

Edition 1.0 2021-11

INTERNATIONAL STANDARD



Binary power generation systems with capacity less than 100 kW – Performance test methods (standards.iteh.ai)

IEC 63277:2021 https://standards.iteh.ai/catalog/standards/sist/87bd0bcb-50f4-41de-a2e1-e9c76e0e0946/iec-63277-2021





THIS PUBLICATION IS COPYRIGHT PROTECTED Copyright © 2021 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office 3, rue de Varembé CH-1211 Geneva 20 Switzerland

Tel.: +41 22 919 02 11 info@iec.ch www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublishedStay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore iec ch/csc If you wish to give us your feedback on this publication or

need further assistance, please contact the Customer Service Centre: sales@iec.ch. IEC 63277:2021

ds.iteh.ai

IEC online collection - oc.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

https://standards.iteh.ai/catalog/standards/sist/87bd0bcb-50f4-41de-a2e1

e9c76e0e0946/iec-63277-2021



Edition 1.0 2021-11

INTERNATIONAL STANDARD



Binary power generation systems with capacity less than 100 kW – Performance test methods (standards.iteh.ai)

<u>IEC 63277:2021</u> https://standards.iteh.ai/catalog/standards/sist/87bd0bcb-50f4-41de-a2e1-e9c76e0e0946/iec-63277-2021

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 27.190 ISBN 978-2-8322-1046-6

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FC	DREWORL)	3			
IN	TRODUC	TION	5			
1	Scope.		6			
2	Normat	ive references	6			
3	Terms a	and definitions	6			
4	Constru	iction, power of binary power generation system	8			
	4.1 General construction of binary power generation system					
		et power (Sending-end output) / Gross power (Generating power)				
5	Test co	ndition	8			
	5.1 G	eneral test condition	8			
	5.2 R	ated test condition	9			
	5.2.1	General				
	5.2.2	Tolerance of the rated net power				
		ccuracy of instruments used for measurement				
	5.3.1	Thermometer				
	5.3.2	Flowmeter				
	5.3.3	Three-phase power meter				
6	0.3.4 Measur	Calibration Care Action Action Department and calculation method of power output and power generation	10			
U	efficien	cy(standards.iteh.ai)	10			
		easurement method of net power (sending-end output)				
		easurement method of flow r <mark>ate and tem</mark> perature of hot water	11			
	6.2.1	Tempterature measurement of nortwater bd0bcb-50f4-41de-a2e1-	11			
	6.2.2	Flow rate measurement of not water	12			
		easurement method of flow rate and temperature of cooling water				
		alculation method of power output and power generation efficiency				
	6.4.1	Receiving heat amount from hot water in the evaporator Q_{H} (kW)				
	6.4.2	Net power (sending-end output) L_{net} (kW)	12			
	6.4.3	Power generation efficiency η_{eout}	13			
7	Marking	g documentation	13			
	7.1 M	arking on the product	13			
	7.2 D	escription in the technical documentation	13			
		formative) Specification of grid-connected inverter for power generation				
sy						
		utline of the equipment				
		equired specification				
	•	formative) Calculation of electric power efficiency				
Ar	inex C (int	formative) Items of test report	17			
Fig	gure 1 – B	inary power generation system	8			
	-	erformance measuring method				
		xample of arrangement of hot water flowmeter				
		Interconnection circuit diagram using grid-connect inverter				
Та	ble 1 – Te	est conditions	9			

INTERNATIONAL ELECTROTECHNICAL COMMISSION

BINARY POWER GENERATION SYSTEMS WITH CAPACITY LESS THAN 100 KW – PERFORMANCE TEST METHODS

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC/National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies 7:2021
- 6) All users should ensure that they have the latest edition of this publication 4-41de-a2e1-
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 63277 has been prepared by IEC project committee 126: Binary power generation systems.

The text of this International Standard is based on the following documents:

Draft	Report on voting		
126/35/FDIS	126/38/RVD		

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- · reconfirmed,
- · withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

iTeh STANDARD PREVIEW (standards.iteh.ai)

<u>IEC 63277:2021</u> https://standards.iteh.ai/catalog/standards/sist/87bd0bcb-50f4-41de-a2e1-e9c76e0e0946/iec-63277-2021

INTRODUCTION

This document deals with the performance test methods for binary power generation systems.

Binary power generation systems are capable of generating electric power even with a relatively low temperature heat source, such as factory waste heat as well as renewable energy, such as hot spring water, geothermal heat, solar heat, etc..

The system utilizes the heat of said heat source by transferring it to a working fluid via a heat transport medium, instead of directly heating working fluid. Hence, it is called "binary system."

By standardizing the performance measuring method of binary power generation systems, energy conservation performance can be assessed legitimately, and it will also be reflected in energy saving measures based on actual use. Increase of suppliers motivation for realizing high energy saving performance is expected, and energy saving products will be promoted around the world.

In addition, the world demand for binary power generation systems is also rising, and it is expected to grow rapidly in the future.

iTeh STANDARD PREVIEW (standards.iteh.ai)

IEC 63277:2021 https://standards.iteh.ai/catalog/standards/sist/87bd0bcb-50f4-41de-a2e1-e9c76e0e0946/iec-63277-2021

BINARY POWER GENERATION SYSTEMS WITH CAPACITY LESS THAN 100 KW – PERFORMANCE TEST METHODS

1 Scope

This document specifies the performance test methods for binary power generation systems.

It defines the normalized test conditions and estimates the power generation efficiency of binary power generation systems.

It specifies the binary power generation systems having heating medium of non-pressurized hot water, with a maximum temperature less than 100 °C created by renewable energy or wasted heat in the industrial field and cold water as cooling medium.

It is applied to binary power generation systems with electric power generation capacity of less than 100 kW.

This document specifies performance testing, the standard conditions and the test methods for determining the electric power output and power generation efficiency of binary power generation systems. **Teh STANDARD PREVIEW**

It includes heating conditions (temperature flow rate) and cooling conditions (temperature, flow rate).

The requirements of testing and rating contained in this document are based on the use of matched assemblies.

e9c76e0e0946/iec-63277-2021

This document does not include binary power generation systems more than 100 kW in electric power generation capacity.

The subject heating medium here is non-pressurized hot water with a temperature of less than 100 °C.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1

binary power generation system

consists of five main components, i.e., an evaporator, a condenser, a working fluid pump, an expander and a generator, and a system in which a working fluid having a low boiling point is heated and evaporated by hot water, and the expander is driven by the working fluid gas to generate electricity

3.2

working fluid

medium used within the thermodynamic cycle that receives heat from the heat source via a heat transport medium and produces power by fluid expansion

3.3

heat source

supplies heat to drive the system

Note 1 to entry: This power generation system utilizes factory waste heat, hot spring water, geothermal heat and solar heat as heat sources from which it extracts heat with hot water (heat transfer medium) and thereby heats the working fluid through an evaporator to generate vapour.

3.4

cooling source

releases heat taken from the system by the cooling medium

Note 1 to entry: In this system, the working fluid is cooled by cold water (heat transfer medium) through heat exchanger (condenser) to generate a super cooled liquid; the heat received from the system is released into cooling source of ground water, river water, the atmosphere, etc.

3.5

(standards.iteh.ai)

evaporator

heat exchanger that heats and evaporates working fluid liquid by using hot water

https://standards.iteh.ai/catalog/standards/sist/87bd0bcb-50f4-41de-a2e1-e9c76e0e0946/iec-63277-2021

3.6

condenser

heat exchanger that cools and condenses working fluid gas by using cold water

3.7

working fluid pump

fluid machine for sending working fluid liquid by the action of pressure with mechanical energy from condenser to evaporator

3.8

expander

machine that generates power by expanding a high-pressure working medium (working fluid vapour) heated with an evaporator and thereby driving a generator

Note 1 to entry: More specifically, high-pressure medium vapour taken in from the expander's inlet internally expands and then is discharged from the outlet port as low-pressure medium vapour; this process converts fluid energy into mechanical power.

Note 2 to entry: Generally, expanders are categorized according to their expansion mechanism, into kinetic type (centrifugal, axial, etc.) and displacement type (reciprocating, rotary, scroll, screw, etc.), and are selected depending on operating conditions and capacity range.

3.9

grid-connected inverter

module that converts high-frequency AC (Alternating Current) from a power generator into DC (Direct Current), and then converts that DC into high-quality AC for connecting to power grid

4 Construction, power of binary power generation system

4.1 General construction of binary power generation system

The binary power generation system consists of evaporator, expander, condenser, working fluid pump, and generator as shown in Figure 1.

A system in which a **working fluid** having a low boiling point is heated by the hot water and the **expander** is driven by the **working fluid** gas to generate electricity. The **heat source** is hot water and **cooling source** is cooling water. See Annex A for the informative specification for **grid-connected inverter**.

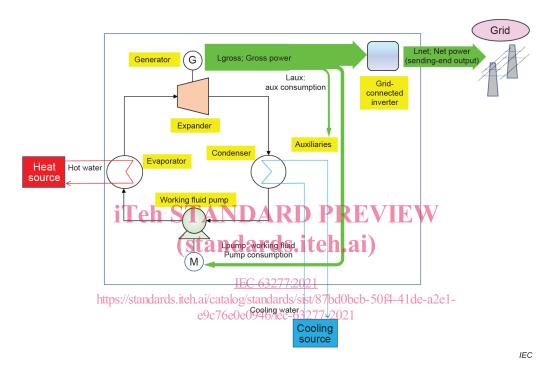


Figure 1 - Binary power generation system

4.2 Net power (Sending-end output) / Gross power (Generating power)

The sending-end output shall be the net power output of the system deducting the internal power consumed, such as the **working fluid pump**, **grid-connected inverter**, auxiliaries in the system from the gross power. And the gross power output shall be from the **generator** terminal.

5 Test condition

5.1 General test condition

General test conditions from Test 1 to Test 6 are shown in Table 1. Moreover, the tests provide a validation of nominal performance declared by the manufacturer datasheet (test condition 7).

All the measured values of Y1 kW to Y6 kW shall be recorded, unless specifically required by the manufacturer.

The generating power is measured with a combination of 6 temperature points.

Table 1 - Test conditions

Test	Item	Hot water temperature	Hot water flow rate	Cooling water temperature	Cooling water flow rate	Tolerance	Measured net power
1	5.2	90 °C ± 1 °C	20 l/min/kW ± 1 l/min/kW	20 °C ± 1 °C	30 l/min/kW ± 1,5 l/min/kW	within ±10 % declared by manufacturer brochure	Y1 kW To be compared with value declared by manufacturer brochure
2	5.1	80 °C ± 1 °C	20 l/min/kW ± 1 l/min/kW	20 °C ± 1 °C	30 l/min/kW ± 1,5 l/min/kW	_	Y2 kW
3	5.1	70 °C ± 1 °C	20 I/min/kW ± 1 I/min/kW	20 °C ± 1 °C	30 l/min/kW ± 1,5 l/min/kW	_	Y3 kW
4	5.1	90 °C ± 1 °C	20 l/min/kW ± 1 l/min/kW	30 °C ± 1 °C	30 l/min/kW ± 1,5 l/min/kW	_	Y4 kW
5	5.1	80 °C ± 1 °C	20 I/min/kW ± 1 I/min/kW	30 °C ± 1 °C	30 l/min/kW ± 1,5 l/min/kW	_	Y5 kW
6	5.1	70 °C ± 1 °C	20 l/min/kW ± 1 l/min/kW	30 °C ± 1 °C	30 l/min/kW ± 1,5 l/min/kW	_	Y6 kW
7	5.2	As specified in manufacturer brochure,	within ±10 % declared by manufacturer brochure	Y7 kW To be compared with value declared by manufacturer brochure			

(standards.iteh.ai)

5.2 Rated test condition

IEC 63277:2021

5.2.1 General https://standards.iteh.ai/catalog/standards/sist/87bd0bcb-50f4-41de-a2e1-e9c76e0e0946/iec-63277-2021

The rated values (performance) shall be evaluated under the conditions of Test 1 in Table 1, at hot water temperature of 90 $^{\circ}$ C \pm 1 $^{\circ}$ C and cooling water temperature of 20 $^{\circ}$ C \pm 1 $^{\circ}$ C.

If the manufacturer defines the rated value under its own operating conditions other than the specified test conditions, the manufacturer shall specify the test conditions as shown in Test 7 of Table 1, and evaluated as rated value.

5.2.2 Tolerance of the rated net power

The measured rated net power shall be within $\pm 10~\%$ of rated net power stated in the specification brochure of the manufacturer.

5.3 Accuracy of instruments used for measurement

5.3.1 Thermometer

The accuracy of a thermometer used for measurement shall be \pm 0,1 °C.

5.3.2 Flowmeter

The accuracy of a flowmeter used for measurement shall be \pm 2 %.

5.3.3 Three-phase power meter

The accuracy of a three-phase power meter used for measurement shall be ± 0,2 %.