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ANSI/ASHRAE Standard 41.11-2023
Standard Methods for Power Measurement

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NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE website at www.ashrae.org/technology.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

Whether electrical power measurements are to be taken in a laboratory or in the field, selecting the appropriate instruments and components should be based on the required measurement accuracy. Once an instrument has been selected, the user may need to consult with the instrument manufacturer regarding installation specifics, operating range limits, calibration limits, and other performance specifics in order to obtain the expected measurement accuracy.

Working with electricity can be hazardous. Users of this standard are cautioned to obtain appropriate electrical safety training and equipment at the outset. For example, NFPA 70E, Standard for Electrical Safety in the Workplace *[A1], and OSHA 29 CFR 1910, Subpart S [A2] describe all of the safety equipment required to perform energized equipment measurements, including arc-flash protection, approach boundaries, and other personal protective equipment.*

The 2023 edition of Standard 41.11 includes updated methods for determining when steady-state operation has been achieved for data recording, as well as changes to make it easier for higher-tier standards to adopt this standard by reference. This standard meets ASHRAE's mandatory language requirements.

1. PURPOSE

This standard prescribes methods for power measurements.

2. SCOPE

This standard applies to power measurements under laboratory and field conditions when testing heating, ventilating, air-conditioning, and refrigerating systems and components.

3. DEFINITIONS

accuracy: the degree of conformity of an indicated value to the corresponding true value.

active power: see *power, active.*

apparent power: see *power, apparent.*

constant-speed drive (CSD): a device fitted between a rotating power source and the rotating load to achieve constant rotational speed regardless of the power source rotational speed. Compare to *variable-speed drive*.

crest factor: the ratio of peak value to root-mean-square (RMS) value of a waveform.

current shunt: a low-resistance device used to measure current in a circuit. Measure the voltage and apply Ohm's Law to calculate the current.

current transducer: a current transducer (sensor) is a device that detects electrical current (AC or DC) in a conductor and generates a signal proportional to it. The combinations of sensed current and the output signal are as follows:

a. Alternating current (AC) input with
   1. analog output that duplicates the wave shape of the sensed current.
   2. bipolar output that duplicates the wave shape of the sensed current.
   3. unipolar output that is proportional to the average or RMS value of the sensed current.

b. Direct current (DC) input with
   1. unipolar output that duplicates the wave shape of the sensed current.
   2. digital output that switches where the sensed current exceeds a certain threshold.

current transformer (CT): a transformer intended to have its primary winding connected in series with a circuit carrying the current to be measured or controlled; the current is measured across the secondary winding.

energy: capability to do work, J ($ft \cdot lb_f$). Forms include chemical, electrical, mechanical, and thermal. Energy may be either stored or transient and can be transformed from one form into another. Compare to *power*.

error: the difference between the observed value of the measurand and its corresponding true value.

harmonics: currents or voltages with frequencies that are integer multiples of the fundamental power frequency.

linear: sinusoidal waveform (for example, a constant-speed drive).

measurement system: the instruments; signal conditioning systems if any; and data acquisition system if any.