

American National Standard

Requirements for Power-Line Carrier Carrier Traps

Approved 1995

American National Standards Institute

The Institute of Electrical and Electronics Engineers, Inc.
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American National Standard—
**Requirements for
Power-Line
Carrier Line Traps**

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Foreword (This Foreword is not part of American National Standard C93.3-1995)

This document was developed by Standards Committee C93, on Power-Line Carrier Equipment and Coupling Capacitor Voltage Transformers. During its development the standard received the benefits of a consensus of input from a balanced group representing the consumer, producer, and general-interest viewpoints. These inputs were harmonized and integrated into the standard in its present approved form.

Standards Committee C93 was established to coordinate, review, and update the existing documents into an effective group of American National Standards, including this standard for line traps. A Separate standard will be developed to cover each type of equipment described in the Committee's scope.

This standard includes technical definitions, performance ratings, testing methods and manufacturing requirements for line traps. It is related to ANSI C93.1-1990, ANSI C93.4-1990.

Suggestions for improvement of this standard are welcome. They should be sent to:

Secretary, ANS C93, Power-Line Carrier
National Electrical Manufacturers Association
1300 N. 17th Street, Suite 1847
Rosslyn, Virginia 22209

This standard was processed and approved for submission to ANSI by Accredited Standards Committee C93 on Power-Line Carrier Equipment and Coupling Capacitor Voltage Transformers. Committee approval of this standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the C93 Committee had the following members:

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Requirements for Power-Line Carrier Line Traps

1 Scope

This standard applies to a line trap inserted into a power circuit to minimize carrier-frequency signal losses. The standard covers line traps in which the main coil is designed as a single phase, air-cooled inductor of the dry type.

2 Normative references

When the following standards referred to in this document are superseded the revision shall apply:

ANSI C29.8-1985, *American National Standard for Wet-Process Porcelain Insulators (Apparatus, Cap and Pin Type)*

ANSI C84.1-1992, *American National Standard for Voltage Ratings for Electrical Systems and Equipment (60 Hz)*

ANSI C92.2-1981, *American National Standard for Preferred Voltage Ratings for Alternating-Current Electric Systems and Equipment Operating at Voltages above 230 Kilovolts Normal*

ANSI C93.1-1990, *American National Standards Requirements for Power Line Carrier Coupling Capacitors & Coupling Capacitor Voltage Transformers*

ANSI/IEEE 4-1978, *American National Standard for Techniques for Dielectric Tests*

ANSI/IEEE C62.11-1987, *American National Standard for Metal-Oxide Surge Arresters for AC Power Circuits*

ANSI/IEEE 100-1988, *American National Standard for Dictionary of Electrical and Electronics Terms*

ANSI/IEEE C57.21-1990, *IEEE Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500kVA*

NEMA Standards Publication 107, *Methods of Measuring Radio Noise*

NEMA Standards Publication CC 1, *Electrical Power Connectors for Substations*

3 Definitions

All definitions, except as specifically covered in this standard, shall be in accordance with ANSI/IEEE 100 and ANSI C93.1.

3.1 Auxiliary protective device: A device associated with the tuning device to protect individual components by limiting transient overvoltages.

3.2 Bandwidth: The frequency range within which the blocking impedance is not less than a specified amount.

- 3.3 Blocking impedance:** The complex impedance of the complete line trap within a specified carrier-frequency range.
- 3.4 Emergency overload current:** A value of power frequency current, greater than the rated continuous current, which the line traps may be required to carry for some limited period of time.
- 3.5 Geometric mean frequency (GMF):** The geometric mean of the bandwidth limit frequencies, which is the square root of their product.
- 3.6 Inductance**
- 3.6.1 Apparent power-frequency inductance (L_p):** The reactance of the main coil divided by the angular frequency at which the reactance is determined, uncompensated for the effects of self-capacitance.
- 3.6.2 Rated inductance (L_m):** The minimum value of true inductance determined at 100 kHz.
- 3.6.3 True inductance (L):** The self-inductance of the main coil at a specified frequency, compensated for the effects of the self-capacitance.
- 3.7 Line trap:** A main coil with a protective device, with or without tuning device(s), series connected in a power circuit to provide a high impedance at carrier frequencies, and negligible impedance at the power frequency.
- 3.8 Main coil:** An inductor which carries the power frequency current.
- 3.9 Protective device:** A device that protects the line trap by limiting transient overvoltages. It is shunt-connected to the tuning device and the main coil.
- 3.10 Rated blocking impedance (Z_b):** The minimum value of blocking impedance over the bandwidth.
- 3.11 Rated continuous current (I_m):** The rms power frequency current which the line trap can carry continuously without exceeding the maximum temperature rise for its insulation temperature index.
- 3.12 Rated short-time current (I_{km}):** The rms symmetrical value of current which a line trap is capable of carrying for two seconds without exceeding a specified temperature.
- 3.13 Resistive bandwidth:** The frequency range within which the resistive blocking impedance is not less than a specified amount.
- 3.14 Resistive blocking impedance (R_b):** The resistive component of the blocking impedance.
- 3.15 Resonant frequency:** The frequency or frequencies to which the line trap is tuned.
- 3.16 Self-capacitance (C_s):** The capacitance resulting from the turn-to-turn, layer-to-layer and terminal-to-terminal configuration of the main coil.
- 3.17 Self-resonant frequency:** The frequency at which the combination of true inductance and self-capacitance becomes resonant.
- 3.18 Self-tuned trap:** A line trap without a tuning device and for wide-band operation designed such that the self-resonant frequency is in the carrier band.

3.19 Single-frequency line trap: A line trap which is adjustably tuned for parallel resonance at one selected carrier frequency.

3.20 Tapping loss (A_t): A loss A_t sustained by a carrier-frequency signal due to the finite blocking ability of the line trap. It is defined in terms of the ratio of the signal voltages across an impedance equal to the characteristic impedance of the transmission line with and without the shunt connection of the line trap and is expressed in decibels.

3.21 Tapping loss based on blocking impedance (A_{bt}): The loss A_{bt} , expressed in decibels, sustained by a carrier-frequency signal due to the shunt connection of the line trap impedance.

3.22 Tuning device: A passive network which, when shunt-connected to the main coil, produces a relatively high line trap impedance for one or more frequencies or frequency bands. It consists of capacitors and may include inductors, resistors and auxiliary protective devices.

3.23 Tuning range: The portion of the carrier frequency band through which the geometric mean frequency or resonant frequency may be adjusted.

3.24 Two-frequency line trap: A line trap which is adjustably tuned for parallel resonance at two selected carrier frequencies.

3.25 Wideband line trap: A line trap which provides a greater bandwidth than a single-frequency line trap for the same main coil inductance, resonant (or geometric mean) frequency, and impedance level.

4 Service conditions

4.1 Usual service conditions

- 1) Outdoor service
- 2) Ambient temperature range: -40°C to $+45^{\circ}\text{C}$. With regard to temperature range, table 1 defines the upper ambient temperature limit conditions.
- 3) Maximum altitude: 3300 feet (1000 meters) above sea level.
- 4) Power frequency: 50Hz or 60Hz.
- 5) Atmosphere free of damaging fumes or excessive or abrasive dust, explosive mixtures of dust or gases, steam, and salt spray.
- 6) Carrier frequency range 30–500 kHz.

4.2 Unusual service conditions

4.2.1 Ambient temperature

When a line trap is applied in ambient temperatures that exceed the limits specified in table 1, the allowable temperature rise shall be reduced by the same number of degrees the ambient temperature exceeds the upper temperature limit.

Table 1 – Upper ambient temperature limit conditions

Maximum Ambient Temperature Limit Conditions (Degrees Celsius)		
Mean Over 1 Hour	Mean Over 24 Hours	Mean Over 1 Year
45	40	30

4.2.2 Altitude

4.2.2.1 Temperature rise

Line traps may be used at altitudes greater than 3300 feet (1000 meters) provided that the current correction factors in table 2 are applied and the temperature of the cooling air does not exceed the mean values given in table 3.

Table 2 – Current correction factors

Altitude (Above Sea Level)	Correction Factor
3,300 feet (1,000 meters)	1.00
5,000 feet (1,500 meters)	.99
10,000 feet (3,000 meters)	.96

Table 3 – Altitude versus temperature

Maximum Mean Temperature of Cooling Air Over 24 Hours	
Altitude (Above Sea Level)	Air (Degree Celsius)
3,300 feet (1,000 meters)	40
5,000 feet (1,500 meters)	37
10,000 feet (3,000 meters)	30

4.2.2.2 Dielectric strength

When a line trap is applied at altitudes greater than 3,300 feet (1,000 meters), the dielectric strength correction factors for air-insulated components as given in table 4 shall apply.

Table 4 – Dielectric strength correction factors

Altitude (Above Sea Level)	Correction Factor
3,300 feet (1,000 meters)	1.00
5,000 feet (1,500 meters)	.95
10,000 feet (3,000 meters)	.80