AS 2915—1987

Australian Standard®

SOLAR PHOTOVOLTAIC MODULES— PERFORMANCE REQUIREMENTS

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The following interests are represented on Committee TE/15:

Australian Electrical and Electronic Manufacturers Association

Confederation of Australian Industry

Department of Aviation

Department of Housing and Construction

Department of Industry, Technology and Commerce

Energy Authority of New South Wales

Institution of Engineers Australia

Solar Energy Industries Association of Australia

Solar Energy Research Institute of Western Australia

Telecom Australia

University of New South Wales

Victorian Solar Energy Council

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PREFACE

This standard was prepared under the authority of the Association's Committee on Solar Photovoltaic Cells and Modules.

The standard specifies performance requirements for terrestrial flat-plate solar photovoltaic modules and gives methods of measurement for module performance and environmental tests. The aim of these tests is to establish the minimum electrical and mechanical performance requirements thought likely to produce a life expectancy in the field in excess of ten years. Safety requirements are specified for systems operating at safety extra-low voltage, extra-low voltage and low voltage.

There are currently no International standards for solar photovoltaic cells or modules but Australia is taking part in the preparation of a series of standards by the International Electrotechnical Commission (IEC). In the preparation of this standard documents consulted included drafts circulated by IEC/TC 82, Solar Photovoltaic Energy Systems, relevant specifications issued by the Commission of the European Communities and reports on the subject by the National Aeronautic and Space Administration (NASA) and the Jet Propulsion Laboratories (JPL) of the United States. Acknowledgement is made of the assistance received from these sources.

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STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
SOLAR PHOTOVOLTAIC MODULES—PERFORMANCE REQUIREMENTS

1 SCOPE. This standard specifies the performance requirements for two types of terrestrial flat-plate solar photovoltaic modules suitable for use throughout Australia to produce electricity directly.

A method of characterizing photovoltaic module performance is specified. Techniques for measuring module performance are described. Environmental and mechanical tests are specified.

Some of the tests and measurements described may not be suitable for application to all types of photovoltaic cells or modules, e.g. thin-film cells or photo-chemical cells. However, the standard will in future be revised to take advantage of any developments in hardware or procedure.

2 REFERENCED DOCUMENTS. The following standards are referred to in this standard:

AS 1099 Basic Environmental Testing Procedures for Electrotechnology
Part 2—Tests

AS 2535 Glazed Flat-plate Solar Collectors with Water as the Heat Transfer Liquid—Methods for Testing Thermal Performance

AS 3000 SAA Wiring Rules

AS 3100 Approval and Test Specification for Definitions and General Requirements for Electrical Materials and Equipment

3 DEFINITIONS. For the purpose of this standard the following definitions apply:

3.1 Solar cell—a semiconductor device which converts sunlight directly into electricity (the photovoltaic effect).

3.2 Solar module—a packaged unit consisting of a number of interconnected solar cells.

3.3 Solar array—a mechanical assembly consisting of a number of solar modules mounted on a support structure and connected together.

3.4 Interconnects—electrical conductors between cells in a module which are used to connect cells together and to the module terminals.

3.5 Irradiance—the radiant power in the form of electromagnetic waves or photons incident upon unit surface area.

3.6 Nominal peak sunlight—a global irradiance (or solar flux density) on the plane of the solar module of 1 kW/m^2, AM1.5. Solar module performance is often referenced to nominal peak sunlight conditions.

3.7 Air mass (AM)—the length of path through the earth's atmosphere traversed by the direct solar beam expressed as a multiple of the path traversed to a point at sea level with the sun directly overhead.

NOTES:

1. Air Mass is used to broadly describe the spectral properties of the sunlight received at sea level. Due to absorption and scattering by the atmosphere the spectral distribution of sunlight depends on the length of its path.
2. For the purposes of this standard, Air Mass is not related to any absolute value of solar irradiance but is used solely to denote particular sunlight or simulated sunlight spectral distributions.
3. See Appendix B, Table B1, for the AM 1.5 spectral irradiance distribution to be used for the purpose of this standard.

3.8 Standard operating conditions (SOC)—the conditions under which solar module performance is compared for the purposes of this standard, i.e. Irradiance: 1 kW/m^2 ± 10 W/m^2, AM1.5; Cell Temperature: 23 ±2°C.

3.9 Nominal operating cell temperature (NOCT)—the average cell temperature within a module under the following nominal conditions: Irradiance, 800 W/m^2; Air temperature, 20°C; Wind average velocity, 1 m/s; with the module mounted, oriented normal to solar noon and with open circuit. See Appendix A.

3.10 Short-circuit current (I_{sc})—the output current of the solar cell, module or array with zero voltage between the terminals.

3.11 Open-circuit voltage (V_{oc})—the terminal voltage of the solar cell, module or array under no load conditions.

3.12 Nominal peak power (P_p)—the maximum electrical power attainable from a solar cell, module or array under specified operating conditions.

3.13 Nominal peak power voltage (V_{pp})—the voltage corresponding to nominal peak power.

3.14 Fill factor (FF)—the ratio of the nominal peak power to the product of the open circuit voltage and the short circuit current.

3.15 Nominal module voltage—the nominal voltage of a storage battery that the module could charge in a solar system.

3.16 Conversion efficiency—the ratio of maximum electrical power output to irradiance input. Two variations can be quoted for conversion efficiency:

(a) *Encapsulated cell efficiency*—which considers the solar radiation falling on the total cell area.

(b) *Module efficiency*—which considers the solar radiation falling on the total surface area of the module.

3.17 Type I module—a module intended for consumer use and where high reliability and long life are not required.

3.18 Type II module—a module intended for professional use and where both long life and high reliability are required.

3.19 Class A module—a module designed as suitable for use only in systems the maximum system voltage of which is less than or equal to 50 V.

3.20 Class B module—a module designed as suitable for use in systems where the maximum system voltage is greater than 50 V but less than 1000 V.