ANSI/AHRI Standard 1211 (SI) with Addendum 1

2011 Standard for

Performance Rating of Variable Frequency Drives

Approved American National Standard

ANSI

Approved by ANSI on April 17, 2012

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ANSI/AHRI STANDARD 1211 (SI)-2011 WITH ADDENDUM 1

Performance Rating of Variable Frequency Drives
June 2013

Addendum 1 (dated June 2013) of ANSI/AHRI Standard 1211 (SI)-2011, "*Changes to ANSI/AHRI Standard 1211 (SI)-2011"* is provided as follows. The following changes have been incorporated (deletions are shown by ~~strikethroughs~~, additions are shown by shading) into the already published 2011 version of ANSI/AHRI Standard 1211 (SI) to avoid confusion:

Note: This addendum was approved by ANSI on October 1, 2013.

The changes include:

1. Remove 16% from Table 3 and replace with 25% to align with values in Table 2.

Table 3. Speed/Torque Test Points for Powerline Harmonics Test

		Percent Torque		
		~~16%~~25%	56%	100%
Percent Speed	40%			CT
	50%	VT		CT
	75%		VT	CT
	100%			CT/VT

Notes:
1. Output frequency or other readouts from the VFD shall not be used to determine percent speed.

2. Only those cells that contain CT or VT are test points

2. Remove I_3 and I_9 from Table 5 and add units of amps for current in Table 5.

Table 5. Reported Harmonic Current

Size (hp)	Reported R_{SCE}	Reported Individual Harmonic Current[1], I_n/I_1[a] (%) at 100% Load(%)						Reported Harmonic Current Distortion Factors, (%) up to 40th Harmonic
		~~I_3~~	I_5	I_7	~~I_9~~	I_{11}	I_{13}	*THD*

Note 1: Report individual harmonic current (A) arithmetic average value based on the three line currents.

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IMPORTANT

SAFETY DISCLAIMER

AHRI does not set safety standards and does not certify or guarantee the safety of any products, components or systems designed, tested, rated, installed or operated in accordance with this standard/guideline. It is strongly recommended that products be designed, constructed, assembled, installed and operated in accordance with nationally recognized safety standards and code requirements appropriate for products covered by this standard/guideline.

AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that any tests conducted under its standards/guidelines will be non-hazardous or free from risk.

Note:

This is a new standard.

This standard seeks to provide an uniform method of measuring and comparing Variable Frequency Drives by establishing testing and rating requirements; specifically data requirements for Drive System Efficiency, Power Line Harmonics and Motor Insulation Stress.

For I-P ratings, see ANSI/AHRI Standard 1210 (I-P)-2011

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TABLE OF CONTENTS

SECTION		PAGE
Section 1.	Purpose	1
Section 2.	Scope	1
Section 3.	Definitions	1
Section 4.	Classifications	2
Section 5.	General Test Requirements	3
Section 6.	Rating Requirements	6
Section 7.	Minimum Data Requirements for Published Requirements	6
Section 8.	Marking and Nameplate Data	7
Section 9.	Conformance Conditions.	7

TABLES

Table 1A.	Voltage Classes	3
Table 1B.	Power Classifications	3
Table 2.	Speed/Torque Test Points for Drive System Efficiency and Motor Stress Insulation Tests	4
Table 3.	Speed/Torque Test Points for Powerline Harmonics Test	4
Table 4.	VFD to Motor Conductor Sizes	5
Table 5.	Reported Harmonic Current	6

APPENDICES

Appendix A.	References – Normative	8
Appendix B.	References – Informative	9
Appendix C.	Method of Testing Rating Variable Frequency Drives - Normative	10

FIGURES FOR APPENDICES

Figure C1.	Test Set-up for Drive System Efficiency and Powerline Harmonics Test Methods	11

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PERFORMANCE RATING OF VARIABLE FREQUENCY DRIVES

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish for Variable Frequency Drives (VFDs): definitions; classifications; general test requirements; rating requirements; minimum data requirements for Published Ratings; marking and nameplate data; and conformance conditions.

1.1.1 *Intent.* This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users.

1.1.2 *Review and Amendment.* This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope.* This standard applies, within the heating, ventilating, air-conditioning and refrigeration (HVACR) context, to VFDs used in the control of asynchronous induction motors. The range includes all those found within a building including: low voltage (≤ 600 V) and drives that are stand alone, not mechanically integrated into motors.

2.2 *Exclusions.* This standard does not apply to VFDs applied to motors other than those listed above.

Section 3. Definitions

All terms in this document follow the standard industry definitions in the current edition of ASHRAE *Terminology of Heating, Ventilation, Air Conditioning, and Refrigeration* unless otherwise defined in this section.

3.1 *Carrier Switching Frequency*. The frequency at which the power output devices of a VFD are switched on and off.

3.2 *Constant Torque (CT)*. Applications where the torque requirement of the driven load remains constant or nearly so over the normal speed range of use. Positive-displacement pumps and reciprocating compressors are examples of constant-torque loads.

3.3 *Drive System Efficiency*. Ratio of the output power from the motor to the input power of the VFD including motor and VFD losses.

3.4 *Equipment Under Test (EUT)*. Test sample.

3.5 *Motor Insulation Stress*. The voltage stress placed on a motor's insulation due to high Peak Voltages and short-rise times that occur when the motor is driven by a VFD.

3.6 *Motor Thermal Equilibrium*. When the observed temperature rise of the motor winding does not vary more than 1K over a period of 30 minutes, or when the observed motor frame or core temperature rise does not vary more than 1K over a period of 60 minutes.

3.7 *Peak Voltage*. The maximum instantaneous voltage measured at a motor's terminals when operated from a VFD.

3.8 *Percent Speed*. The percentage of rated motor rpm as measured.

3.9 *Percent Torque.* The percentage of the motor rated Full Load torque.

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3.10 *Power Line Harmonics*. Components of the power line voltage and current at the input of the VFD that are integer multiples of the fundamental sinusoidal frequency of the power source (example 60 Hz).

3.11 *Published Rating.* A rating of the assigned values of those performance characteristics, under stated Rating Conditions, by which a unit may be chosen to fit its application. These values apply to all units of like nominal size and type (identification) produced by the same manufacturer. As used herein, the term Published Rating includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated Rating Conditions.

3.11.1 *Application Rating.* A rating based on tests performed at application Rating Conditions (other than Standard Rating Conditions).

3.11.2 *Standard Rating.* A rating based on tests performed at Standard Rating Conditions.

3.12 *Rating Conditions.* Any set of operating conditions under which a single level of performance results and which causes only that level of performance to occur (e.g. line voltage, ambient temperature).

3.12.1 *Standard Rating Conditions.* Rating Conditions used as the basis of comparison for performance characteristics.

3.13 *"Shall" or "Should."* "Shall" or "should" shall be interpreted as follows:

3.13.1 *Shall.* Where "shall" or "shall not" is used for a provision, that provision is mandatory if compliance with the standard is claimed.

3.13.2 *Should.* "Should" is used to indicate provisions which are not mandatory but are desirable as good practice.

3.14 *Short Circuit Ratio (R_{SCE}).* The short-circuit power at the point of common coupling (PCC), divided by the rated apparent power of the drive and as defined in IEC Standard 61000-3-12, Section 3.14 Subsection C.

3.15 *Supply Voltage (V_s).* The line to line input voltage to the equipment at time of testing.

3.16 *System Loss*. The combination of electrical and mechanical losses represented by the difference between input power to the drive and output power from the motor.

3.17 *Total Harmonic Distortion*. A measure of power line distortion that sums the contributions of the individual harmonics. VFDs typically only contribute odd numbered harmonics with a decreasing impact of the higher order harmonics.

3.18 *Variable Frequency Drive (VFD).* A power electronic device that regulates the speed of an alternating current (AC) motor by adjusting the frequency and the voltage of the electrical power supplied to the motor.

3.19 *Variable Torque (VT)*. Applications where the torque requirement of the driven load is reduced as speed is reduced. Centrifugal fans and pumps are examples of variable-torque (VT) loads.

3.20 *Voltage Class*. The range of utilitization voltages that categorize equipment.

3.21 *Voltage Rise Time (dv/dt).* The time required for the voltage to increase, measured at the motor terminals when operated from a VFD, from 10% to 90% of the VFD steady state DC bus voltage.

Section 4. Classifications

4.1 *Classifications*. VFDs falling within the scope of this standard based on Voltage Class specified in Table 1A. shall be classified as shown in Table 1B.

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