

Specification and Test Parameters for Surge Protective Devices

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Safety and Performance. While there are many varying criteria to be considered during a design effort, if the design engineer neglects the importance of either of these two areas for the products being specified, there can be serious implications for the client.

On a typical project, an engineer may specify dozens or even hundreds of different electrical products. Determining product performance, though, can be a difficult task. The complexity of which is multiplied exponentially as the number of differing, required products increases. The most common method for determining whether or not a proposed product will meet the needed technical requirements for a project is through the review of the manufacturer's test data.

Evaluating Surge Protective Devices

As an integral part of a facility's reliability, surge protective devices (SPD) are no different from other equipment in having to deliver both safety and performance. A poorly specified SPD can pose serious consequences for the owner, equating to damaged or failed equipment, loss of productivity and loss of revenue.

Among the common questions heard by manufacturers of surge protective devices is, "How do I compare and evaluate surge suppression products?"

With various technologies and designs (not to mention sales and marketing posturing), reviewing SPD products can become a daunting task. Additionally, the engineer may not have the desire or time required to become knowledgeable about every product.

Importance of Test Data

Borrowing from the example of the lighting industry, illumination systems are one of the best known examples of where a review of manufacturer's test data is most critical. Lighting systems must be capable of illuminating a given space to a specified foot-candle rating. Photometric test data is the manufacturer's proof to the engineer that the specified lighting system will achieve the specified illumination requirements. Especially in areas related to safety, the maturity of the lighting industry has made this requirement commonplace. In fact, the need for this data is so well understood that, in many cases, it can be a legal requirement of the state or other reviewing authority, before acceptance of the installation is granted.

When using test data to review or compare products, there are several guidelines that should be followed:

- test criteria should adhere to industry recognized standards,
- be supported by other manufacturers in the same industry, and
- test results should be easily replicated.

This documented test data demonstrates, unequivocally, whether or not the product being reviewed will meet the requirements.

Establishing the Recommendation

In 1992 NEMA (the National Electrical Manufacturers Association) issued Standards Publication No. LS 1-1992 to eliminate "misunderstandings between manufacturers and the purchaser and to assist the purchaser in selecting and obtaining the proper product for their particular need" (NEMA LS 1-1992, pg. 1). Comprising 24 member companies, all manufacturers of surge protection-related products and services, NEMA adopted LS 1-1992 with the intent to establish a standard methodology for presentation and testing of the technical parameters of SPDs. Without a level playing field, no two products can be compared equally. LS 1 defined the playing surface whereby surge suppression products may be compared and evaluated.

NEMA LS 1 is a recognized Standard (NEMA LS 1-1992, pg. i), not a requirement of any standards body (or agency approval organization). In-

stead it is an industry's recommendation to its users on how to select and evaluate surge suppression products.

Document Overview

NEMA LS 1 is divided into two primary sections:

- Section 2, *Specification Parameters, Introduction and Definitions*, defines the performance parameters that make up a proper SPD specification.
- Section 3, *Test and Evaluation Parameters*, defines the methodology for determining accuracy to these parameters.

"Ultimately, it is the manufacturers' responsibility to accurately specify their product. Manufacturers should, therefore, make every effort to include applicable performance parameters" (NEMA LS 1-1992, Section 2.1).

While a portion of LS 1 discusses fairly generic information (i.e. device name, model number, intended installation location and functionality) the focus is soon shifted to the performance characteristics of the product.

Among the recommended performance criteria are:

1. Maximum Continuous Operating Voltage – The maximum steady state voltage at which the SPD device can operate (NEMA LS 1-1992, Section 2.2.6).
2. Protection Modes – The modes for which the SPD has directly connected protection elements, i.e., line-to-neutral, line-to-ground, neutral-to-ground and line-to-line (NEMA LS 1-1992, Section 2.2.7).
3. Maximum Surge Current (Single Pulse Rated) – The maximum 8/20 μ s surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. Listed by mode

(NEMA LS 1-1992, Section 2.2.9).

4. ANSI/IEEE C62.41 Clamping Voltage Data – In addition to the UL1449 clamping voltage test, NEMA recommends conducting four (4) additional tests to demonstrate clamping performance under a variety of differing conditions (waveforms). The test impulse is to be injected at the 90-degree phase angle position (peak of applied ac sine wave) and measurement is to be taken from zero voltage (i.e., the recorded clamping voltage includes the peak of the ac sine wave) (NEMA LS 1-1992, Section 2.2.10).
5. EMI-RFI Noise Rejection – Filter attenuation is directly related to the frequency of the signal. Due to the nonlinear nature of filters, NEMA recommends that manufacturers provide a continuous plot of noise rejection, also called attenuation, over the rated frequency range of the filter (NEMA LS 1-1992, Section 2.2.11).
6. Safety Agency Approvals and Ratings – Safety agency approvals (i.e., Underwriters Laboratories) denote that the SPD has passed certain requirements, most often safety related (NEMA LS 1-1992, Section 2.2.12).

To help an engineer organize the data review process, the Appendix of NEMA LS 1-1992 provides a Specification Format summary worksheet. This evaluation form provides a method of recording the recommended criteria and allowing proper comparison between multiple products.

Common Questions Asked During Product Reviews of SPDs

Q1. The product has a UL1449 – Second Edition Listing. Is this sufficient?

A1. No. The presence of a UL

mark on an electrical product is most often only an indication of product safety. For surge suppression products, in addition to many safety-related tests, UL also conducts a performance test and publishes the results along with the UL mark. The UL 1449 Limited Voltage Rating is the voltage level to which the test impulse (6,000V/500A) was reduced.

While this test does indicate SPD performance, it should not mislead a reviewer to the conclusion that the product passes every test in an equally successful manner. This approach can be likened to the assumption that the miles per gallon rating published on the window of a new car is an indication of total vehicle performance.

Q2. The manufacturer doesn't have test data available for their product. Why not?

A2. As stated previously, the NEMA Standard LS 1 is not a product requirement. Products can be taken to market without following these recommendations. Most SPD manufacturers, though, do publish the same or similar type of performance parameters as specified by NEMA.

An obvious question to pose to a manufacturer unable to provide proof of product performance is: "What is the source of the published performance numbers on the product data sheet?" The ability to verify designs beyond mere theoretical calculations is the responsibility of the manufacturer. Such testing, NEMA recommends, should be conducted.

Q3. I am reviewing the specification for a product, but the manufacturer's test data is only for the module. Is this sufficient?

A3. Most likely, no. Throughout the NEMA Standard the words "product" and "device" are used synonymously to refer to the surge suppressor as a whole. If what is being specified is only a module, then test data for that isolated component could show satisfactory perform-

Specifications for SPDs

ance. If, on the other hand, a product is to be installed, of which the module is a simply a component, then product performance *has not* been demonstrated – simply the performance of an individual component.

Conclusion

In May 2000, NEMA voted to reaffirm LS 1-1992 for another five year period and it still remains the *only* NEMA approved document for SPD specification parameters. NEMA continues to elevate awareness and understanding of SPDs and through this document, the importance of specifying and testing products in a uniform manner.

Engineers have an important responsibility and obligation to fulfill for their clients. Surge suppression products, which are designed to elevate the performance and reliability of the client's facility, should be evaluated with the same level of importance as other mission-critical pieces of equipment. NEMA provides a very straightforward approach to helping this review process go smoothly. By using the format of LS 1, an engineer will gain a better understanding of the product being specified and help ensure not only a safe, but a well performing product, for the client.

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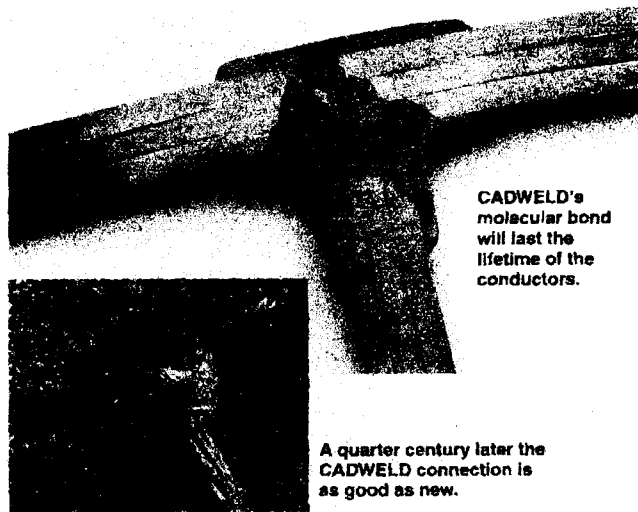
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