

Energy (Joule) Ratings Are NOT Recognized By Surge Suppression Standards

A Joule is a unit of energy defined as a Watt-second. ($J = W \cdot s$ $J = V \cdot A \cdot s$.) Joules would appear to be an ideal unit-of-measure for SPD, unfortunately, there are inherent deficiencies. Consumer class SPD use of Joule ratings for marketing purposes is a problematical way to compare suppressors. There are two fundamental problems using Joule ratings for SPD:

1. There is a common misperception that larger surge amplitudes deposit more energy into a SPD. IEEE research shows this is not the case. Energy deposited into Metal Oxide Varistors (MOVs) actually decreases as surge intensity reaches certain levels. Therefore, Joule ratings are misleading. The surge industry's technical community avoids Joule ratings in this context.

Table A.8—Energy deposited in a 130 V varistor as a function of the branch circuit length and injected peak current, with clearance flashover set at 6 kV

Peak Length (m) \ (kA)	2	3	5	7	10
10	17 J	27 J	51 J	670 mJ	220 mJ
30	17 J	130 mJ	30 mJ	23 mJ	18 mJ
50	70 mJ	35 mJ	17 mJ	11 mJ	10 mJ

Table A.8 illustrates an excerpt from IEEE C62.41.1-2002 page 63, showing that energy deposited into MOVs actually decreases upon reaching certain levels. This is a result of upstream 'flashover', a physical limitation of all distribution systems. Shaded cells indicate decreased Joules.

2. Joule determinations are open to interpretation or questionable usage. By definition, Energy is defined as Power x (multiplied by) Time. In this context, how are Power and Time defined and where are Watts actually going? Moreover, are Watts the amount of power that the SPD is exposed to (i.e. impulse size), the power passed through the SPD, or heat absorbed inside the SPD? Each of these is substantially different.

For example, the first calculation below shows Joules when the SPD gets 'clobbered' by IEEE C62.41's most severe surge. The second calculation shows trivial leakage currents for a little over six months. Joule ratings are the same but the stress on the SPD is very different.

- Assume IEEE worst case surge: C High – 10,000V, 10,000A, 20µs duration: $J = W \cdot s = V \cdot A \cdot s = 10,000V \times 10,000A \times 20\mu s = 2,000J$

- Assume 1µA leakage current through 120V MOV(s) for 193 days: $J = W \cdot s = V \cdot A \cdot s = 120V \times 1\mu A \times 193 \text{ days} = 2,001J$

In another example or Furthermore, can the SPD sustain a "Joule rating" many times, one time, or does it define failure? At least one manufacturer uses a "multiplier". For example or More specifically, if an MOV is rated 1J, but can withstand 5,000 hits, the SPD is rated 1J x 5,000 = 5,000 Joules. In summary, Joule ratings are not recognized by surge suppression Standards due to ambiguity.

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