

5 . Electrical Properties

5 · 1 Dielectric Breakdown Strength

The dielectric breakdown strength of Iupilon / NOVAREX is 18~22MV/m by ASTM-D149, thickness 1.6mm. The characteristics of test piece thickness and temperature are shown in Fig. 5 · 1-1 and Fig. 5 · 1-2, respectively.

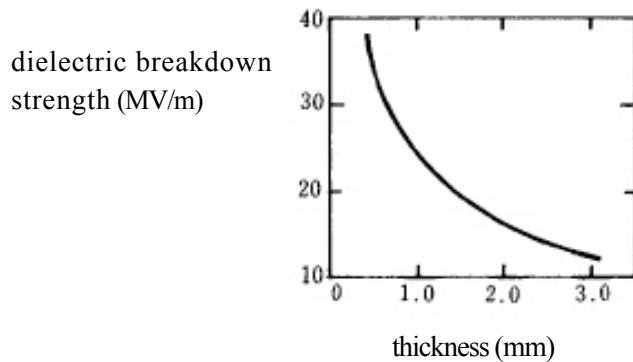


Fig. 5 · 1-1 Dielectric breakdown strength – thickness characteristic of Iupilon/NOVAREX (room temperature, in oil, short time voltage increase)

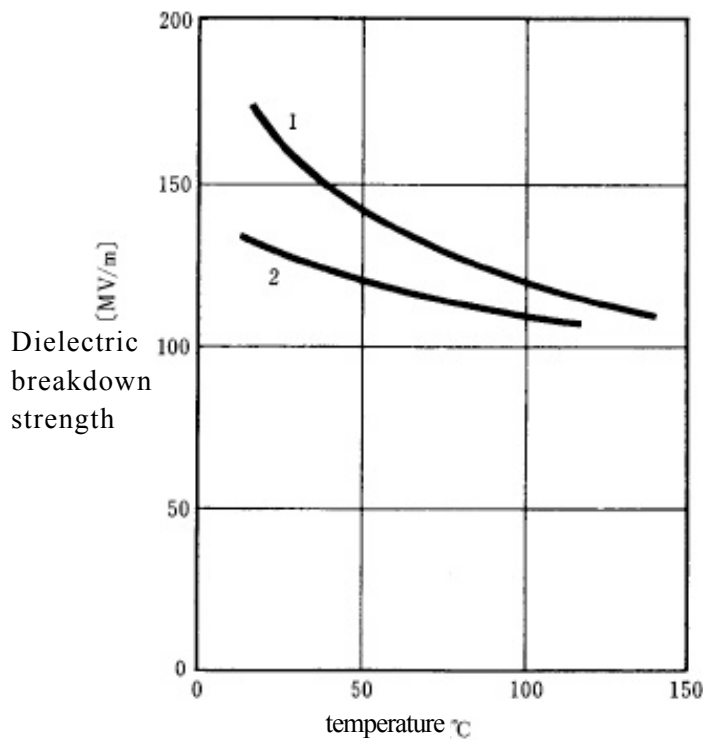


Fig. 5 · 1-2 Dielectric breakdown strength – temperature characteristic of polycarbonate film (1: Polycarbonate, 2: Cellulose acetobutyrate)

Table 5 · 1-1

	Impulse breakdown voltage
Iupilon rod	180—190KV
Epoxy laminated rod	140—150
Phenol laminated rod	130—135
Melamine laminated rod	120—130

The impulse breakdown voltage of Iupilon / NOVAREX is shown in Table 5 · 1-1.

A comparison with other resins is shown in Fig. 5 · 1—3.

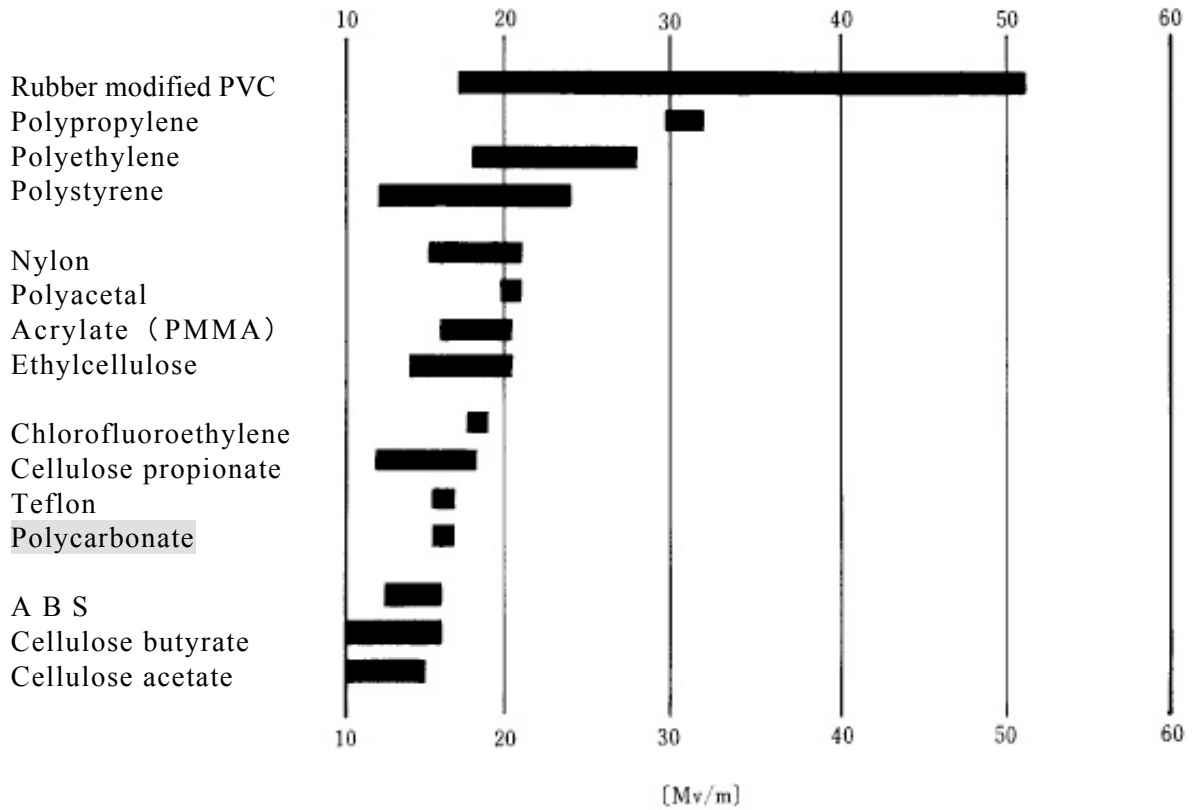


Fig. 5 · 1—3 Dielectric breakdown strength of various resins (short time voltage increase: ASTM-D149)

5 · 2 Insulation Resistance

The volume resistivity of Iupilon/NOVAREX is

ASTM-D257-58	
- 30 ~ - 3°C	$> 10^{17} \Omega \cdot \text{cm}$
23°C	2.1×10^{16}
125°C	2.0×10^{14}

The surface resistivity of polycarbonate is

In the dry state	$\geq 10^{15} \Omega$
Immersed in water for 4 hours (DIN 53482, $\phi 80$, 2mm thickness)	$\geq 10^{15} \Omega$

A comparison of volume resistivity with other resins is shown in Fig. 5 · 2—1.

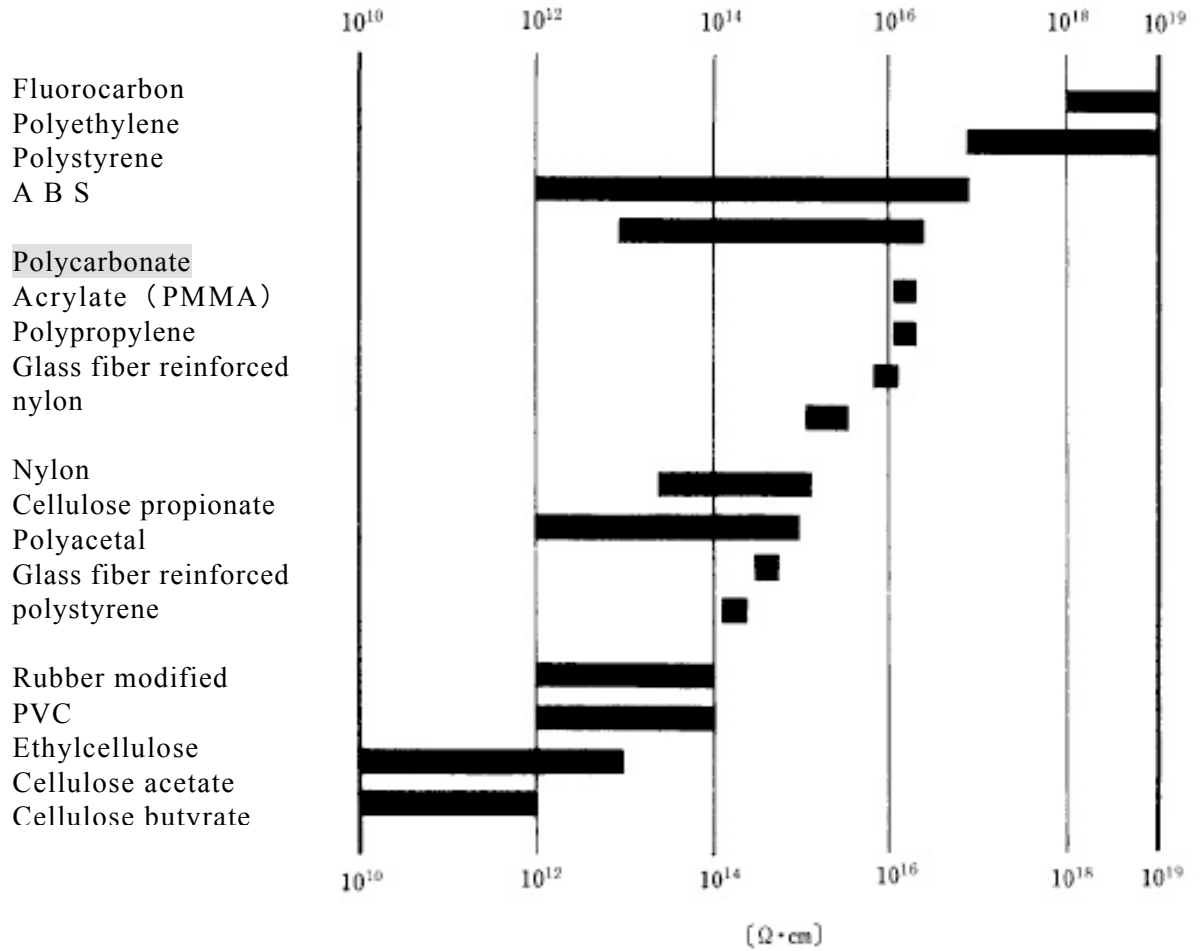


Fig. 5 · 2—1 Volume resistivity of various resins (ASTM-D257)

5 · 3 Dielectric Constant and Dielectric Dissipation Factor

The dielectric constant and dielectric dissipation factor of Iupilon/NOVAREX are

ASTM-D150-54T, 50Hz, normal temperature	
Dielectric constant	26.5PF/m(3.0)
Dielectric dissipation factor	0.0009

The temperature characteristics and frequency characteristics of dielectric constant and dielectric dissipation factor of Iupilon/NOVAREX are shown in Fig. 5 · 3—1 and Fig. 5 · 3—2, respectively.

Also, a comparison of dielectric constant with other resins is shown in Fig. 5 · 3—3.

Resins with low dielectric constant are suitable for use as insulator and those with high dielectric constant are suitable for use as capacitor. Iupilon/NOVAREX can be used for both applications. Also, its feature is that change due to temperature and frequency is small.

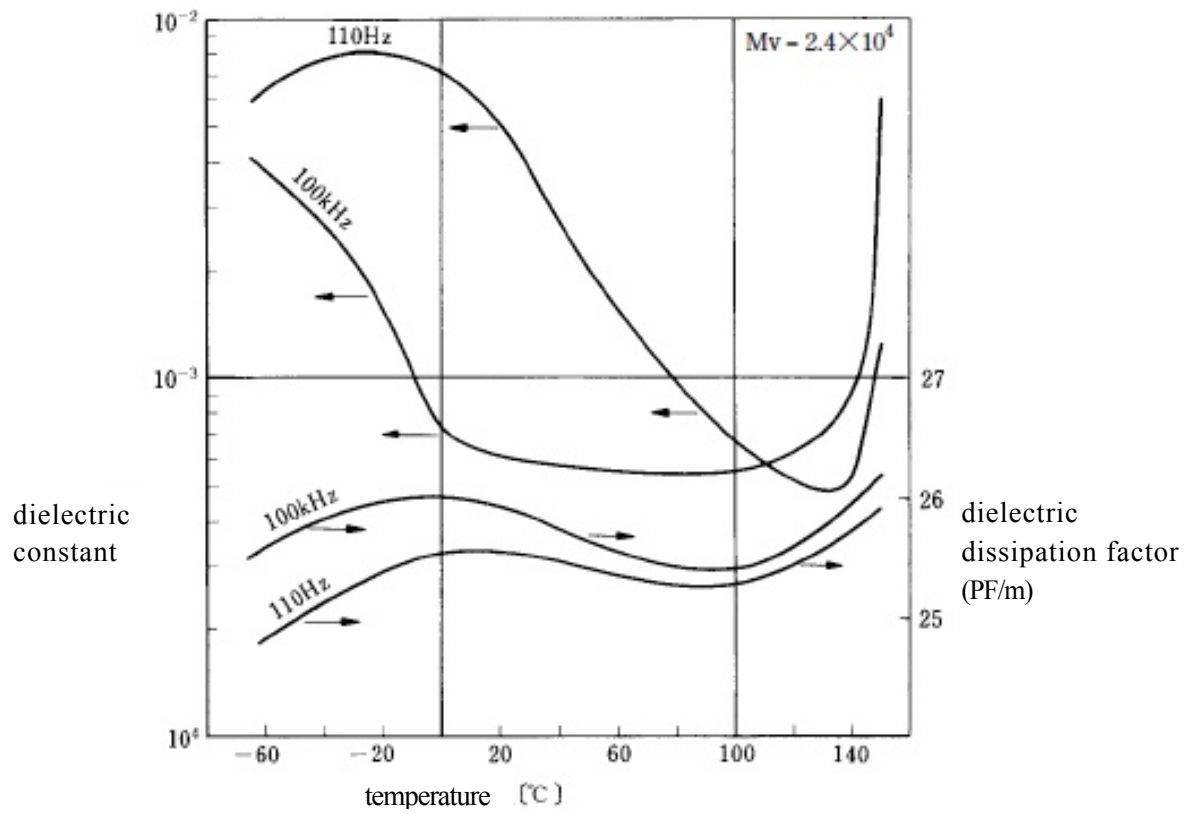


Fig. 5 · 3-1 Temperature characteristics of dielectric constant and dielectric dissipation factor of Iupilon / NOVAREX

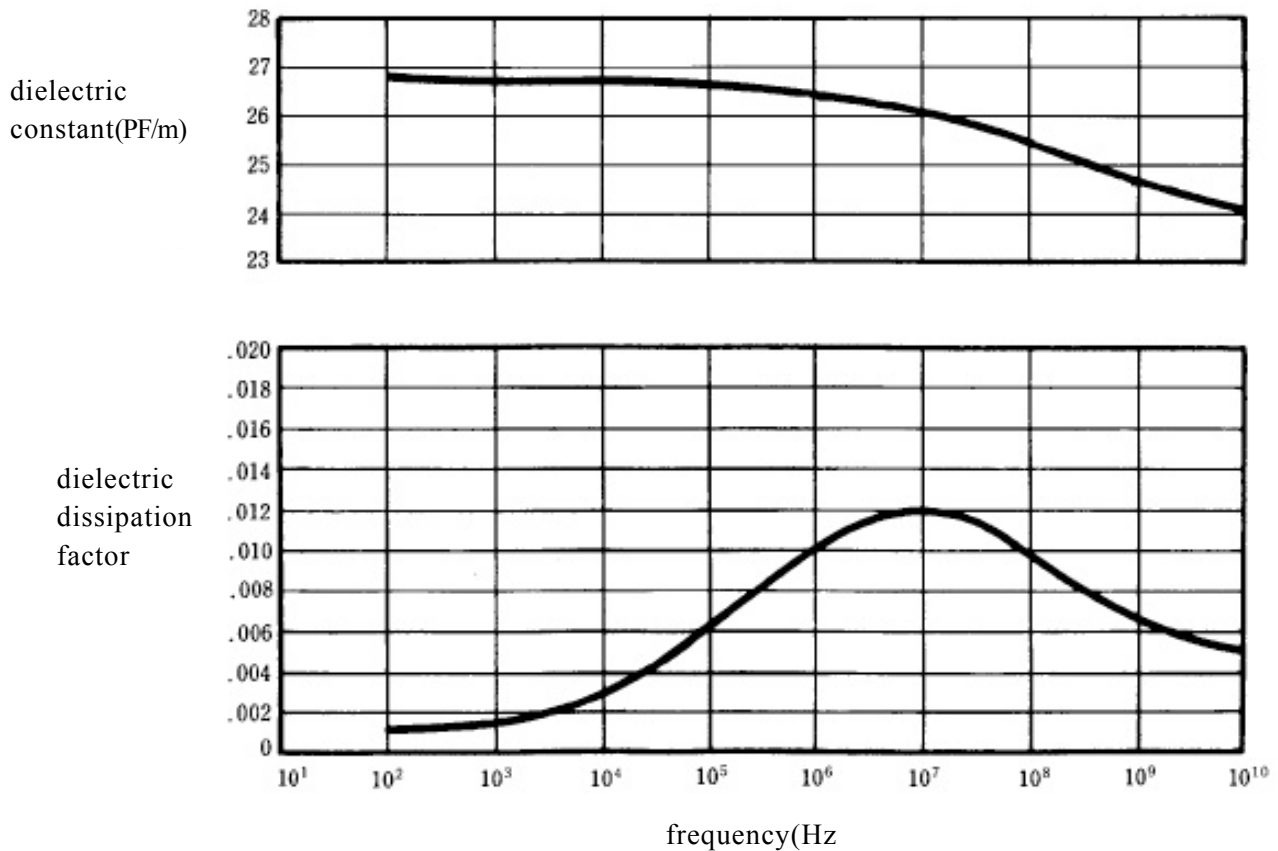


Fig. 5 · 3-2 Frequency characteristics of dielectric constant and dielectric dissipation factor of polycarbonate

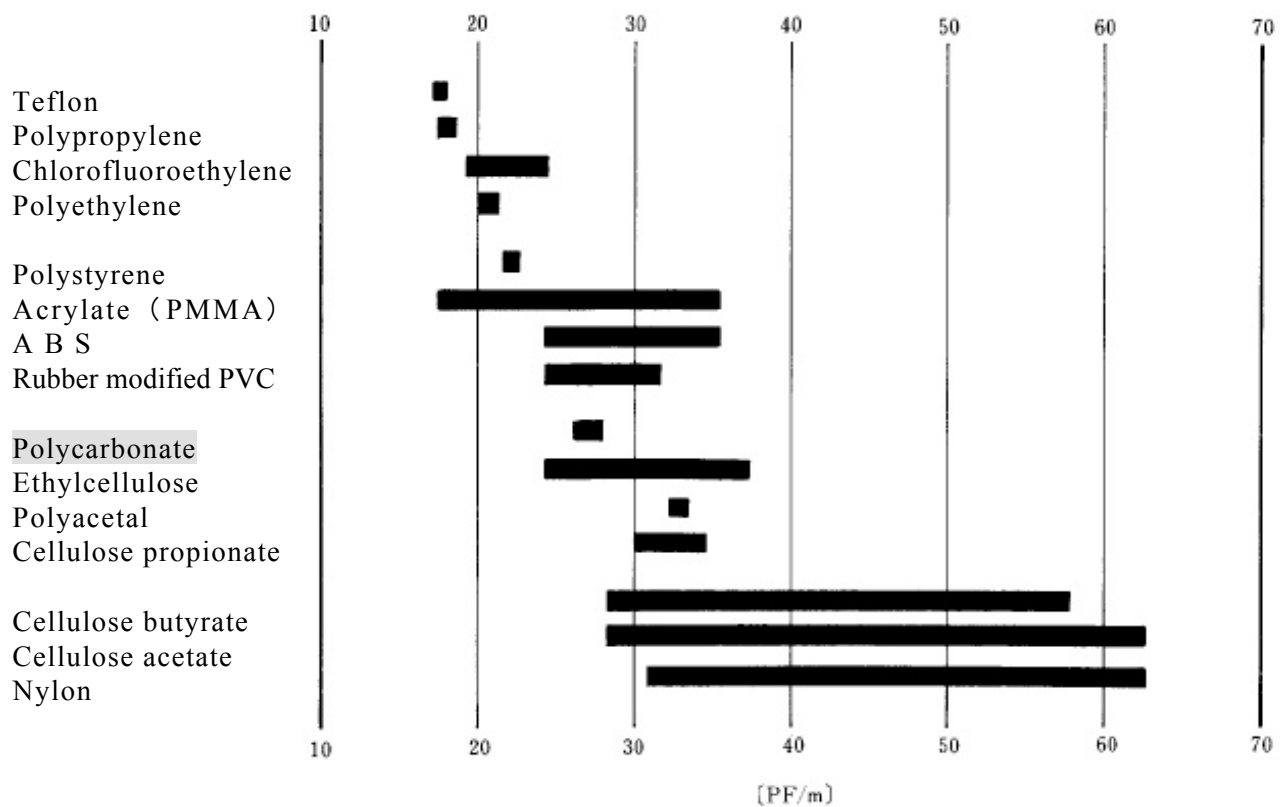


Fig. 5 · 3—3 Dielectric constant of various resins (ASTM-D150, frequency 60~ x 10⁶Hz)

5 · 4 Other Electrical Properties

5 · 4 · 1 Arc Resistance

The arc resistance of Iupilon/NOVAREX based on ASTM-D495 is

Tungsten electrode	100~120sec.
Stainless steel electrode	10~11sec

The arc resistance of Iupilon/NOVAREX after immersing in water at room temperature for 100 hours is

Tungsten electrode	93sec.
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The influence of carbon black addition on the arc resistance of Iupilon/NOVAREX, and the influence of colorant addition are shown in Table 5 · 4 · 1—1 and Table 5 · 4 · 1—2, respectively.

Table 5 · 4 · 1—1 Influence of carbon black addition on the arc resistance of Iupilon/NOVAREX (use of tungsten electrode)

$$Mv = 2.4 \times 10^4$$

Additive rate of carbon black [wt%]	0	0.01	0.03	0.1	0.3	0.6	1.0	3.0	6.0
Arc resistance [sec]	110	116	120	119	120	113	98	58	38

Table 5 · 4 · 1—2 Influence of colorant addition on the arc resistance of Iupilon/NOVAREX
(addition of 0.1wt% colorant, use of tungsten electrode)

$$M_V = 2.4 \times 10^4$$

Colorants	Arc resistance [sec]	Colorants	Arc resistance [sec]
Black	117	Green series	96
Green series	121	Cyanine blue	104
Orange series	110	Orange series	121
Blue series	119	Yellow series	116
Yellow series	119	Orange series	118
“	123	Pink series	118
Red series	107	Fluorescent pigment	122
“	118	Titanium white	119
Green series	109		

The arc resistance of various thermoplastic resins is shown in Table 5 · 4 · 1—3.

Table 5 · 4 · 1—3 Comparison of arc resistance, use of tungsten electrode

Polymers	Arc resistance	
	[sec]	Breakdown status *
Polycarbonate	110	A
Polyacetal	>240	D
66 Nylon	>140	C
Polypropylene	>140	E
6 Nylon	140	B
Polyethylene	>130	E
Polystyrene	>130	E
PBT (composite reinforced)	125	A
12 Nylon	>120	C
Polymethylmethacrylate	>120	E
AS	>120	B. E.
Polyethyleneterephthalate	120	A
PC · ABS blended product	112	A
Ionomer	>111	B. E.
High impact strength polystyrene	>95	E
ABS	93	A
Polysulphone	78	A
Modified PPE	67	A

* Breakdown status

A: arc extinction by carbonization

B: arc extinction by inflammation

C: burn, but arc does not extinct

D: leave a hole due to melting but arc does not extinct

E: burn and leave a hole but arc does not extinct

5 · 4 · 2 Tracking Resistance

The tracking resistance of polycarbonate is

IEC112 (platinum electrode)	240~260
IEC112 (brass electrode)	135~150

5 · 4 · 3 Corona Resistance

The corona resistance of polycarbonate is shown in Fig. 5 · 4 · 3-1. It indicates infinite endurance at about 30MV/m.

The corona inception voltage of Iupilon / NOVAREX is shown in Table 5 · 4 · 3-1.

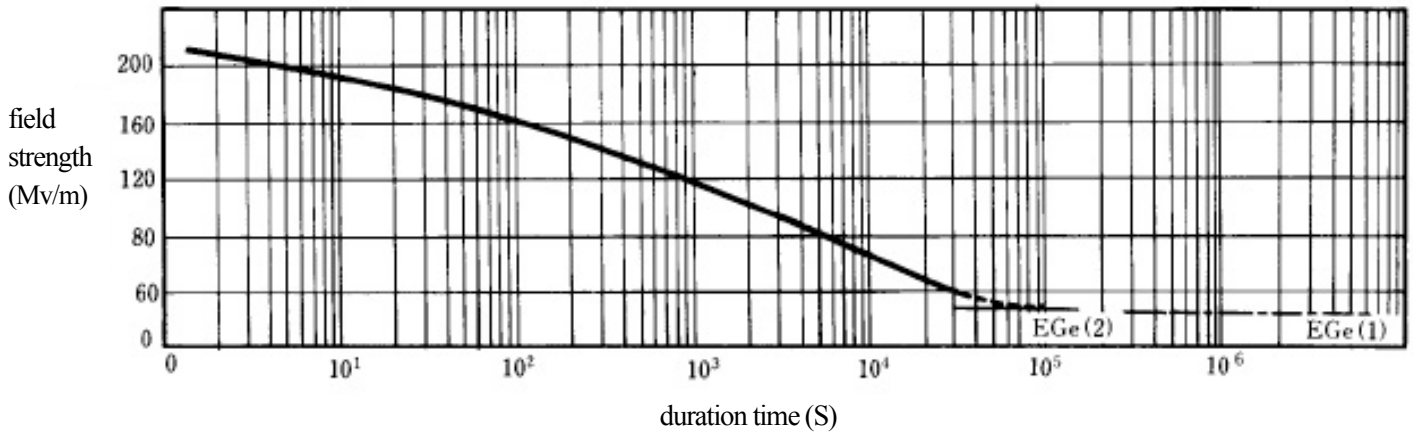


Fig. 5 · 4 · 3-1 Relation between dielectric breakdown voltage (frequency 50Hz) and exposure time of polycarbonate

Table 5 · 4 · 3-1

	Corona inception voltage (kV)	Flashover voltage (kV)
Iupilon / NOVAREX rod	45-50	Above 50
Epoxy laminated rod	50	Above 50
Phenol laminated rod	30-50	Above 40-50
Melamine laminated rod	30-50	Above 50