

**Loren Wagenaar**

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**From:** Joseph Melanson [joem-bj@msn.com]

**Sent:** Monday, April 25, 2011 2:21 PM

**To:** Loren Wagenaar

**Subject:** Front of wave chart for C57.12.00

**Attachments:** Front of wave chart 1980.pdf

Loren,

I am attaching a copy of the 1980 Table 4 with the front of wave voltages and times to flashover. The present chart in the back of C57.12.00 is different in that it includes the front of wave information for the Class I transformers as well as the Class II transformers. The other difference is the Rate of Rise column, which you can see was not in the standards. It was required in customer specifications. The rate of rise starting at 350 BIL and above should always be 1000 kV/microsecond as you can calculate from the time to flashover and Minimum Crest Voltage. If it is left on the present chart it should be revised to reflect the 1000 kV per microsecond.

The tolerance for the time to flashover has been established as + 0.3 and -0.1 microseconds. See C57.21 - 1990 paragraph 10.5.5.5 for this information.

I would like to have the chart revised to remove the rate of rise column. I don't think it offers any information that is useful, especially if you hold the test to the times and minimum voltages. There is no tolerance on the voltage if you read the heading at the top of the column.

The introductory paragraph is also in error. There are still users that specify the test, therefore the table is the only reference in the standard that provides the necessary information to perform the test. The paragraph should indicate this is still an active test. It was always an "Other" test and thus never required except by users who wanted the test performed.

Can you put a proposal on the agenda to consider revising the table?

Drop me a line and let me know what you think.

Thanks,

Joe

Table 4  
Interrelationships of Dielectric Insulation  
Levels for Transformers Used on Systems with  
BILs 2425 kV and Below

Application	BIL kV	Low Frequency Voltage Insulation Level (kV rms)	*Impulse Levels			†Front-of-Wave Impulse Levels		*Switching Surge Level (line-to- ground) (kV Crest)
			Full Wave (kV Crest)	Chopped Wave		Minimum Crest Voltage (kV)	Specific Time to Sparkover (μs)	
				(kV Crest)	Minimum Time to Flashover (μs)			
Distribution	30	10	30	36	1.0	—	—	—
	45	15	45	54	1.5	—	—	—
	60	19	60	69	1.5	—	—	—
	75	26	75	88	1.6	—	—	—
	95	34	95	110	1.8	—	—	—
	125	40	125	145	2.25	—	—	—
	150	50	150	175	3.0	—	—	—
	200	70	200	230	3.0	—	—	—
	250	95	250	290	3.0	—	—	—
	350	140	350	400	3.0	—	—	—
Power	45	10	45	54	1.5	—	—	‡20
	60	15	60	69	1.5	—	—	‡35
	75	19	75	88	1.6	—	—	‡38
	95	26	95	110	1.8	165	0.5	‡55
	110	34	110	130	2.0	195	0.5	‡75
	150	50	150	175	3.0	260	0.5	‡100
	200	70	200	230	3.0	345	0.5	‡140
	250	95	250	290	3.0	435	0.5	‡190
	350	140	350	400	3.0	580	0.58	‡280
	450	185	450	520	3.0	710	0.71	375
	550	230	550	630	3.0	825	0.825	460
	650	275	650	750	3.0	960	0.96	540
	750	325	750	865	3.0	1070	1.07	620
	825	360	825	950	3.0	1150	1.15	685
	900	395	900	1035	3.0	1240	1.24	745
	975	430	975	1120	3.0	—	—	810
	1050	460	1050	1210	3.0	1400	1.40	870
	1175	520	1175	1350	3.0	1530	1.53	975
1300	575	1300	1500	3.0	—	—	1080	
1425	630	1425	1640	3.0	—	—	1180	
1550	690	1550	1780	3.0	—	—	1290	
1675	750	1675	1925	3.0	—	—	1390	
1800	800	1800	2070	3.0	—	—	1500	
1925	860	1925	2220	3.0	—	—	1600	
2050	920	2050	2360	3.0	—	—	1700	
2175	980	2175	2500	3.0	—	—	1800	
2300	1040	2300	2650	3.0	—	—	1900	
2425	1090	2425	2800	3.0	—	—	2010	

\*Test made only when specified.

†Must be specified prior to transformer design.

‡When specified, switching surge tests are normally specified only on one winding of 450 kV BIL and higher.

These voltage values shall be used to establish the limiting induced switching surge voltage in low-voltage windings when a high-voltage winding is tested.

## Annex A

(informative)

### Front-of-wave test levels

With improved arrester technology, front-of-wave tests may not be necessary or standard for distribution or power transformers, so these tests were removed as a requirement from IEEE Std C57.12.00. Gapped silicon carbide arresters had switching characteristics that closely mimicked steep front-of-wave shapes. Metal oxide varistor (MOV) surge arresters have clamping characteristics that more nearly emulate full-wave and chopped-wave conditions. They have replaced silicon carbide arresters, negating the need for front-of-wave testing. Here in Annex A is the last published table of front-of-wave test levels from IEEE Std C57.12.00-1980, for historical reference.

<b>Front-of-wave test, voltages in kV</b>			
Note that this test is no longer specified but is documented for historical purposes.			
Lightning impulse (BIL) kV crest, $1.2 \times 50 \mu\text{s}$	Front of wave		
	kV crest	Min. time to flashover ( $\mu\text{s}$ )	Min. effective rate of rise (kV/ $\mu\text{s}$ )
Col 1	Col 2	Col 3	Col 4
30	75	0.5	125
45	75	0.5	125
60	125	0.5	210
75	165	0.5	210
95	165	0.5	275
110	195	0.5	430
125	220	0.5	430
150	260	0.5	430
200	345	0.5	575
250	435	0.5	725
350	580	0.58	850
450	710	0.71	850
550	825	0.825	850
650	960	0.96	850
750	1070	1.07	850
825	1150	1.15	850
900	1240	1.24	850
1050	1400	1.40	850
1175	1530	1.53	850
1300	—	—	—
1550	—	—	—