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Transfer Impedance Testing

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Foreword

In December 1985, the NEMA Electronic Wire and Cable Technical Committee decided to evaluate transfer impedance test procedures. The goal was to establish measurements of shield effectiveness that would provide correlation among manufacturers and end-users. A series of four round robin test programs were performed in conjunction with technical discussions about the merits of different test procedures. This program led to the development of a NEMA Transfer Impedance Test Procedure. The test program and discussions are summarized below.

First Round Robin Test—Results published in minutes of NEMA Ad Hoc Task Force on Transfer Impedance Testing, April 8, 1986. Six manufacturers tested the transfer impedance of coaxial and twisted pair samples shielded with copper tubes. No specific test method was called out, but MIL-C-85485 and the terminated triaxial fixture were the only procedures used. Correlation between test facilities and methods was sufficient to encourage testing of production cables rather than lab constructions.

Second Round Robin Test—Final results published in the minutes of the NEMA Electronic Wire and Cable Technical Committee Meeting, December 10, 1986. Samples of RG-213 and RG-58 from one lot of one source were evaluated by eight manufacturers. Correlation was not good. In some cases, the same manufacturer got varying results on the same cable type. The frequency limitations of both the terminated triaxial and the MIL-C-85485 methods became obvious.

Third Round Robin Test—Results published in Conference Report of Ad Hoc Task Force on Transfer Impedance Meeting, September 28,1987. Samples of RO-58 and RG-213 shielded with a steel tube were prepared by Belden and tested by seven manufacturers. This shielding was chosen because its transfer impedance could be calculated. Each company prepared its samples for testing per MIL-C-85485. After testing, these samples were circulated to other participants in the program. The data showed that different facilities got close results on the same samples. This implied that measurement equipment was not the significant source of the errors. This was no surprise because this transfer impedance measurement is an insertion lost test. The data demonstrated the theoretical upper frequency limit of the MIL-C-85485 method as described in the referenced paper by A. Martin and M. Mendenhall. That paper and additional testing by the Task Force suggested that the upper frequency limit could be extended from 30 MHz to 100 MHz by testing shorter samples. The most significant source of error in the test was determined to be sample preparation.

Fourth Round Robin Test—Results published in the Conference Report of Ad Hoc Task Force on Transfer Impedance Meeting, March 9, 1988. Spectra-Snip built MIL-C85485 type 1/3 m transfer impedance fixtures. These were submitted as a Standard for measurement. Four companies tested the fixtures and the correlation up to 100 MHz was excellent. The data established that different test facilities testing identically constructed stable devices would achieve the theoretical results.

Conclusion—This procedure is an effective tool for comparing shield effectiveness. Different shields over the same core, coaxial and twisted pairs, can be quantified and ranked logically. Results are repeatable. However, the method does have inherent limitations, but within its range, results can be verified with other test methods. This procedure is recommended as an efficient, effective means of evaluating cable shield performance.

This Standards Publication input of users and other interested parties has been sought and evaluated. Inquiries, comments, and proposed or recommended revisions should be submitted to the concerned NEMA product subdivision by contacting the:

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Scope

This Standard is intended to provide a reliable surface transfer impedance test method for coaxial cables and shielded multiconductor cables over the frequency range from DC to 100 MHz.