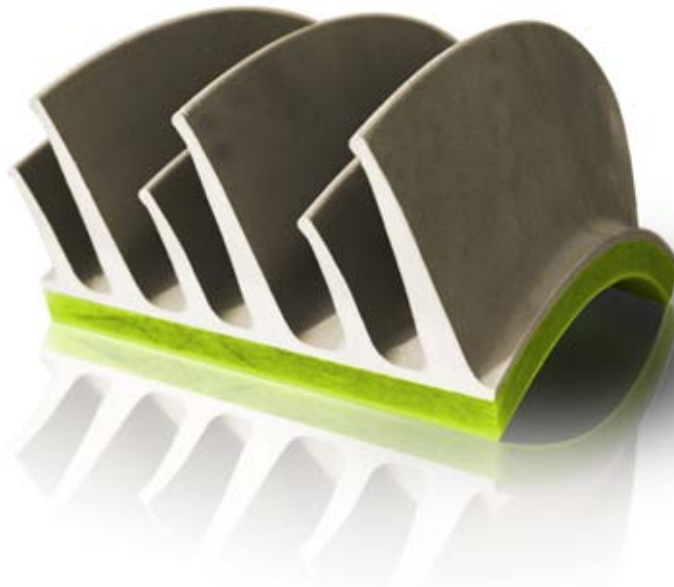
### Material specification, Silicone rubber

Platina curing, solid silicone rubber based on polydimethylsiloxane (PDMS) with aluminum trihydrate (ATH) filler.

Properties	Unit	Specific value	Test method
<b>Vulcanized rubber</b>			
Color		ANSI 70 5.0BG 7.0/0.4	
Tensile strength, RT	MPa	min. 3.0	ASTM D412
Elongation at break, tensile	%	min. 170	ASTM D412
Hardness	Shore A	65-75	ASTM D2204
Tear strength	kN/m	min. 15	ASTM D 624B
Dielectric strength, 1 mm sheet, RT_L	kV/mm	23	IEC 60243
Tracking resistance		1A4.5	IEC 60587
Dielectric constant 100 Hz, RT		3.67	IEC 60250
Dissipation factor 50 Hz, RT		0.017	IEC 60250
Volume resistivity	$\Omega\text{cm}$	$2.0 \times 10^{14}$	IEC 60093

### Material specification, Aluminum alloys

Material designation	Alloy description (DIN EN 1706)		Numeric short symbol (DIN 1725-2)	Material number (DIN 1725-2)	Tensile strength Rm (MPa)	Yield strength Rp 0.2 (MPa)	Elongation at break A5 %	Brinell hardness HBS
	Chemical symbol	Numeric						
GK-AISi7Mg	EN AC-AISi7Mg0.3	EN AC-42100-T6	G-AISi7Mg	3.2371	290	210	4	90
GK-AISi10Mg	EN AC-AISi10Mg(a)	EN AC-43000-T6	G-AISi10Mg	3.2581	260	220	1	90
	EN AC-AISi10Mg(b)	EN AC-4310-T6			260	220	1	90
	EN AC-AISi10Mg(Cu)	EN AC-43200-T6	G-AISi10Mg(Cu)	3.2383	240	200	1	90





# Customer request form

Please use this request form to specify your ABB composite insulator

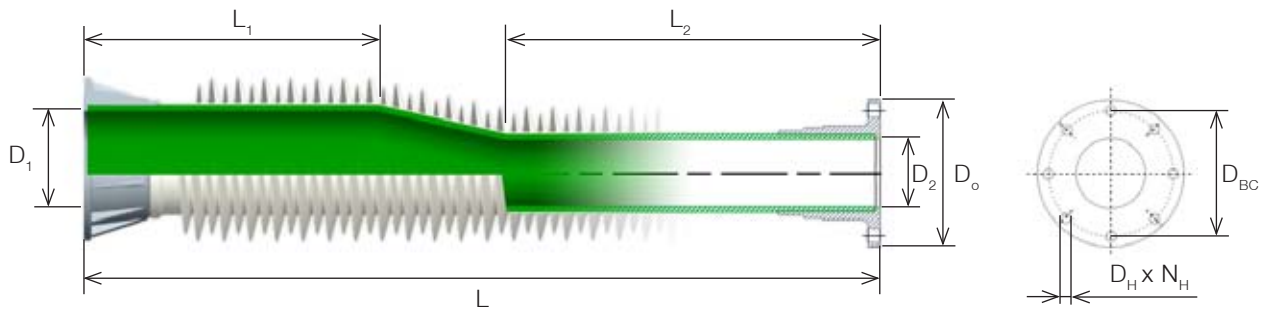
Company: \_\_\_\_\_  
 Contact person: \_\_\_\_\_ Phone no: \_\_\_\_\_  
 Type of apparatus: \_\_\_\_\_  
 Annual quantity: \_\_\_\_\_ Batch size: \_\_\_\_\_  
 Insulating medium: \_\_\_\_\_  
 Service temperature range: \_\_\_\_\_ to \_\_\_\_\_ °C

## Mechanical requirements acc. IEC 61462

Max. mechanical load, MML: \_\_\_\_\_ kN  
 Max. deflection at MML: \_\_\_\_\_ mm  
 Max. service pressure, MSP: \_\_\_\_\_ MPa

## Electrical requirements

Min. arcing distance: \_\_\_\_\_ mm  
 Min. creepage distance: \_\_\_\_\_ mm



## Dimensions

If it is possible, please give us dimension limits (max. and min.)

### Cylindrical

	Max.	Min.
Length of insulator, L:	_____ mm	_____ mm
Inner diameter, $D_1$ :	_____ mm	_____ mm

### Conical

	Max.	Min.
Length of insulator, L:	_____ mm	_____ mm
$L_1$ :	_____ mm	_____ mm
$L_2$ :	_____ mm	_____ mm
Inner diameter 1, $D_1$ :	_____ mm	_____ mm
Inner diameter 2, $D_2$ :	_____ mm	_____ mm

## Flange design

	Top flange	Bottom flange
Outer diameter, $D_0$ :	_____ mm	_____ mm
Hole dimension, $D_H$ :	_____ mm	_____ mm
Bolt circle diameter, $D_{BC}$ :	_____ mm	_____ mm
Number of holes, $N_H$ :	_____ pcs	_____ pcs

Additional information: \_\_\_\_\_  
 \_\_\_\_\_



# Contact us

## **ABB AB**

### **Composites**

Box 273

SE-941 26 Piteå

SWEDEN

Phone: +46 911 728 00

Fax: +46 911 728 84

E-Mail: [OrderComposites@se.abb.com](mailto:OrderComposites@se.abb.com)

[www.abb.com/composites](http://www.abb.com/composites)