



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS C 8962 : 2008

(JEMA)

**Testing procedure of power
conditioner for small photovoltaic
power generating systems**

ICS 27.160

Reference number : JIS C 8962 : 2008 (E)

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Date of Establishment: 1997-07-20

Date of Revision: 2008-02-20

Date of Public Notice in Official Gazette: 2008-02-20

Investigated by: Japanese Industrial Standards Committee
Standards Board

Technical Committee on Electricity Technology

JIS C 8962:2008, First English edition published in 2008-07

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

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Printed in Japan

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Electrical Manufacturers' Association (JEMA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS C 8962:1997** is replaced with this Standard.

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Testing procedure of power conditioner for small photovoltaic power generating systems

Introduction

This Japanese Industrial Standard is a revised edition of **JIS C 8962** which was established in 1997.

No corresponding International Standard has been published at this point.

1 Scope

This Standard specifies the test methods for stand-alone power conditioners of constant a.c. output voltage and constant output frequency, d.c. power conditioners of constant output voltage and utility-connected power conditioners, all of which are power conditioners for photovoltaic power generating system complying with **a)** and **b)** below.

The test methods of utility interaction protective function and utility interaction protective device, as components of utility-connected power conditioner, are excluded. Further, only the accumulator device connected with the input side of conditioner is the object of this test and the power conditioner to be combined with the accumulator device shall be tested with the accumulator device removed.

- a) In the case where the rated output power is 10 W or over to and excl. 100 W
 - 1) D.C. input and output voltage: 30 V or over up to and incl. 750 V
 - 2) A.C. output voltage: 30 V or over up to and incl. 600 V
- b) In the case where the rated output power is 100 W or over to and excl. 20 kW
 - 1) D.C. input and output voltage: 750 V or under
 - 2) A.C. output voltage: 600 V or under

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS C 0010 *Environmental testing Part 1: General and guidance*

JIS C 1302 *Insulation resistance testers*

JIS C 1509-1 *Electroacoustics—Sound level meters—Part 1: Specifications*

JIS C 8905 *General rules for stand-alone photovoltaic power generating system*

JIS C 8960 *Glossary of terms for photovoltaic power generation*

JIS C 8961 *Measuring procedure of power conditioner efficiency for photovoltaic systems*

JIS C 8980 *Power conditioner for small photovoltaic power generating system*

JIS C 60068-2-38 *Basic environmental testing procedures Part 2: Tests Test Z/AD: Composite temperature/humidity cyclic test*

JIS Z 8731 *Acoustics—Description and measurement of environmental noise*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS C 8905** and **JIS C 8960** and the following apply:

3.1 photovoltaic array simulation power supply

a d.c. power supply which can simulate output I–V characteristic of photovoltaic array

3.2 equivalent solar irradiation

an assumed solar irradiation for determination of output power capacity of a photovoltaic array simulation power supply

3.3 multi-input type power conditioner

power conditioner having plural input circuits

4 Test items

In this Standard, the test methods for the items stated in table 1 are described. Application of individual items is determined in accordance with **JIS C 8980**. Other tests, if carried out, are subjected to agreement between the parties concerned with acceptance.

Table 1 Test items and their applicability of power conditioners for photovoltaic power generating system

Test item		D.C. power conditioner		Stand-alone power conditioner of a.c. output		Utility-connected power conditioner	
		With accumulator device	Without accumulator device	With accumulator device	Without accumulator device	With accumulator device	Without accumulator device
1 Insulation resistance test		○	○	○	○	○	○
2 Dielectric withstand voltage test		○	○	○	○	○	○
3 Lightning impulse withstand voltage test		○	○	○	○	○	○
4 Leak current test		○	○	○	○	○	○
5 Protective function test	a) Input overvoltage and undervoltage protective function test	○	○	○	○	○	○
	b) Input overcurrent protective function test	○	○	○	○	○	○
	c) Output overcurrent protective function test	○	○	○	○	○	○
	d) Output overvoltage and undervoltage protective function test	○	○	○	○	○	○
	e) Input side ground-fault protective function test	○	○	○	○	○	○

Table 1 (continued)

Test item		D.C. power conditioner		Stand-alone power conditioner of a.c. output		Utility-connected power conditioner	
		With accumulator device	Without accumulator device	With accumulator device	Without accumulator device	With accumulator device	Without accumulator device
5 Protective function test	f) Output side ground-fault protective function test	○	○	○	○	○	○
	g) Current limiting and power limiting function test	○	○	○	○	○	○
	h) Temperature rise protective function test	○	○	○	○	○	○
	i) Frequency increase and decrease protective function test			○	○	○	○
	j) Test of protective function to prevent direct current from leaking			○	○	○	○
	k) Unbalanced excess voltage protective function test			○	○	○	○
	l) Output voltage rise restrictive function test					○	○
6 Steady state characteristic test	a) Efficiency test	○	○	○	○	○	○
	b) No-load loss test	○	○	○	○	○	○
	c) Overload capability test	○	○	○	○	○	○
	d) Manual start and stop test	○	○	○	○	○	○
	e) Temperature rise test	○	○	○	○	○	○
	f) Input constant voltage accuracy test	○	○	○	○	○	○
	g) D.C. input current ripple test	○	○	○	○	○	○
	h) D.C. output voltage ripple test	○	○				
	i) Output constant voltage accuracy test	○	○	○	○		
	j) Power factor range test			○	○		
	k) Output frequency accuracy test			○	○		
	l) A.C. output voltage distortion test			○	○		
	m) Output voltage unbalance test			○	○		
	n) Stand-by loss test					○	○
	o) Automatic start and stop test					○	○
	p) A.C. output power factor test					○	○
	q) Voltage and frequency following range test					○	○
	r) A.C. output current distortion test					○	○
	s) Utility voltage distortion test					○	○
	t) Utility unbalance test					○	○
	u) Isolated operation function test					○	○

Table 1 (concluded)

Test item		D.C. power conditioner		Stand-alone power conditioner of a.c. output		Utility-connected power conditioner	
		With accumulator device	Without accumulator device	With accumulator device	Without accumulator device	With accumulator device	Without accumulator device
7 Transient response characteristic test	a) Input power sudden change test		○		○		○
	b) Load sudden change test	○	○	○	○		
	c) Load make and break test	○	○	○	○		
	d) Instantaneous overload test	○	○	○	○		
	e) Input voltage sudden change test	○	○	○	○		
	f) Input rush current test	○	○	○	○		
	g) Utility voltage sudden change test					○	○
	h) Utility phase sudden change test					○	○
	i) Load breaking test					○	○
8 External fault test	a) Input side short circuit test	○	○	○	○	○	○
	b) Output side short circuit test	○	○	○	○	○	○
	c) Utility voltage instantaneous interruption and drop test	○	○	○	○	○	○
9 Environmental suitability test	a) Noise test	○	○	○	○	○	○
	b) Higher harmonics noise test	○	○	○	○	○	○
10 Environmental resistance test	a) Composite temperature/humidity cyclic test	○	○	○	○	○	○
	b) Immunity test	○	○	○	○	○	○

4.1 Insulation resistance test

The insulation between the live parts and the ground is examined.

4.2 Dielectric withstand voltage test

The characteristic to withstand the voltage of dielectrics between the live parts and the ground is examined.

4.3 Lightning impulse withstand voltage test

The dielectric withstand voltage against lightning impulse voltage is examined.

4.4 Leak current test

The value of the current which leaks from the body of the power conditioner to the ground is tested.

4.5 Protective function tests

- a) **Input overvoltage and undervoltage protective function test** The characteristics of protective function against input overvoltage and undervoltage are examined.
- b) **Input overcurrent protective function test** The characteristic of protective function against input overcurrent is examined.
- c) **Output overcurrent protective function test** The characteristic of protective function against output overcurrent is examined.
- d) **Output overvoltage and undervoltage protective function test** The characteristics of protective function against output overvoltage and undervoltage are examined.
- e) **Input side ground-fault protective function test** The characteristic of protective function against ground fault which has occurred in input side circuits is examined.
- f) **Output side ground-fault protective function test** The characteristic of protective function against ground fault which has occurred in output side circuits is examined.
- g) **Current limiting and power limiting function test** The characteristic of current limiting function or power limiting function to prevent overload operation from occurring is examined.
- h) **Temperature rise protective function test** The characteristic of protective function to prevent abnormal internal temperature rise of a power conditioner is examined.
- i) **Frequency increase and decrease protective function test** The characteristics of protective function against output frequency increase and decrease are examined.
- j) **Test of protective function to prevent direct current from leaking** Protective function to prevent direct current from leaking to the load or the system is tested.
- k) **Unbalanced excess voltage protective function test** Protective function in the power conditioners of single-phase, three-wire electric system to prevent the overvoltage between the neutral wire of the output side and each 200 V line from occurring is tested.
- l) **Output voltage rise restrictive function test** Protective function of restraining the rise of the output voltage within the specified range is tested.

4.6 Steady state characteristic tests

- a) **Efficiency test** The efficiency at steady operation is examined.
- b) **No-load loss test** The power consumption when the power conditioner is operating at effective output power of 0 W is examined.

- c) **Overload capability test** The operating characteristics and temperature characteristic at overload operation and the operating characteristics after the overload operation are examined.
- d) **Manual start and stop test** The characteristics of manual start and stop function are examined.
- e) **Temperature rise test** The characteristic of temperature rise at each part of power conditioner under steady state operation is examined.
- f) **Input constant voltage accuracy test** The input voltage characteristic is examined.
- g) **D.C. input current ripple test** This is the test carried out when specified by the manufacturer of accumulator device if the device is used in the d.c. power supply and the d.c. ripple current characteristics under steady operation are examined. Even if the accumulator device is not installed the test is carried out in the same way because the ripple results in decrease of utilization of solar cell.
- h) **D.C. output voltage ripple test** The characteristic of output voltage ripple under steady operation is examined.
- i) **Output constant voltage accuracy test** The constant voltage characteristic of output is examined.
- j) **Power factor range test** The characteristic of load power factor following in a specified range is examined.
- k) **Output frequency accuracy test** The characteristic of output constant frequency is examined.
- l) **A.C. output voltage distortion test** The characteristic of output voltage distortion is examined.
- m) **Output voltage unbalance test** The characteristic of output voltage unbalance when the loads between lines are unbalanced is examined.
- n) **Stand-by loss test** The power consumption of power conditioner under stand-by is examined.
- o) **Automatic start and stop test** The characteristics of automatic start and stop are examined.
- p) **A.C. output power factor test** The characteristic of output power factor is examined.
- q) **Voltage and frequency following range test** The characteristics to follow the changes of utility voltage and frequency in the specified range are examined.
- r) **A.C. output current distortion test** The characteristic of output current distortion under steady operation is examined.
- s) **Utility voltage distortion test** The operating characteristics, when distortion is occurring within the specified range in the utility voltage, is examined.

- t) **Utility unbalance test** The operating characteristics, when unbalance is occurring within the specified range in the utility line voltages.
- u) **Isolated operation function test** The isolated operation function, function of maintaining isolation at the time of system power-failure, and function of switching to the utility operation upon power recovery.

4.7 Transient response characteristic tests

- a) **Input power sudden change test** The operating characteristics at sudden change of input power due to sudden change of solar irradiance are examined.
- b) **Load sudden change test** The operating characteristics at sudden change of power consumption of load are examined.
- c) **Load make and break test** The operating characteristics at switching in and switching off the load are examined.
- d) **Instantaneous overload test** The operating characteristics at instantaneous overload state caused at starting the load are examined.
- e) **Input voltage sudden change test** The operating characteristics at sudden change of input voltage are examined.
- f) **Input rush current test** The operating characteristics at switching in of d.c. power supply are examined.
- g) **Utility voltage sudden change test** The operating characteristics when the utility voltage changes suddenly through the specified range are examined.
- h) **Utility phase sudden change test** The operating characteristics when the utility voltage phase changes suddenly through the specified range are examined.
- i) **Load breaking test** The operating characteristics at breaking of the load are examined.

4.8 External fault tests

- a) **Input side short circuit test** The operating characteristics when short-circuit fault occurs in the input side circuit are examined.
- b) **Output side short circuit test** The operating characteristics when short-circuit fault occurs in the output side circuit are examined.
- c) **Utility voltage instantaneous interruption and drop test** The operating characteristics when instantaneous interruption or drop of utility voltage occurs are examined.

4.9 Environmental suitability tests

- a) **Noise test** The noise characteristics under steady operation are examined.
- b) **Higher harmonics noise test** The characteristic of noise terminal voltage produced by a power conditioner under steady operation.