PACIFIC POWER SOURCE
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ISO 5151 Standard HVAC Testing & AC Power Requirements

Supplying Clean and Stable AC Power to Test Setups

Applicable to:
ADF Series
AFX Series
LSX Series

1 Abstract

This application note addresses the required AC grid immunity test requirement for non-ducted commercial and industrial Air Conditioners and Heat Pumps (HVAC) of all sizes to meet the ISO 5151-2017 Test Standard and other related national product test standards. The use of a programmable AC power source is required to meet these international and national standards. Pacific Power Source offers a variety of solutions for these tests at suitable power levels and phase output configuration to meet these requirements. This is particularly relevant to AC unit manufacturers and commercial compliance test labs. Note that additional equipment is required to test and evaluate cooling performance as well.

2 Climate Change drives HVAC Markets

Rising average global temperatures, a growing world population and increasing urbanization are driving demand for HVAC equipment world-wide. This puts increasing pressure on operating efficiency and reduced energy consumption for this type of equipment. As demand for these products grows, testing performance to international standards and regulations becomes increasingly important.

3 AC Power Test Requirements per ISO 5151-2017

The ISO 5151 is an international standard for Non-ducted Air Conditioner and Heat Pumps. Other standards apply for specific countries and other Air Conditioner types such as ISO 13253, ISO 15042, GB/T 7725, GB 21455, ARI-310/380, JIS B 8515 & JIS C 9612. Most of these standards require similar high line and low line AC input voltage immunity tests to ensure adequate performance under adverse AC grid conditions.

The use of a stable solid-state programmable AC power source is imperative to ensure testing to AC voltage and Frequency variations and excursion that often occur on public power grids, especially in developing countries. Pacific Power Source offers a range of models at various power levels to match the power, voltage and frequency requirements of a wide range of air conditioner equipment.

4 Air Enthalpy Calorimeter Room Test Setup

When using the indoor air enthalpy method as illustrated in Figure 1, the data collection period shall be extended until 3 hours have elapsed or until the heat pump completes three complete cycles during the period, whichever occurs first. If at an elapsed time of 3 hours, the heat pump is conducting a defrost cycle, the cycle shall be completed before terminating the collection of data. A complete cycle consists of a heating period and a defrost period; from defrost termination to defrost termination.

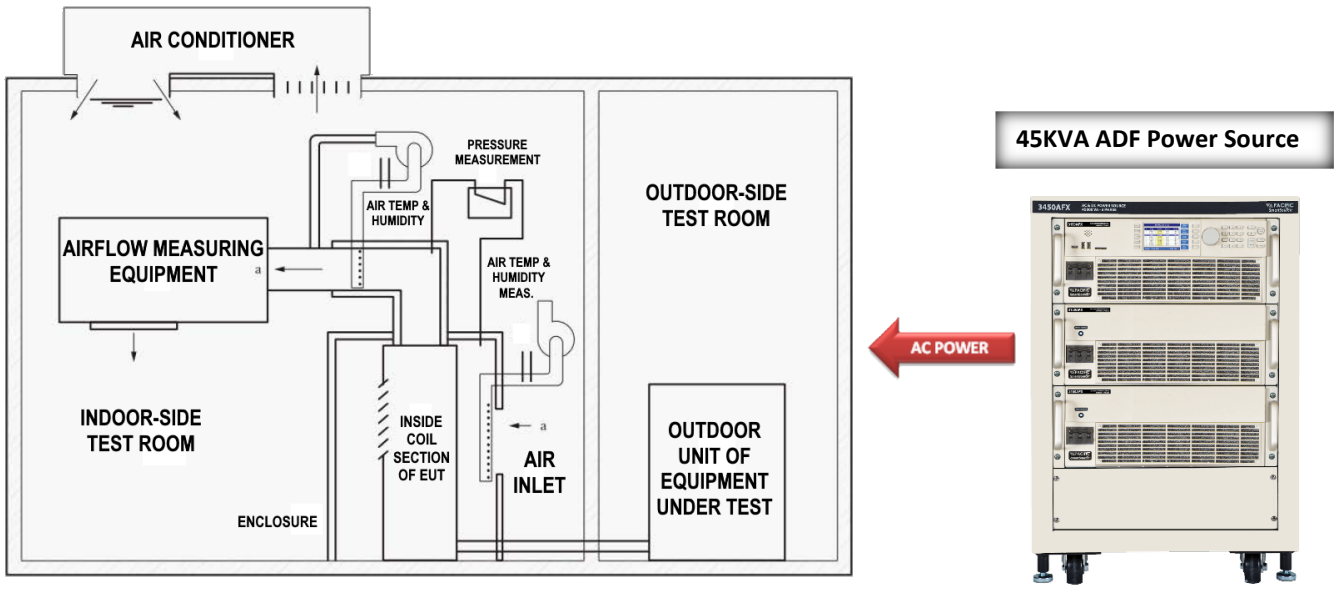

Figure 1: Air Enthalpy Calorimeter Room Test Setup

The use of a programmable AC power source ensures no grid anomalies will affect the unit under test and any AC line current noise that may exist in the local power grid is eliminated due to the AC input to output galvanic isolation of the AC power source. It also allows for testing at both 50Hz and 60Hz for systems that may be exported to different countries.

5 Balanced Room-Type Calorimeter Room Test Setup

If using the calorimeter method as illustrated in Figure 2, the data collection period shall be extended until 6 hours have elapsed or until the heat pump completes six complete cycles during the period, whichever occurs first. If at an elapsed time of 6 h, the heat pump is conducting a defrost cycle, the cycle shall be completed before terminating the collection of data. A complete cycle consists of a heating period and a defrost period; from defrost termination to defrost termination.

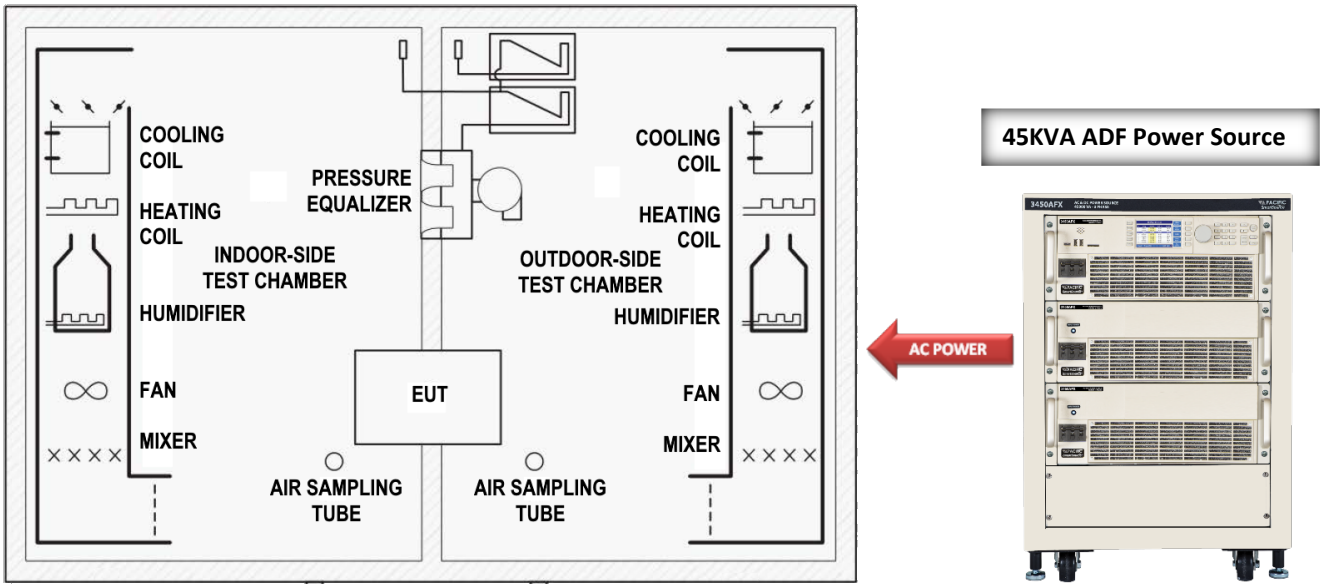

Figure 2: Balanced Room-Type Calorimeter Room Test Setup

6 AC Voltage Test Levels

Air conditioning equipment is required to have a name plate stating its required AC input voltage range, frequency, and power. This may be a fixed voltage and frequency or a voltage and frequency range such as 120Vac ~ 240Vac and 50/60Hz ±3Hz.

The ISO 5151-2017 test standard stipulates the required test voltage for a range of nominal AC voltage ratings in Table 2 shown below. It also specifies what test voltages to use for equipment with a wider voltage input range or dual voltage range.

Table 2 — Voltages for capacity and performance tests

Rated (nameplate) voltage[a] V	Test voltage[b] V
90 to 109	100
110 to 127	115
180 to 207	200
208 to 253	230
254 to 341	265
342 to 420	400
421 to 506	460
507 to 633	575

[a] For equipment with dual-rated voltages, such as 115/230 and 220/440, the test voltages would be 115 V and 230 V in the first example, and 230 V and 460 V in the second example. For equipment with an extended voltage range, such as 110 V to 120 V or 220 V to 240 V, the test voltage would be 115 V or 230 V, respectively. Where the extended voltage range spans two or more of the rated voltage ranges, the mean of the rated voltages shall be used to determine the test voltage from this table.

EXAMPLE For equipment with an extended voltage range of 200 V to 220 V, the test voltage would be 230 V, based on the mean voltage of 210 V.

[b] The voltages in this table are for capacity and performance tests other than the maximum cooling and the maximum heating performance tests.

Figure 3: ISO 5151 - Table 2 Test AC Voltages

Air conditioners may use single phase, split phase or three phase forms of AC input voltage so using a programmable AC power source that supports all three phase modes is advantageous. The size of the programmable AC power source should be chosen based on the largest Air Conditioner that needs to be tested so the power source has sufficient load current available for the low voltage line tests at 90% of nominal voltage. This means the power level of the AC source should be selected carefully to meet the worst-case test requirement.

7 Maximum Cooling Performance Test – Voltage Settings

Per Table 3 of the ISO 5151-2017 standard, performance testing of an Air Conditioning unit is to be done at both Low Line (90%) and High Line (110%) of nameplate voltage rating. This requires the use of programmable AC power source with sufficient accuracy. All Pacific Power Source models exceed the requirements for voltage accuracy for these tests.

Table 3 — Maximum cooling performance test conditions

Parameter	Standard rating conditions		
	T1	T2	T3
Temperature of air entering indoor-side:			
— dry-bulb	32 °C	27 °C	32 °C
— wet-bulb	23 °C	19 °C	23 °C
Temperature of air entering outdoor-side:			
— dry-bulb	43 °C	35 °C	52 °C
— wet-bulb[a]	26 °C	24 °C	31 °C
Test frequency[b]	Rated frequency		
Test voltage	a) 90 % and 110 % of rated voltage with a single nameplate rating; b) 90 % of the lower rated voltage and 110 % of the higher rated voltage for units with a dual or extended nameplate voltage.		

[a] The wet-bulb temperature condition shall only be required when testing air-cooled condensers that evaporate the condensate.

[b] Equipment with dual-rated frequencies shall be tested at each frequency.

Figure 4: ISO 5151 - Table 3 Maximum Cooling Performance test Voltage and Frequency

8 Power Measurements Reporting

The reporting requirements for ISO 5151-2017 per Tables 13 and 14 for the calorimeter test method and Table 15 for the air enthalpy test method include the following electrical parameters to be measured with a measurement uncertainty better than 0.5% and included in the test report. Furthermore, the AC test voltage applied during these tests much be within a mean of 1.0% and no more than 2.0% max.

Item	Data
5	Applied AC Voltage, in Vrms
6	Frequency, in Hz
7	Total current input to the equipment, in Arms
8	Total power input to the equipment, in Watts, except if more than one external power connection is provided on the equipment; record input to each connection separately.

The Pacific Power ADF, AFX and LSX Series AC power source provide all measurements required, exceeds the required measurement accuracies, and includes data logging for these measurements as a standard feature.

9 Customer Support

For application support, contact Pacific Power Source's Customers Service - Toll Free US: +1 (800) 854-2433 / support@pacificpower.com or your local authorized Pacific Power Source distributor.

Recommended AC Power Source models for HVAC System test:

Model 120LSX single phase, 2kVA AC Source for small HVAC units.

Model 3150ADF Single or Three Phase, 15kVA to 150kVA AC Source for medium to high power HVAC units.

Model 3150AFX Single, Split and Three Phase capable, 6kVA to 180kVA AC & DC Source for medium to high power HVAC units.

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