SLOVENSKI STANDARD

SIST EN 61307:1999

prva izdaja
julij 1999

Industrial microwave heating installations - Test methods for the determination of power output (IEC 61307:1994)

ICS 25.180.10

Referenčna številka
SIST EN 61307:1999(en)

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61307

September 1996

ICS 25.180.10

Descriptors: Electroheating installation, industrial heating, dielectric heating, microwave heating, output power, test method

English version

Industrial microwave heating installations
Test methods for the determination of power output
(IEC 1307:1994)

Installations industrielles de chauffage à hyperfréquence - Méthodes d'essais pour la détermination de la puissance de sortie (CEI 1307:1994)

Industrielle Mikrowellen-Erwärmungsanlagen - Meßverfahren für die Bestimmung der Ausgangsleistung (IEC 1307:1994)

This European Standard was approved by CENELEC on 1996-07-02. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of the International Standard IEC 1307:1994, prepared by IEC TC 27, Industrial electroheating equipment, was submitted to the formal vote and was approved by CENELEC as EN 61307 on 1996-07-02 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-06-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1997-06-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annex ZA is normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 1307:1994 was approved by CENELEC as a European Standard without any modification.

CONTENTS

INDUSTRIAL MICROWAVE HEATING INSTALLATIONS – TEST METHODS FOR THE DETERMINATION OF POWER OUTPUT

Section 1: General

1.1 Scope and object

This International Standard is applicable to industrial microwave heating installations used for the purpose of thermal applications of loads containing water or moisture such as heating, drying of partially conductive or non-conductive materials, such as wood, textiles, paper, foodstuffs, etc., in both normal and protective atmospheres, using for example, inert gas or vacuum. For other loads (for example, plastics) the test methods are under consideration.

This standard relates to microwave power generators in the frequency range 300 MHz to 6 GHz comprising an assembly of electrical and mechanical devices intended for the transfer of microwave power to the material to be treated.

Equipment operating at the lower end of the microwave frequency spectrum (i.e. between 300 MHz and about 600 MHz) may use vacuum tubes or alternative microwave emitters. If the power output measurement systems specified in this standard cannot be applied for particular applications within this frequency range, then the alternative systems would be those of IEC 1308.

The main purpose of this standard is to give test methods for industrial microwave energy generators. Due to the large variety of microwave heating applications, any output power figures obtained as a result of these tests should not be taken as representing the amount of power that can be dissipated into a particular product within a particular microwave heating installation, but in certain instances, the output figures could be used as an indication of performance.

The amount of power required to achieve an aim for enthalpy change in a product within a fixed period of time will be dependent, for example, on the product's composition, the evolution of its loss factor with temperature, as well as the construction of the applicator system, the way the generator is matched to the product within the applicator and the amount of coupling between generators when more than one is used.

Two types of microwave industrial heating equipment exist:

Type A

Equipment with microwave power generators (for example, power supplies plus magnetrons or klystrons), independent of or separable from the applicators, to which they provide the microwave power, for example via a waveguide or a coaxial feeder. This is mostly the case when high-power magnetrons or klystrons are used. Usually, a circulator is mounted between the magnetrons or klystrons and the applicator to protect them from reflected power.

Type B

Equipment with microwave power generators directly coupled to the applicator, i.e. inserting a circulator or a water load between the generator or generators and the applicator itself, becomes structurally impossible.

This standard relates to equipment normally operating under continuous rated conditions.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50(726): 1982, *International Electrotechnical Vocabulary (IEV) – Chapter 726: Transmission lines and waveguides*

IEC 50(841): 1983, *International Electrotechnical Vocabulary (IEV) – Chapter 841: Industrial electroheating*

IEC 519-1: 1984, *Safety in electroheat installations – Part 1: General requirements*

IEC 519-6: 1982, *Safety in electroheat installations – Part 6: Specifications for safety in industrial microwave heating equipment*

IEC 519-9: 1987, *Safety in electroheat installations – Part 9: Particular requirements for high-frequency dielectric heating installations*

IEC 1308: 1994, *High-frequency dielectric heating installations – Test methods for the determination of power output*

1.3 Definitions

For the purpose of this International Standard, the basic definitions are defined in IEC 50(726), IEC 50(841), IEC 519-6, IEC 519-9 and supplemented by the following definitions.

1.3.1 **circulator:** Three-port device, allowing incident power transmission, but deflecting (with the help of ferrites and magnetic field), reflected power to a third port equipped with a water load. See IEV 726-17-08 for full description of a circulator.

1.3.2 **microwave output power – type A equipment:** Power measured in a calorimeter load defined in this standard.

When more than one microwave power generator is used in one installation, then the microwave output power of the installation will be the sum of the output of the individual microwave power generators as measured into the calorimeter load defined in this standard.

1.3.3 **microwave output power – type B equipment:** Microwave output power cannot be measured on type B equipment because its construction does not allow a circulator or water load to be interposed between the generator and the applicator. Therefore, only a calculated microwave output power can be specified.

When more than one microwave power generator is used in one installation, then the calculated microwave output power of the equipment cannot exceed the sum of the individual calculated microwave output powers.

1.3.4 **calculated microwave output power:** The calculated microwave output power in watts

$$P = U \times I \times \eta$$

where

U is the applied anode voltage, in volts;

I is the anode current through the magnetron or klystron, in amperes;

η is the efficiency quoted by the manufacturer of the magnetron or klystron or alternative microwave emitter for the operating conditions of the microwave power generator.

Section 2: Tests

2.1 Power output test loads

There are three different types of output power test loads for use in microwave heating installations. Only the principals are outlined. Detailed constructions shall conform to known engineering techniques.

2.1.1 *Calorimeter load*

A calorimeter load is used on independent microwave power generators or on type A equipment. It is used to determine the microwave output power of a microwave power generator where the normal load is replaced by this test load.

2.1.2 *Dummy load*

A dummy load is used for applications where it is required only to dissipate the load power of a microwave power generator and not to measure the load power. The normal load is replaced by this test load.

2.1.3 *Open-dish load*

An open-dish load is used for applications where it is required only to dissipate the load power in a microwave heating equipment and not to measure the load power.

Section 3: Description of tests

3.1 Methods of test and measurements

Measuring devices should not be affected by electromagnetic fields.

3.1.1 *Calorimeter load*

The calorimeter load consists of a waveguide section, equipped with a microwave transparent tube, through which water can flow. The water should be thoroughly mixed at the temperature measurement position.

The power dissipated in the water is measured directly or compared with a calibrated heated water standard. These loads are commercially available. When in use, the Voltage Standing Wave Ratio (VSWR) seen by the magnetron or klystron shall not exceed 1,2, or the value recommended by the magnetron or klystron manufacturer.

A recommended water flow would be about 1 l/min per kW, but not less than 0,5 l/min.

To avoid the formation of steam, which may lead to explosion, the water flow shall be monitored, for instance by means of flow interlocking switches.

The water inlet temperature shall not exceed 35 °C.

The water outlet temperature shall not exceed 60 °C.

The difference between the outlet temperature and the inlet temperature shall be at least 10 K, to obtain results of an acceptable accuracy.

The specific conductivity of the water shall lie between 200 µS/cm and 600 µS/cm, for frequencies below 900 MHz. For higher frequencies, any tap water can be used.

When the microwave power generators are equipped with a circulator, capable of deflecting 100 % of the incident power, the latter can be used as a water load by short-circuiting the incident power exit port.

The measurement shall be carried out only when the flow rate is stable and the load is in thermal equilibrium. It is necessary to use high-precision thermometers and flowmeters to ensure that the accuracy of power output measurement shall be within ±5 %.

The power output is calculated from the following equation:

$$P = \frac{4,1868 \times Q \times \Delta T}{60} \approx 0,07 \times Q \times \Delta T$$

where

P is the power output, in kW;

Q is the water flow rate, in l/min;

ΔT is the temperature difference, in kelvins, between water inlet and outlet temperatures.

NOTE – 1 cal = 4,1868 J.

The accuracy of power output measurement shall be within ±5 %.