

SIEMENS



3FL Silicone Long Rod Insulators for Distribution and Transmission Overhead Power Lines

Light weight – strong performance

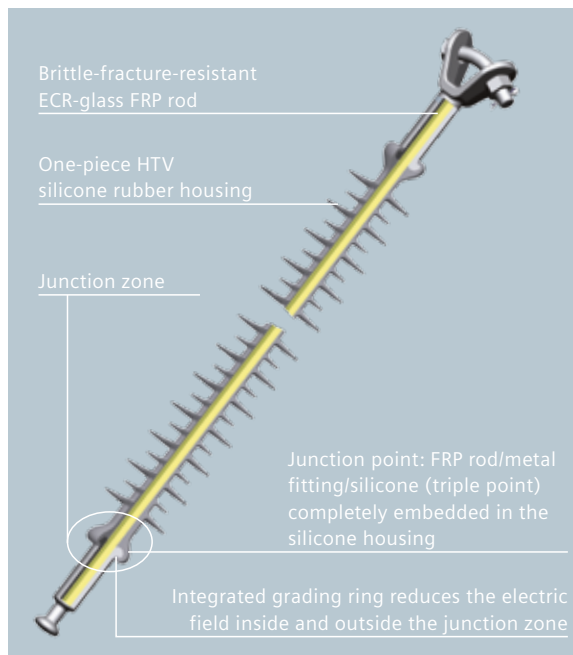
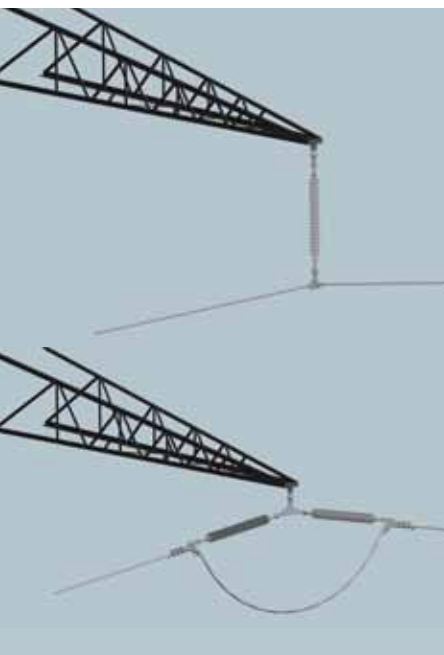
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Answers for energy.

3FL long rod insulators can be used either as suspension or tension insulators

3FL – a superior design to meet the highest requirements

HTV silicone rubber for best pollution performances



3FL silicone long rod insulators – performance meets durability

Good reasons to use 3FL

The new Siemens silicone long rod insulators type 3FL combine the highest levels of electrical insulation and mechanical tensile strength with a compact, lightweight design. Thanks to their superior design and minimized weight, 3FL long rod insulators are especially suited for overhead compact-line applications where low tower design and short line spans are required. They are also more economical to transport and install.

Design

The 3FL insulator housing is a one-piece HTV¹ silicone rubber housing made by the one-shot injection molding process. The HTV silicone is directly molded onto the core rod by overlapping the triple junction point and part of the metal end fittings. The design ensures a total enclosure of the most sensitive part of a silicone insulator – the junction zone (metal end fitting/FRP rod/silicone housing), where usually the highest electrical field strength is concentrated. This overlapping system eliminates any need of traditional sealing systems while preventing any moisture ingress attacks.

Core

The core rod is a boron-free, corrosion-resistant ECR² glass-fiber-reinforced plastic rod (FRP rod). Due to the extremely high hydrolysis and acid resistance of the FRP rod the risk of so-called brittle fracture is completely eliminated for 3FL insulators.

End fittings

The end fittings, made of hot-dip galvanized forged steel or ductile cast iron, are directly attached to the FRP core rod by a circumferential crimping process. Each crimping process is strongly monitored with a special control system. A complete range of end fittings according to the latest IEC and ANSI standards is available up to 210 kN of SML. The 3FL is 100% exchangeable and compatible with existing insulators and line hardware of all types.

The special design of the end fitting in the junction minimizes the electrical field strength and partial discharge inside the junction zone as well as on the silicone housing surface, by utilizing an integrated grading ring. This reliably prevents corrosion of the insulating material and eliminates the risk of subsequent failure of the insulator.

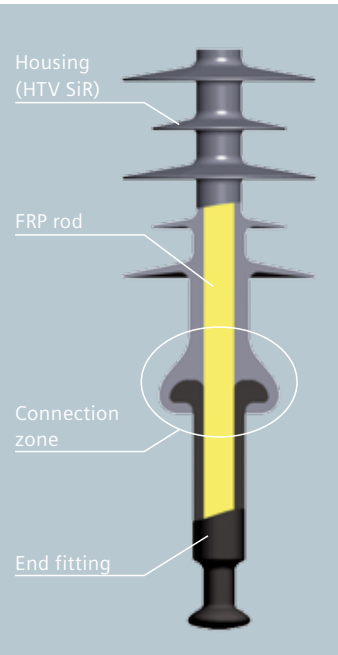
3FL – HTV silicone rubber housing for best pollution performances

The excellent pollution layer characteristics of the HTV silicone rubber ensure maximum reliability of the 3FL insulator, even under extreme service conditions. The high hydrophobic housing prevents the formation of conductive film on its surface. Even the most severe ambient conditions, such as salt fog in coastal regions or dust-laden air in industrial areas, cannot impair the intrinsic hydrophobicity of the HTV silicone rubber. Surface currents and discharges are ruled out. Neither water nor dirt on the housing surface can cause insulator flashovers – a significant factor for insulator performance.

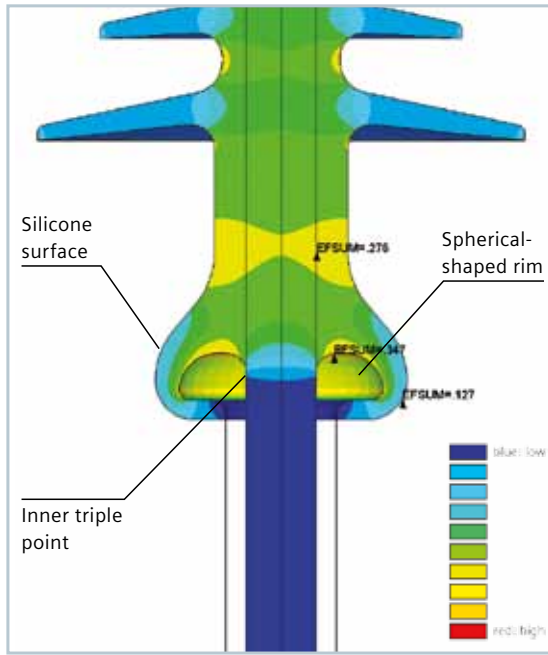
Quality from Siemens

According to long-established Siemens tradition and experience in high-voltage equipment for more than a century, each production step for the 3FL – beginning with numerous incoming raw material inspections through the assembly of the individual components to routine tests of the finished product – is rigorously monitored and well controlled.

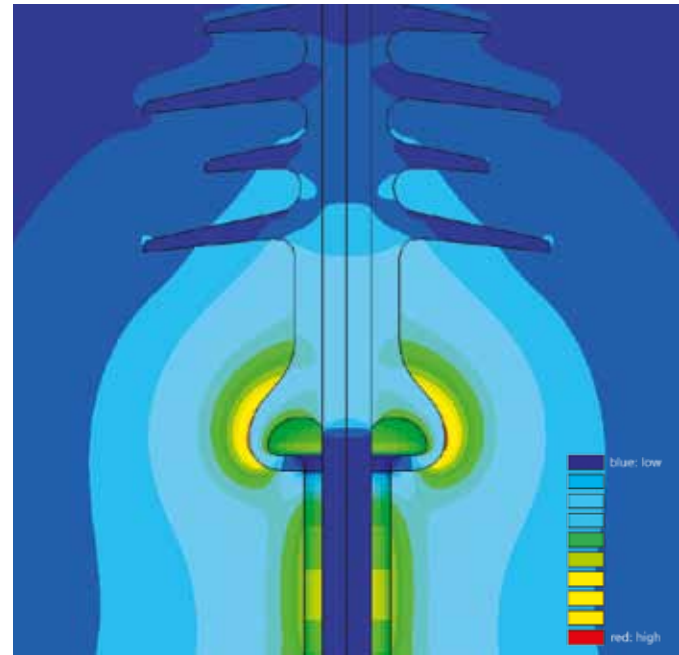
3FL cross-section



E-field distribution (%/mm) in silicone housing and in FRP core rod at 3FL insulator high-voltage end



E-field distribution (%/mm) at 3FL insulator high-voltage end



Maximized service life

No moisture ingress

The **one-piece** housing of the 3FL insulators, i.e. weathersheds and core rod sheath (coating) is one-piece, and has only one internal interface throughout the whole insulator, namely the boundary interface between the housing and the FRP core rod. This design eliminates all internal interfaces between weathersheds and the core rod coating. These kinds of longitudinal interfaces are normally very sensitive to tangential electrical field stress, which in worst case scenarios can easily lead to erosion damage of the polymer interfaces. In particular leading to erosion of the bonding between sheds and rod sheath, and thus damage to the insulator housing.

Furthermore, the junction point in the connection zone, where all three elements (FRP rod, metal end fitting, and silicone housing) meet each other, is absolutely water- and air-tight sealed during manufacturing by using an **overmolding** housing system. It totally encloses this junction point with the HTV silicone rubber of the housing itself. The highest bonding strength of the one-piece HTV silicone housing to the FRP core rod combined with the overmolding design system prevent moisture ingress at the connection zone of the insulator.

Minimized electrical field strength

After numerous electrical calculations regarding E-field distribution along the insulator, and the connection zone on the high-voltage side in particular, the design of the 3FL insulator was optimized for maximum reduction of electrical field stress, reduced corona effect, and minimized RIV value. Two design keys ensure improved life expectancy by reducing electrical field stress in the triple point and on the silicone surface:

- The spherical-shaped rim of the end fitting inside the housing homogenizes the E-field distribution on the high-voltage side of the 3FL insulator with an integrated grading ring up to 170 kV.
- The overmolded design system and the silicone housing shape at the connection zone reduce the electrical field strength inside the housing, at the inner triple point in particular, as well as on the silicone surface directly. This by displacing the higher electrical field strength outside the housing (i.e. to the surrounding air area), and by taking advantage of the higher silicone relative permittivity.

In this way, 3FL insulators can be applied on 170 kV systems without the need for additional grading/corona rings.

Standards and tests

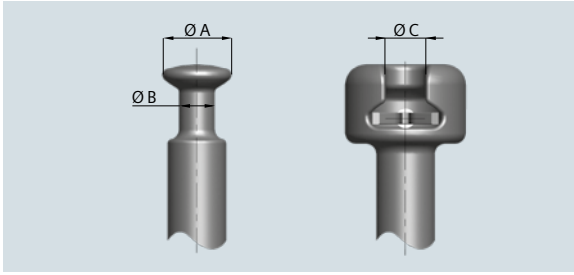
All 3FL long rod insulators are designed and tested in compliance with the latest IEC standards.

Each Siemens 3FL insulator that leaves the factory is routinely tested with a corresponding mechanical tensile test load of at least 50 percent of the defined SML load for at least ten seconds.

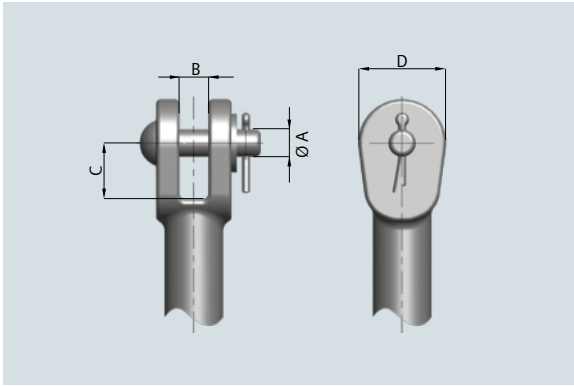
¹HTV: High-temperature vulcanizing

²ECR glass: Electrical- and corrosion-resistant glass

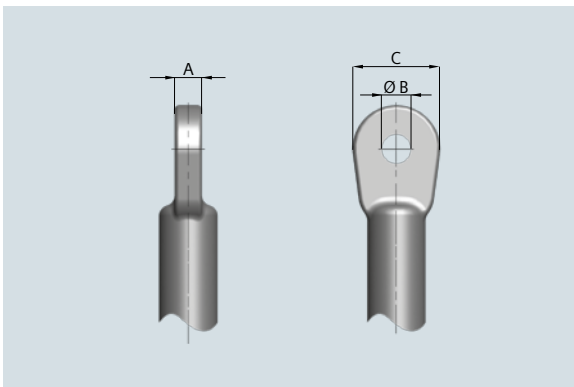
Product standards	
IEC 61109	Insulators for overhead lines – Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1,000 V
IEC 62217	Polymeric insulators for indoor and outdoor use with a nominal voltage >1,000 V
IEC 60815	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions
IEC 61466-1, -2	Composite string insulator units for overhead lines with a nominal voltage greater than 1,000 V



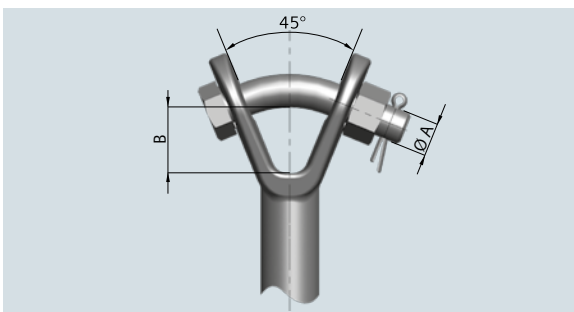
Socket and Ball acc. to IEC 60120				
Designation	SML	Dimensions in mm		
		A	B	C
16	70 kN / 100 kN / 120 kN	33	17	19
20	160 kN / 210 kN	41	21	23



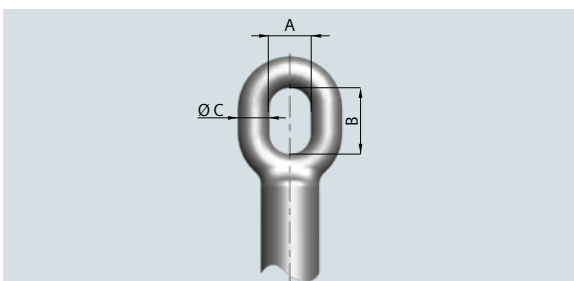
Clevis acc. to IEC 60471 and IEC 61466-1					
Designation	SML	Dimensions in mm			
		A	B	C	D
13L	70 kN	13	14	17	42
16L	100 / 120 kN	16	18	32	46
16N	100 / 120 kN	16	18	32	46
19L	160 kN	19	20	37	56
19N	160 kN	19	22.5	26	56
22L	210 kN	22	20	43	60
22N	210 kN	22	26	30	60



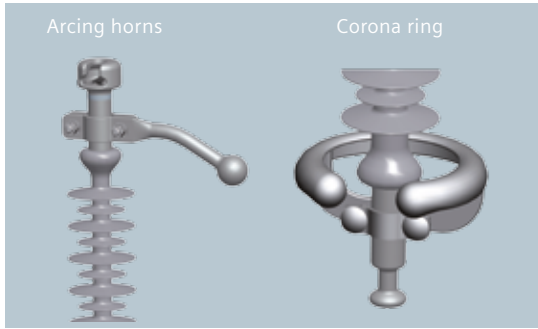
Tongue acc. to IEC 60471 and IEC 61466-1				
Designation	SML	Dimensions in mm		
		A	B	C
13L	70 kN	13	14	42
16L	100 kN / 120 kN	16	17.5	46
16N	100 kN / 120 kN	12.7	17.5	46
19L	160 kN	19	20	56
19N	160 kN	19	20.6	46
22L	210 kN	19	24	60
22N	210 kN	22	23.8	52



Y-Clevis acc. to IEC 61466-1			
Designation	SML	Dimensions in mm	
		A	B
16	70 kN	16	32
19	100 / 120 kN	19	34
22	160 / 210 kN	22	41



Eye acc. to IEC 61466-1				
Designation	SML	Dimensions in mm		
		A	B	C
17	70 kN	20	32	15
24	100 kN / 120 kN	24	48	19
25	160 kN / 210 kN	25	50	22



Recommended corona rings (diameter in mm) by line voltage		
Line voltage (kV)	Ground end (top end fitting)	Line end (conductor end fitting)
≤ 170 kV	None	None
245 kV	None	Ø 210
300 kV	None	Ø 330
362 kV	None	Ø 330
420 kV	Ø 210	Ø 330
550 kV	Ø 210	Ø 420

Accessories

Arc protection devices such as arcing horns and corona rings for reduction of electrical field stress and corona effect are carefully designed based on numerous electrical simulations regarding electrical field distribution. For system voltages above 170 kV corona rings are included in 3FL insulator application as a standard feature. Customer-specific solutions as well as other connection and cable clamps are also available on request.

Maximum values		units	3FL2	3FL3	3FL4	3FL5	3FL6
Highest voltage for equipment, U_m	from	kV	12	72.5	72.5	72.5	72.5
	to	kV	72.5	550	550	550	550
Nominal system voltage, U_n	from	kV	10	60	60	60	60
	to	kV	69	500	500	500	500
Specified mechanical load, SML class	–	kN	70	100	120	160	210
Maximum section length, length increments 52 mm (with Socket and Ball)		mm	782	5,553	5,553	5,603	5,603

Long rod insulators type 3FL2, SML 70 kN

3FL2 long rod insulators are designed to meet the highest requirements in distribution power systems up to 72 kV. They have high lightning impulse and power frequency withstand voltages and a long creepage class (> 31 mm/kV). 3FL2 insulators are available with mechanical ratings up to SML = 70 kN.

End fittings with SML = 70 kN		
Designation as per standard	Standard	Connection length
Name/size		V, mm
Ball 16	IEC 60120	75
Socket 16A	IEC 60120	79
Clevis 13L	IEC 60471	87
Tongue 13L	IEC 60741	87
Y-clevis 16	IEC 61466-1	94
Eye 17	IEC 61466-1	93

Technical data 3FL2									
Highest voltage for equipment	Typical nominal system voltages	Lightning impulse withstand voltage (1.2/50 μ s, dry)	Power frequency withstand voltage (50 Hz, 1 min., wet)	Arcing distance	Creepage distance	Housing length	Section length* (with Socket and Ball)	Catalog number	Weight (with Socket and Ball)
U_m , kV	U_n , kV	LIWL min, kV	PFWL min, kV	S, mm	C, mm	H, mm	L, mm		W, kg
12.0	10, 11, 12	158	73	214	420	178	332	3FL2-009-4xx00-1xx1	1.6
24.0	15, 20, 22, 24	216	89	304	799	268	422	3FL2-014-4xx00-1xx1	2.0
36.0	30, 33, 35, 36	243	111	394	1178	358	512	3FL2-017-4xx00-1xx1	2.4
72.5	60, 66, 69, 72	400	200	664	2315	628	782	3FL2-032-4xx00-1xx1	3.6

*Reference value of the section length of the insulator for version with Socket and Ball end fittings of size 16 in accordance with IEC 60120. In order to obtain the section length of the insulator implemented with other end fittings, the housing length and connection lengths (see table "End fittings") of both end fittings must be added together. All electrical values refer to an insulator without arcing horns or corona rings.

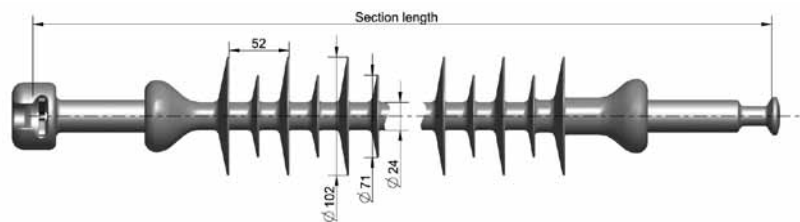
Long rod insulators

3FL3 and 3FL4

	3FL3	3FL4
Specified mechanical load SML:	100 kN	120 kN
Routine test load	50 kN	60 kN

3FL silicone long rod insulators for suspension and tension applications are available in lengths appropriate for 60 kV through 550 kV. Length increments are 52 mm. Just a few selected insulator lengths are listed in the following catalog table. Intermediate, shorter, or longer lengths available on request.

Technical data 3FL3 and 3FL4										
Highest voltage for equipment based on 25 mm/kV specific creepage distance	Lightning impulse withstand voltage (1.2/50 μ s, dry)	Switching impulse withstand voltage (250/2,500 μ s, positive, dry)	Power frequency withstand voltage (50 Hz, 1 min., wet)	Arcing distance	Creepage distance	Housing length	Section length* with Socket and Ball	Catalog number	Grading ring diameter top / bottom	Approx. net weight
U_m kV	LIWV kV	SIWV min kV	PFVV kV	S mm	C mm	H mm	L mm	3FLx - -3X'X*10-1X'X*1	D mm	W kg
<72.5	443	–	238	644	1,706	614	821	3FLx-044-3SB10-1XX1	x / x	2.6
72.5	470	–	255	696	1,868	666	873	3FLx-047-3SB10-1XX1	x / x	2.7
72.5	498	–	272	748	2,031	718	925	3FLx-050-3SB10-1XX1	x / x	2.7
72.5	525	–	289	800	2,194	770	977	3FLx-053-3SB10-1XX1	x / x	2.8
72.5	552	–	305	852	2,356	822	1,029	3FLx-055-3SB10-1XX1	x / x	2.9
72.5	579	–	322	904	2,519	874	1,081	3FLx-058-3SB10-1XX1	x / x	3.0
72.5	606	–	339	956	2,681	926	1,133	3FLx-061-3SB10-1XX1	x / x	3.1
72.5	633	–	356	1,008	2,844	978	1,185	3FLx-063-3SB10-1XX1	x / x	3.2
72.5	661	–	373	1,060	3,007	1,030	1,237	3FLx-066-3SB10-1XX1	x / x	3.2
123	688	–	390	1,112	3,169	1,082	1,289	3FLx-069-3SB10-1XX1	x / x	3.3
123	715	–	407	1,164	3,332	1,134	1,341	3FLx-072-3SB10-1XX1	x / x	3.4
123	742	–	424	1,216	3,494	1,186	1,393	3FLx-074-3SB10-1XX1	x / x	3.5
145	769	–	441	1,268	3,657	1,238	1,445	3FLx-077-3SB10-1XX1	x / x	3.6
145	797	–	458	1,320	3,820	1,290	1,497	3FLx-080-3SB10-1XX1	x / x	3.7
145	824	–	475	1,372	3,982	1,342	1,549	3FLx-082-3SB10-1XX1	x / x	3.7
145	851	–	491	1,424	4,145	1,394	1,601	3FLx-085-3SB10-1XX1	x / x	3.8
170	882	–	501	1,476	4,307	1,446	1,653	3FLx-088-3SB10-1XX1	x / x	3.9
170	912	–	511	1,528	4,470	1,498	1,705	3FLx-091-3SB10-1XX1	x / x	4.0
170	943	–	520	1,580	4,633	1,550	1,757	3FLx-094-3SB10-1XX1	x / x	4.1
170	974	–	530	1,632	4,795	1,602	1,809	3FLx-097-3SB10-1XX1	x / x	4.2
170	1,005	–	539	1,684	4,958	1,654	1,861	3FLx-101-3SB10-1XX1	x / x	4.2
170	1,036	–	549	1,736	5,121	1,706	1,913	3FLx-104-3SB10-1XX1	x / x	4.3
170	1,066	–	558	1,788	5,283	1,758	1,965	3FLx-107-3SB10-1XX1	x / x	4.4
170	1,097	–	568	1,840	5,446	1,810	2,017	3FLx-110-3SB10-1XX1	x / x	4.5
170	1,128	–	577	1,892	5,608	1,862	2,069	3FLx-113-3SB10-1XX1	x / x	4.6
170	1,159	–	587	1,944	5,771	1,914	2,121	3FLx-116-3SB10-1XX1	x / x	4.7
170	1,190	–	596	1,996	5,934	1,966	2,173	3FLx-119-3SB10-1XX1	x / x	4.7
245	1,220	–	606	2,003	6,096	2,018	2,225	3FLx-122-3SB10-1XR1	x / Ø210	5.8
245	1,251	–	615	2,055	6,259	2,070	2,277	3FLx-125-3SB10-1XR1	x / Ø210	5.9
245	1,282	–	618	2,107	6,421	2,122	2,329	3FLx-128-3SB10-1XR1	x / Ø210	6.0
245	1,312	–	621	2,159	6,584	2,174	2,381	3FLx-131-3SB10-1XR1	x / Ø210	6.0
245	1,342	–	623	2,211	6,747	2,226	2,433	3FLx-134-3SB10-1XR1	x / Ø210	6.1
245	1,372	–	626	2,263	6,909	2,278	2,485	3FLx-137-3SB10-1XR1	x / Ø210	6.2
245	1,403	–	629	2,315	7,072	2,330	2,537	3FLx-140-3SB10-1XR1	x / Ø210	6.3
245	1,433	–	631	2,367	7,234	2,382	2,589	3FLx-143-3SB10-1XR1	x / Ø210	6.4
245	1,463	1,020	634	2,419	7,397	2,434	2,641	3FLx-146-3SB10-1XR1	x / Ø210	6.5
300	1,493	1,030	637	2,456	7,560	2,486	2,693	3FLx-149-3SB10-1XR1	x / Ø330	8.7
300	1,524	1,040	639	2,508	7,722	2,538	2,745	3FLx-152-3SB10-1XR1	x / Ø330	8.8
300	1,554	1,049	642	2,560	7,885	2,590	2,797	3FLx-155-3SB10-1XR1	x / Ø330	8.9
300	1,614	1,069	647	2,664	8,210	2,694	2,901	3FLx-161-3SB10-1XR1	x / Ø330	9.1
300	1,645	1,079	650	2,716	8,373	2,746	2,953	3FLx-165-3SB10-1XR1	x / Ø330	9.2
300	1,705	1,099	655	2,820	8,698	2,850	3,057	3FLx-171-3SB10-1XR1	x / Ø330	9.3
300	1,735	1,109	658	2,872	8,861	2,902	3,109	3FLx-174-3SB10-1XR1	x / Ø330	9.4
362	1,766	1,119	660	2,924	9,023	2,954	3,161	3FLx-177-3SB10-1XR1	x / Ø330	9.5
362	1,796	1,129	663	2,976	9,186	3,006	3,213	3FLx-180-3SB10-1XR1	x / Ø330	9.6



Technical data 3FL3 and 3FL4

Highest voltage for equipment based on 25 mm/kV specific creepage distance	Lightning impulse withstand voltage (1.2/50 µs, dry)	Switching impulse withstand voltage (250/2,500 µs, positive, dry)	Power frequency withstand voltage (50 Hz, 1 min., wet)	Arcing distance	Creepage distance	Housing length	Section length* with Socket and Ball	Catalog number	Grading ring diameter top / bottom	Approx. net weight
U_m kV	LIWV kV	SIWV min kV	PFVV kV	S mm	C mm	H mm	L mm	3FLx - -3X ¹ X ² 10-1X ³ X ⁴ 1	D mm	W kg
362	1,826	1,139	666	3,028	9,348	3,058	3,265	3FLx-183-3SB10-1XR1	x / Ø330	9.7
362	1,843	1,148	668	3,080	9,511	3,110	3,317	3FLx-184-3SB10-1XR1	x / Ø330	9.7
362	1,860	1,158	670	3,132	9,674	3,162	3,369	3FLx-186-3SB10-1XR1	x / Ø330	9.8
362	1,877	1,168	672	3,184	9,836	3,214	3,421	3FLx-188-3SB10-1XR1	x / Ø330	9.9
362	1,894	1,178	674	3,236	9,999	3,266	3,473	3FLx-189-3SB10-1XR1	x / Ø330	10.0
362	1,911	1,188	676	3,288	10,161	3,318	3,525	3FLx-191-3SB10-1XR1	x / Ø330	10.1
362	1,927	1,198	678	3,340	10,324	3,370	3,577	3FLx-193-3SB10-1XR1	x / Ø330	10.2
362	1,944	1,208	680	3,392	10,487	3,422	3,629	3FLx-194-3SB10-1XR1	x / Ø330	10.2
420	1,961	1,218	682	3,399	10,649	3,474	3,681	3FLx-196-3SB10-1RR1	Ø210 / Ø330	11.3
420	1,978	1,228	684	3,451	10,812	3,526	3,733	3FLx-198-3SB10-1RR1	Ø210 / Ø330	11.4
420	1,995	1,238	686	3,503	10,974	3,578	3,785	3FLx-200-3SB10-1RR1	Ø210 / Ø330	11.5
420	2,012	1,247	688	3,555	11,137	3,630	3,837	3FLx-201-3SB10-1RR1	Ø210 / Ø330	11.5
420	2,029	1,257	690	3,607	11,300	3,682	3,889	3FLx-203-3SB10-1RR1	Ø210 / Ø330	11.6
420	2,046	1,267	692	3,659	11,462	3,734	3,941	3FLx-205-3SB10-1RR1	Ø210 / Ø330	11.7
420	2,063	1,277	694	3,711	11,625	3,786	3,993	3FLx-206-3SB10-1RR1	Ø210 / Ø330	11.8
420	2,080	1,287	696	3,763	11,787	3,838	4,045	3FLx-208-3SB10-1RR1	Ø210 / Ø330	11.9
420	2,096	1,297	698	3,815	11,950	3,890	4,097	3FLx-210-3SB10-1RR1	Ø210 / Ø330	12.0
420	2,113	1,307	700	3,867	12,113	3,942	4,149	3FLx-211-3SB10-1RR1	Ø210 / Ø330	12.0
420	2,130	1,317	702	3,919	12,275	3,994	4,201	3FLx-213-3SB10-1RR1	Ø210 / Ø330	12.1
420	2,147	1,327	704	3,971	12,438	4,046	4,253	3FLx-215-3SB10-1RR1	Ø210 / Ø330	12.2
420	2,164	1,337	706	4,023	12,600	4,098	4,305	3FLx-216-3SB10-1RR1	Ø210 / Ø330	12.3
420	2,181	1,346	708	4,075	12,763	4,150	4,357	3FLx-218-3SB10-1RR1	Ø210 / Ø330	12.4
420	2,198	1,356	710	4,127	12,926	4,202	4,409	3FLx-220-3SB10-1RR1	Ø210 / Ø330	12.5
420	2,215	1,366	713	4,179	13,088	4,254	4,461	3FLx-222-3SB10-1RR1	Ø210 / Ø330	12.5
420	2,249	1,386	717	4,283	13,414	4,358	4,565	3FLx-225-3SB10-1RR1	Ø210 / Ø330	12.7
550	2,282	1,406	721	4,367	13,739	4,462	4,669	3FLx-228-3SB10-1RR1	Ø210 / Ø420	14.7
550	2,299	1,416	723	4,471	14,064	4,566	4,773	3FLx-232-3SB10-1RR1	Ø210 / Ø420	14.9
550	2,299	1,416	723	4,679	14,714	4,774	4,981	3FLx-238-3SB10-1RR1	Ø210 / Ø420	15.2
550	2,299	1,416	723	4,887	15,365	4,982	5,189	3FLx-245-3SB10-1RR1	Ø210 / Ø420	15.5
550	2,299	1,416	723	4,991	15,690	5,086	5,293	3FLx-249-3SB10-1RR1	Ø210 / Ø420	15.7
550	2,299	1,416	723	5,199	16,340	5,294	5,501	3FLx-255-3SB10-1RR1	Ø210 / Ø420	16.0
550	2,299	1,416	723	5,251	16,503	5,346	5,553	3FLx-257-3SB10-1RR1	Ø210 / Ø420	16.1

* Reference section length for insulator configuration with Socket (S) and Ball (B) end fittings. To obtain the section length of other end fitting configuration, please use the section length adjustment table.
X¹: Upper end fitting (earth side) X²: Bottom end fitting (high-voltage side) X³: Upper corona ring (earth side) X⁴: Bottom corona ring (high-voltage side)

End fittings				
SML	Type	Standard	Catalog number	Length
120 kN	Ball 16	IEC 60120	B	108 mm
120 kN	Socket 16A	IEC 60120	S	99 mm
120 kN	Socket 16B	IEC 60120	R	103 mm
120 kN	Clevis 16L	IEC 60471	C	119 mm
120 kN	Tongue 16L	IEC 60741	T	118 mm
120 kN	Y-clevis 19	IEC 61466-1	Y	127 mm
120 kN	Eye 24	IEC 61466-1	E	128 mm

Section length adjustment table**			
Base end fittings: Socket and Ball (Code: SB)			
Top end fitting (tower connection)	Bottom end fitting (conductor connection)	Catalog number	Length change, mm
Clevis 16L	Tongue 16L	CT	30
Clevis 16L	Clevis 16L	CC	31
Clevis 16L	Eye 24	CE	40
Clevis 16L	Ball 16	CB	20
Tongue 16L	Tongue 16L	TT	29
Eye 24	Ball 16	EB	29
Eye 24	Eye 24	EE	49
Y-clevis 19	Eye 24	YE	48
Y-clevis 19	Ball 16	YB	28

** To determine the section length for an insulator with a different end fitting combination, please add or subtract the displayed length change in the table above. For configurations not shown, use the catalog number key or contact your Siemens representative.

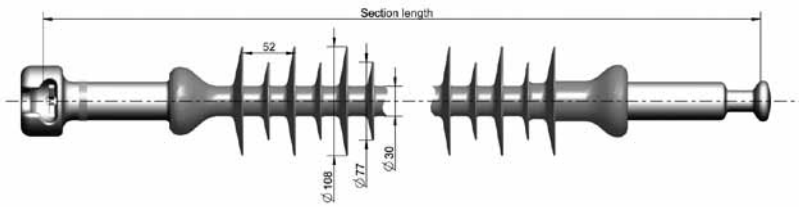
Long rod insulators

3FL5 and 3FL6

	3FL5	3FL6
Specified mechanical load SML:	160 kN	210 kN
Routine test load	RTL: 80 kN	105 kN

3FL silicone long rod insulators for suspension and tension applications are available in lengths appropriate for 60 kV through 550 kV. Length increments are 52 mm. Just a few selected insulator lengths are listed in the following catalog table. Intermediate, shorter, or longer lengths available on request.

Technical data 3FL5 and 3FL6										
Highest voltage for equipment based on 25 mm/kV specific creepage distance	Lightning impulse withstand voltage (1.2/50 μ s, dry)	Switching impulse withstand voltage (250/2,500 μ s, positive, dry)	Power frequency withstand voltage (50 Hz, 1 min., wet)	Arcing distance	Creepage distance	Housing length	Section length* with Socket and Ball	Catalog number	Grading ring diameter top / bottom	Approx. net weight
U_m kV	LIWV kV	SIWV min kV	PFVV kV	S mm	C mm	H mm	L mm	3FLx - -3X'X*20-1X'X*1	D mm	W kg
<72.5	443	-	238	643	1,702	614	871	3FLx-044-3SB20-1XX1	x / x	4.2
72.5	470	-	255	695	1,865	666	923	3FLx-047-3SB20-1XX1	x / x	4.3
72.5	498	-	272	747	2,027	718	975	3FLx-050-3SB20-1XX1	x / x	4.4
72.5	525	-	289	799	2,190	770	1,027	3FLx-053-3SB20-1XX1	x / x	4.5
72.5	552	-	305	851	2,353	822	1,079	3FLx-055-3SB20-1XX1	x / x	4.6
72.5	579	-	322	903	2,515	874	1,131	3FLx-058-3SB20-1XX1	x / x	4.7
72.5	606	-	339	955	2,678	926	1,183	3FLx-061-3SB20-1XX1	x / x	4.9
72.5	633	-	356	1,007	2,840	978	1,235	3FLx-063-3SB20-1XX1	x / x	5.0
123	661	-	373	1,059	3,003	1,030	1,287	3FLx-066-3SB20-1XX1	x / x	5.1
123	688	-	390	1,111	3,166	1,082	1,339	3FLx-069-3SB20-1XX1	x / x	5.2
123	715	-	407	1,163	3,328	1,134	1,391	3FLx-072-3SB20-1XX1	x / x	5.3
123	742	-	424	1,215	3,491	1,186	1,443	3FLx-074-3SB20-1XX1	x / x	5.4
145	769	-	441	1,267	3,653	1,238	1,495	3FLx-077-3SB20-1XX1	x / x	5.5
145	797	-	458	1,319	3,816	1,290	1,547	3FLx-080-3SB20-1XX1	x / x	5.6
145	824	-	475	1,371	3,979	1,342	1,599	3FLx-082-3SB20-1XX1	x / x	5.8
145	851	-	491	1,423	4,141	1,394	1,651	3FLx-085-3SB20-1XX1	x / x	5.9
170	882	-	501	1,475	4,304	1,446	1,703	3FLx-088-3SB20-1XX1	x / x	6.0
170	912	-	511	1,527	4,466	1,498	1,755	3FLx-091-3SB20-1XX1	x / x	6.1
170	943	-	520	1,579	4,629	1,550	1,807	3FLx-094-3SB20-1XX1	x / x	6.2
170	974	-	530	1,631	4,792	1,602	1,859	3FLx-097-3SB20-1XX1	x / x	6.3
170	1,005	-	539	1,683	4,954	1,654	1,911	3FLx-101-3SB20-1XX1	x / x	6.4
170	1,036	-	549	1,735	5,117	1,706	1,963	3FLx-104-3SB20-1XX1	x / x	6.5
170	1,066	-	558	1,787	5,279	1,758	2,015	3FLx-107-3SB20-1XX1	x / x	6.7
170	1,097	-	568	1,839	5,442	1,810	2,067	3FLx-110-3SB20-1XX1	x / x	6.8
170	1,128	-	577	1,891	5,605	1,862	2,119	3FLx-113-3SB20-1XX1	x / x	6.9
170	1,159	-	587	1,943	5,767	1,914	2,171	3FLx-116-3SB20-1XX1	x / x	7.0
170	1,190	-	596	1,995	5,930	1,966	2,223	3FLx-119-3SB20-1XX1	x / x	7.1
245	1,220	-	606	2,002	6,093	2,018	2,275	3FLx-122-3SB20-1XR1	x / Ø210	8.2
245	1,251	-	615	2,054	6,255	2,070	2,327	3FLx-125-3SB20-1XR1	x / Ø210	8.3
245	1,282	-	618	2,106	6,418	2,122	2,379	3FLx-128-3SB20-1XR1	x / Ø210	8.4
245	1,312	-	621	2,158	6,580	2,174	2,431	3FLx-131-3SB20-1XR1	x / Ø210	8.6
245	1,342	-	623	2,210	6,743	2,226	2,483	3FLx-134-3SB20-1XR1	x / Ø210	8.7
245	1,372	-	626	2,262	6,906	2,278	2,535	3FLx-137-3SB20-1XR1	x / Ø210	8.8
245	1,403	-	629	2,314	7,068	2,330	2,587	3FLx-140-3SB20-1XR1	x / Ø210	8.9
245	1,433	-	631	2,366	7,231	2,382	2,639	3FLx-143-3SB20-1XR1	x / Ø210	9.0
245	1,463	1,020	634	2,418	7,393	2,434	2,691	3FLx-146-3SB20-1XR1	x / Ø210	9.1
300	1,493	1,030	637	2,455	7,556	2,486	2,743	3FLx-149-3SB20-1XR1	x / Ø330	11.4
300	1,524	1,040	639	2,507	7,719	2,538	2,795	3FLx-152-3SB20-1XR1	x / Ø330	11.5
300	1,584	1,059	644	2,611	8,044	2,642	2,899	3FLx-158-3SB20-1XR1	x / Ø330	11.8
300	1,614	1,069	647	2,663	8,206	2,694	2,951	3FLx-161-3SB20-1XR1	x / Ø330	11.9
300	1,645	1,079	650	2,715	8,369	2,746	3,003	3FLx-165-3SB20-1XR1	x / Ø330	12.0
300	1,675	1,089	652	2,767	8,532	2,798	3,055	3FLx-168-3SB20-1XR1	x / Ø330	12.1
300	1,735	1,109	658	2,871	8,857	2,902	3,159	3FLx-174-3SB20-1XR1	x / Ø330	12.3
362	1,766	1,119	660	2,923	9,019	2,954	3,211	3FLx-177-3SB20-1XR1	x / Ø330	12.4
362	1,796	1,129	663	2,975	9,182	3,006	3,263	3FLx-180-3SB20-1XR1	x / Ø330	12.6



Technical data 3FL5 and 3FL6

Highest voltage for equipment based on 25 mm/kV specific creepage distance	Lightning impulse withstand voltage (1.2/50 µs, dry)	Switching impulse withstand voltage (250/2,500 µs, positive, dry)	Power frequency withstand voltage (50 Hz, 1 min., wet)	Arcing distance	Creepage distance	Housing length	Section length* with Socket and Ball	Catalog number	Grading ring diameter top / bottom	Approx. net weight
U_m kV	LIWV kV	SIWV min kV	PFVV kV	S mm	C mm	H mm	L mm	3FLx - -3X'X²20-1X³X¹	D mm	W kg
362	1,826	1,139	666	3,027	9,345	3,058	3,315	3FLx-183-3SB20-1XR1	x / Ø330	12.7
362	1,843	1,148	668	3,079	9,507	3,110	3,367	3FLx-184-3SB20-1XR1	x / Ø330	12.8
362	1,860	1,158	670	3,131	9,670	3,162	3,419	3FLx-186-3SB20-1XR1	x / Ø330	12.9
362	1,877	1,168	672	3,183	9,833	3,214	3,471	3FLx-188-3SB20-1XR1	x / Ø330	13.0
362	1,894	1,178	674	3,235	9,995	3,266	3,523	3FLx-189-3SB20-1XR1	x / Ø330	13.1
362	1,911	1,188	676	3,287	10,158	3,318	3,575	3FLx-191-3SB20-1XR1	x / Ø330	13.2
362	1,927	1,198	678	3,339	10,320	3,370	3,627	3FLx-193-3SB20-1XR1	x / Ø330	13.3
362	1,944	1,208	680	3,391	10,483	3,422	3,679	3FLx-194-3SB20-1XR1	x / Ø330	13.5
420	1,961	1,218	682	3,398	10,646	3,474	3,731	3FLx-196-3SB20-1RR1	Ø210 / Ø330	14.6
420	1,978	1,228	684	3,450	10,808	3,526	3,783	3FLx-198-3SB20-1RR1	Ø210 / Ø330	14.7
420	1,995	1,238	686	3,502	10,971	3,578	3,835	3FLx-200-3SB20-1RR1	Ø210 / Ø330	14.8
420	2,012	1,247	688	3,554	11,133	3,630	3,887	3FLx-201-3SB20-1RR1	Ø210 / Ø330	14.9
420	2,029	1,257	690	3,606	11,296	3,682	3,939	3FLx-203-3SB20-1RR1	Ø210 / Ø330	15.0
420	2,046	1,267	692	3,658	11,459	3,734	3,991	3FLx-205-3SB20-1RR1	Ø210 / Ø330	15.1
420	2,063	1,277	694	3,710	11,621	3,786	4,043	3FLx-206-3SB20-1RR1	Ø210 / Ø330	15.2
420	2,080	1,287	696	3,762	11,784	3,838	4,095	3FLx-208-3SB20-1RR1	Ø210 / Ø330	15.4
420	2,096	1,297	698	3,814	11,946	3,890	4,147	3FLx-210-3SB20-1RR1	Ø210 / Ø330	15.5
420	2,113	1,307	700	3,866	12,109	3,942	4,199	3FLx-211-3SB20-1RR1	Ø210 / Ø330	15.6
420	2,130	1,317	702	3,918	12,272	3,994	4,251	3FLx-213-3SB20-1RR1	Ø210 / Ø330	15.7
420	2,147	1,327	704	3,970	12,434	4,046	4,303	3FLx-215-3SB20-1RR1	Ø210 / Ø330	15.8
420	2,164	1,337	706	4,022	12,597	4,098	4,355	3FLx-216-3SB20-1RR1	Ø210 / Ø330	15.9
420	2,181	1,346	708	4,074	12,759	4,150	4,407	3FLx-218-3SB20-1RR1	Ø210 / Ø330	16.0
420	2,198	1,356	710	4,126	12,922	4,202	4,459	3FLx-220-3SB20-1RR1	Ø210 / Ø330	16.1
420	2,215	1,366	713	4,178	13,085	4,254	4,511	3FLx-222-3SB20-1RR1	Ø210 / Ø330	16.3
420	2,232	1,376	715	4,230	13,247	4,306	4,563	3FLx-223-3SB20-1RR1	Ø210 / Ø330	16.4
420	2,249	1,386	717	4,282	13,410	4,358	4,615	3FLx-225-3SB20-1RR1	Ø210 / Ø330	16.5
550	2,282	1,406	721	4,366	13,735	4,462	4,719	3FLx-228-3SB20-1RR1	Ø210 / Ø420	18.5
550	2,299	1,416	723	4,418	13,898	4,514	4,771	3FLx-230-3SB20-1RR1	Ø210 / Ø420	18.6
550	2,299	1,416	723	4,574	14,386	4,670	4,927	3FLx-235-3SB20-1RR1	Ø210 / Ø420	19.0
550	2,299	1,416	723	4,782	15,036	4,878	5,135	3FLx-242-3SB20-1RR1	Ø210 / Ø420	19.4
550	2,299	1,416	723	4,886	15,361	4,982	5,239	3FLx-245-3SB20-1RR1	Ø210 / Ø420	19.6
550	2,299	1,416	723	5,250	16,499	5,346	5,603	3FLx-257-3SB20-1RR1	Ø210 / Ø420	20.4

* Reference section length for insulator configuration with Socket (S) and Ball (B) end fittings. To obtain the section length of other end fitting configuration, please use the section length adjustment table.
 X¹: Upper end fitting (earth side) X²: Bottom end fitting (high-voltage side) X³: Upper corona ring (earth side) X¹: Bottom corona ring (high-voltage side)

End fittings				
SML	Type	Standard	Catalog number	Length
210 kN	Ball 20	IEC 60120	B	130 mm
210 kN	Socket 22	IEC 60120	S	127 mm
210 kN	Clevis 19L	IEC 60471	C	145 mm
210 kN	Clevis 22L	IEC 60471	C	154 mm
210 kN	Tongue 19L	IEC 60741	T	153 mm
210 kN	Tongue 22L	IEC 60741	T	153 mm
210 kN	Y-clevis 22	IEC 61466-1	Y	156 mm
210 kN	Eye 25	IEC 61466-1	E	153 mm

Section length adjustment table**			
Base end fittings: Socket and Ball (Code: SB)			
Top end fitting (tower connection)	Bottom end fitting (conductor connection)	Catalog number	Length change, mm
Clevis 19L	Tongue 19L	CT	36
Clevis 19L	Clevis 19L	CC	36
Clevis 19L	Eye 25	CE	36
Clevis 19L	Ball 20	CB	36
Tongue 19L	Tongue 19L	TT	52
Eye 25	Ball 20	EB	52
Eye 25	Eye 25	EE	52
Y-clevis 22	Eye 25	YE	58
Y-clevis 22	Ball 20	YB	58

** To determine the section length for an insulator with a different end fitting combination, please add or subtract the displayed length change in the table above. For configurations not shown, use the catalog number key or contact your Siemens representative.

Order number	3 F L 4 066 - 3 S B 1 0 - 1 X X 1						
Polymer suspension/tension insulator:	3FL						
Specified mechanical load SML [kN], according to IEC 61466-1:							
70 kN							2
100 kN							3
120 kN							4
160 kN							5
210 kN							6
Lightning impulse withstand voltage (1.2/50 µs, dry) LIWV/10 [kV], for example: if LIWV is 661 kV, then enter 066:							066
-							
Internal usage:							
3FL2							4
3FL3, 3FL4, 3FL5, 3FL6							3
Upper end fitting (earth side):							
	SML class:	70	100	120	160	210	
	(according to IEC 61466-1)						
Ball, size acc. to IEC 60120:	16	16	16	20	20		B
Socket, size acc. to IEC 60120:	16A	16A	16A	20	20		S
	16B	16B	16B				U
Clevis, size acc. to IEC 60471:	13L	16L	16L	19L	22L		C
Clevis, size acc. to IEC 61466-1:	16N	16N	16N	19N	22N		D
Tongue, size acc. to IEC 60471:	13L	16L	16L	19L	22L		T
Tongue, size acc. to IEC 61466-1:	16N	16N	16N	19N	22N		V
Eye, size acc. to IEC 61466-1:	17	24	24	25	25		E
Y-clevis, size acc. to IEC 61466-1:	16	19	19	22	22		Y
Special (other end fitting types available on request):							Z
Bottom end fitting (high-voltage side):							
	SML class:	70	100	120	160	210	Torsion angle
	(according to IEC 61466-1)						
Ball, size acc. to IEC 60120:	16	16	16	20	20		n/a
Socket, size acc. to IEC 60120:	16A	16A	16A	20	20		n/a
Clevis, size acc. to IEC 60471:	13L	16L	16L	19L	22L		0°
							90°
Clevis, size acc. to IEC 61466-1:	16N	16N	16N	19N	22N		0°
							90°
Tongue, size acc. to IEC 60471:	13L	16L	16L	19L	22L		0°
							90°
Tongue, size acc. to IEC 61466-1:	16N	16N	16N	19N	22N		0°
							90°
Eye, size acc. to IEC 61466-1:	17	24	24	25	25		0°
							90°
Y-clevis, size acc. to IEC 61466-1:	16	19	19	22	22		0°
							90°
Special (other end fitting types available on request):							Z
Internal usage:							
3FL2, 3FL3, 3FL4:							1
3FL5, 3FL6:							2
Internal usage:							0
-							
Standard:							
IEC 61109, IEC 61466-1, -2							1
Accessories on earth side:							
Arcing horn							H
Corona ring							R
No accessories required							X
Special							Z
Accessories on high-voltage side:							
Arcing horn							H
Corona ring							R
No accessories required							X
Special							Z
Application:							
Single string							1
Double string							2
V-string							5
Special							9



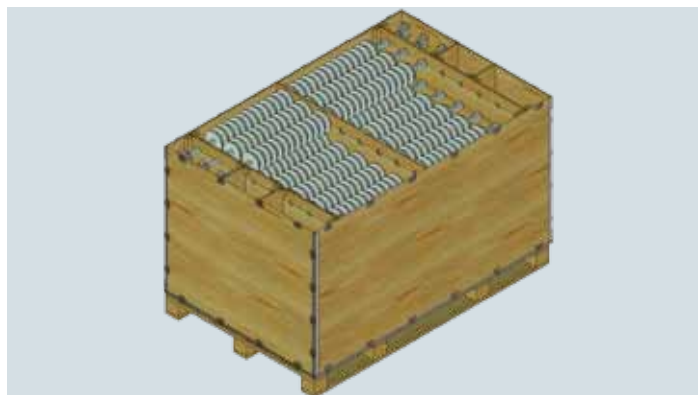
Marking and nameplate of 3FL insulators

A nameplate is installed on each 3FL insulator when it successfully passes the mechanical routine test. It is a weather- and UV-proof stainless steel band with locking system, placed on the ground end fitting of the insulator. The etched marking includes: catalog number, SML, RTL, LIWV, creepage distance, end fittings designation, and production date code.



Packaging

3FL insulators are packaged in wooden crates with the following dimensions: width is 1,120 mm, height is equal to or lower than 944 mm, the length is determined by the insulator length. The maximum weight of one crate is 900 kg.



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