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ISO 6742-4

Second edition
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Cycles — Lighting and retro-reflective devices —

Part 4: Lighting systems powered by the cycle's movement

Cycles — Éclairage et dispositifs rétroréfléchissants —
Partie 4: Systèmes d'éclairage alimentés par dynamo

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Foreword

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This document was prepared by Technical Committee ISO/TC 149, *Cycles*, Subcommittee SC 1, *Cycles and major sub-assemblies*.

This second edition cancels and replaces the first edition (ISO 6742-4:2015), which has been technically revised.

The main changes are as follows:

— terms and definitions: “open system” and “closed system” were added;

— overall structure changes to clarify requirements and test methods;

— addition of “6 V/3 W with electric load” positive drive generators;

— changes in generator characteristic requirements;

— clarify test methods and improvement of requirements for open systems;

— changes in closed system requirements and test methods;

— improvement of Clause 8;

— improvement of Clause 9;

— improvement of Annex A;

— improvement of Annex B;

— improvement of Annex C.

A list of all parts in the ISO 6742 series can be found on the ISO website.

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Cycles — Lighting and retro-reflective devices —

Part 4:
Lighting systems powered by the cycle's movement

1 Scope

This document is applicable to lighting systems used on cycles intended to be used on public roads and, especially, bicycles complying with ISO 4210[1] and ISO 8098[2].

This document specifies requirements and test methods for the performance of lighting systems powered by the cycle's movement. It applies to lighting and light signalling devices complying with ISO 6742-1. Lighting systems include lighting and light signalling devices and power supplied by cycle's movement such as generator.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6742-1:2023, *Cycles — Lighting and retro-reflective devices — Part 1: Lighting and light signalling devices*

ISO 6742-3:2023, *Cycles — Lighting and retro-reflective devices — Part 3: Installation and use of lighting and retro-reflective devices*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6742-1 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
frictional drive generator
generator for which the rotor or stator is linked to a pulley which press against the driving wheel over a swivel bearing through force

3.2
positive drive generator
generator which is not concerned by the definition of *frictional drive generator* (3.1)

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3.3
open system
system of lamp and power source (i.e. generator or battery) combinations which are interchangeable if they meet the requirements

Note 1 to entry: The requirements are specified in this document or ISO 6742-5[3].

3.4
closed system
system in which lamp and power source (i.e. generator or battery) are integrated, or in which the combination is specified by the manufacturer.

4 Requirements for lighting systems powered by the cycle's movement

4.1 General

There are two types of lighting systems powered by the cycle's movement: open systems and closed systems, and they shall meet the respective requirements shown in Table 1.

The requirements shall be met by the maximum and minimum wheel diameters of the cycle intended for use.

Table 1 — lighting systems powered by the cycle's movement

Light system		Requirement	Test method
Both system		4.2	7.1
		4.3	7.2
Open system	Front lamp	5.2	7.3
	Rear lamp	5.3	7.4
	Generators	5.4	7.5
Closed system		6	7.6

4.2 Corrosion resistance

All functions of the lighting system shall work after testing in accordance with the test method described in 7.1.

4.3 Water resistance

All functions of the lighting system shall work after testing in accordance with the test method described in 7.2.

5 Requirements for open system

5.1 General

The complete system shall be designed as open system which requires compatibility between lamps and generators.

5.2 Front lights for open system

Front lights for open system (lamps emitting light to the front) shall correspond with the requirements of ISO 6742-1:2023, 4.2, 4.5, 4.6 and 4.9, when tested in accordance with 7.3.

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Voltage limiting resources shall only become effective above the test voltage. Here, the value of the DC voltage, U, corresponds with the root mean square of the AC voltage, U_{rms}.

Furthermore:

— the nominal voltage of the light source shall be equal to the system voltage or the light source shall be powered via an appropriate electronic ballast;

— the lighting effect shall be deployed at 3 U_{rms} at the latest;

— the lighting evaluation shall be performed at test voltage;

— the power consumption shall be 110 % or less of the nominal value;

— the power consumption shall be 2,4 W or less at the test voltage;

— electronic ballasts in these units shall have the corresponding electrical rating.

Head lamps with integrated capacitor to power the light while halting shall be built so that the load of the entire equipment on the supply system is not substantially higher than that intended for this equipment according to ISO 6742-1:2023, 4.8. The entire equipment shall fulfil the necessary requirements at test voltage, where, based on a discharged capacitor a charging time of 120 s using test voltage is permissible and the reduction of the generator voltage through the charging of the capacitor shall correspond with the following conditions:

a) not exceeding 60 % after 15 s;

b) not exceeding 37 % after 30 s;

c) not exceeding 15 % after 60 s;

d) not exceeding 5 % after 90 s;

e) not exceeding 1,5 % after 120 s.

Any stand light shall emit visible light for at least 240 s.

5.3 Rear lights for open system

Rear lights for open system (lamps emitting light to the rear) shall correspond with the requirements of ISO 6742-1:2023, 4.3, 4.4 and 4.8, when tested in accordance with 7.4. And the power consumption shall be 0,6 W or less at the test voltage.

Rear lamps with integrated stand lights shall be built so that the load of the entire equipment on the supply system is not substantially higher than that intended for this equipment. The entire equipment shall fulfil the necessary requirements at test voltage, where, based on a discharged capacitor, a charging time of 120 s using test voltage is permissible and the reduction of the generator voltage through the charging of the capacitor shall correspond with the following conditions:

a) not exceeding 60 % after 15 s;

b) not exceeding 37 % after 30 s;

c) not exceeding 15 % after 60 s;

d) not exceeding 5 % after 90 s;

e) not exceeding 1,5 % after 120 s.

Any stand light shall emit visible light for at least 240 s.

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5.4 Generators for open system

5.4.1 General characteristics of generators

For measurements in accordance with 7.5, voltage and power of generators shall meet the values of Table 2.

For generators, for which the outputs characteristics are depending on diameter of the wheel, the minimum values given in Table 2 of the voltage and the efficiency refer to the largest outside diameter of the wheel as provided by the manufacturer. The measurement of the maximum values in Table 2 of the voltage refers to the smallest outside diameter of the wheel as stated by the manufacturer.

Table 2 — Characteristics of generators

Type of generator	System	Output	Between 5 km/h and less than 15 km/h		15 km/h		Over 15 km/h up to 30 km/h	
			min	max	min	max	min	max
Frictional drive generator	6 V/3 W and 6 V/2,4 W and 6 V/1,5 W with fixed resistor	Voltage V	3	7,5	5,7	7,5	5,7	7,5
		Resistance N				4		
	6 V/1,5 W with electric load	Power W	0,2	2,35	1,35	3,4	1,35	3,4
		Resistance N				4		
Positive drive generator	6 V/3 W and 6 V/2,4 W and 6 V/1,5 W with fixed resistor	Voltage V	3	7,5	5,7	7,5	5,7	7,5
		Efficiency %			30			
	6 V/1,5 W with electric load	Power W	0,2	2,35	1,35	3,4	1,35	3,4
		Efficiency %			30			
	6 V/3 W with electric load	Power W	0,2	4,7	2,7	4,7	2,7	4,7
		Efficiency %			30			

5.4.2 Frictional drive generator

For generators which press against the driving wheel over a swivel bearing through spring force, the spring force, measured perpendicularly to the rotational axis of the generator, shall be at least 10 N inside of the total swivel area to lose contact with tyre.

The increase in wheel rotation resistance due to contact between the generator and the wheel shall be less than 4 N.

Should an AC voltage of 50 V_{rms} or a DC voltage of 75 V be exceeded for this unloaded generator within the specified speed range, additional measures shall be provided in order to meet this voltage limit.

5.4.3 Positive drive generator

For generators without gears and for the largest outside diameter of the wheel permissible for these generators and at a speed of 5 km/h, the frequency of the AC voltage shall be at least 6 Hz.

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Should an AC voltage of 50 V_{rms} or a DC voltage of 75 V be exceeded for this unloaded generator within the specified speed range, additional measures shall be provided in order to meet this voltage limit.

6 Requirements for closed system

6.1 General

The complete system shall be designed as closed system which does not have compatibility between lamps and generators.

6.2 Photometrical performance requirement between 5 km/h and 15 km/h

When tested by 7.6.1 a), the light shall emit. Continuous light is not required.

6.3 Photometrical performance requirement 15 km/h or higher

When tested by 7.6.1, photometrical performances shall conform with corresponding category of the light included into the system as specified in ISO 6742-1.

6.4 High speed endurance requirement

After tested by 7.6.2, photometrical performances shall comply with corresponding category of the light included into the system. It shall not flash visibly.

7 Test methods

7.1 Corrosion testing for both system

The entire lighting system (front lights, rear lights, generators in functional assembly conditions) shall undergo corrosion testing in accordance with ISO 9227. A total of 96 h shall be run with a salt concentration of 5 %.

7.2 Water resistance for both system

Generators in functional assembly conditions shall be tested in accordance with IPX4 in IEC 60529.

Front lights and rear lights for lighting systems powered by the cycle's movement shall be tested in accordance with IPX3 in IEC 60529.

At the end of the test, the unit may be drained for 1 h.

7.3 Front lights for open system

Front lights for open system (lamps emitting light to the front) shall be tested corresponding with the test methods of ISO 6742-1:2023, 4.2, 4.5, 4.6 and 4.9. The test voltage shall be the rated voltage of substantially sinusoidal AC (frequency 50 Hz or 60 Hz) or DC.

Measure the voltage at the terminal of the generator.

7.4 Rear lights for open system

Rear lights for open system (lamps emitting light to the rear) shall be tested corresponding with the test methods of ISO 6742-1:2023, 4.3, 4.4 and 4.8. The test voltage shall be the rated voltage of substantially sinusoidal AC (frequency 50 Hz or 60 Hz) or DC.

Measure the voltage at the terminal of the generator.

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7.5 Generators for open system

7.5.1 General characteristics of generators

Measure the voltage and power at the terminal of the generator.

The efficiency can be measured according to Annex B and each parameter shall be defined by a manufacturer of generators.

7.5.2 Frictional drive generators

7.5.2.1 Test setup

The test setup is shown in Figure 1.

The measuring arm (Key item 1) is fixed to the axle and supported by a bearing (Key item 2), allowing the arm to rotate freely in relation to the measuring table.

A load cell (Key item 3) is placed at the end of the measuring arm and the wheel is rotated by the drive roller (Key item 4).

A frictional drive generator (Key item 5) is fixed to the measuring arm and a balance weight (Key item 6) attached to the opposite arm cancels the frictional drive generator load.

6 V/3 W generators at a load of 12 Ω, 6 V/2,4 W generators at a load of 15 Ω and 6 V/1,5 W LED generators at an electronic load in accordance with Annex A shall then be applied or at a load of 24 Ω.

Before the measurement, the generator thus loaded shall be operated at an ambient temperature of (23 ± 5) °C without forced cooling for 20 min at a number of revolutions corresponding to a speed of 30 km/h. After cooling of the generator to ambient temperature, the voltage characteristics shall be determined. Here, a driving wheel with a treadless surface shall be used.

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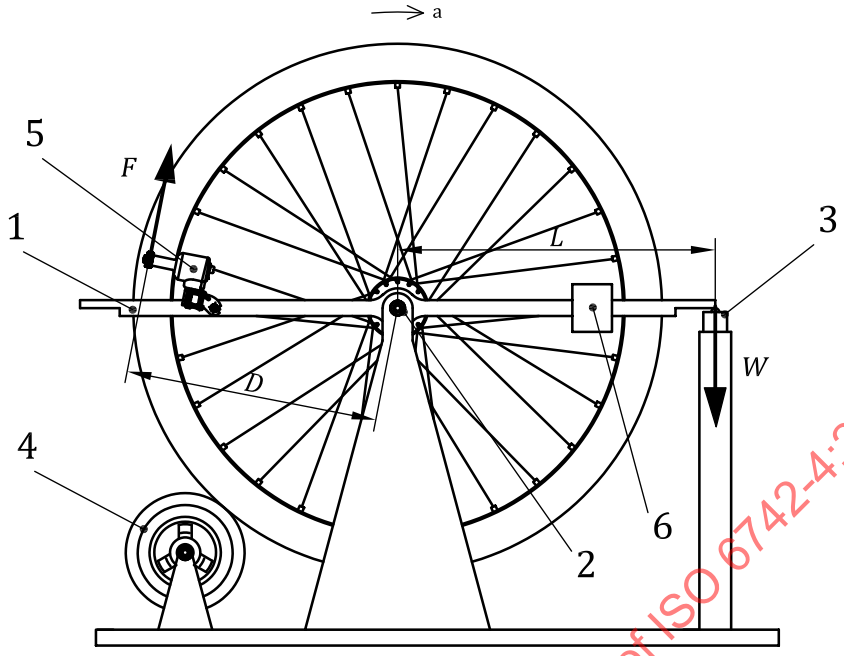

Key

1 measuring arm
2 bearing
3 load cell
4 drive roller
5 frictional drive generator
6 balance weight
F resistance force by generator
W force applied to the load cell
D distance between generator tyre contacts and hub axle
L distance between load cell and hub axle
[a] Direction of rotation.

Figure 1 — Test setup for frictional drive generator

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7.5.2.2 Test procedure

The measurements shall be carried out with the following procedure:

— determine output voltage and resistance after 5 min of continuous operation at a speed of 15 km/h;

— determine output voltage after reduction of speed to 5 km/h;

— determine output voltage after raising speed up to, but not exceeding 30 km/h.

During the test, the load is measured with a load cell.

The resistance of the generator is calculated by the following Formula (1).

$$F = W \times \frac{L}{D} \tag{1}$$

NOTE The electric load can be tested according to circuit in Annex C.

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7.5.3 Positive drive generators

7.5.3.1 Test setup

The test setup is shown in Figure 2.

The torque meter (Key item 2) shall be connected to the output of the servomotor (Key item 1) and directly driven by the positive drive generator via a coupling (Key item 3).

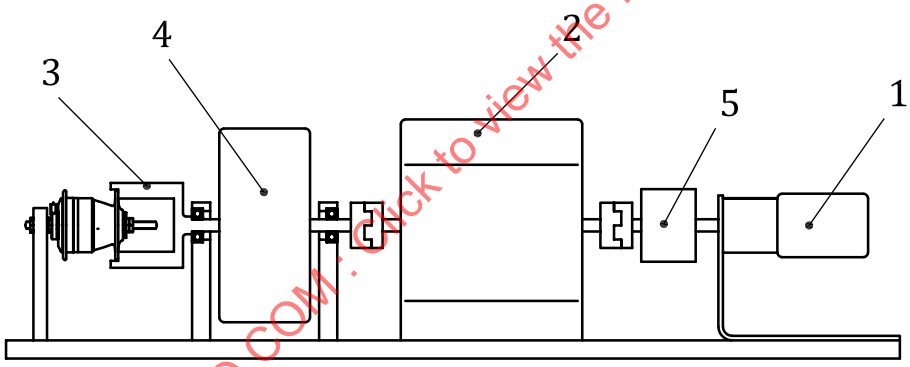
The axle of the positive drive generator shall be fixed to the measuring table.

A flywheel (Key item 4) with a rotating moment equivalent to that of a wheel shall be installed between the generator and the torque meter to prevent the waveform of the generated voltage from changing due to the reaction of the cogging torque.

Install a clutch (Key item 5), if necessary, to prevent the servomotor from burning out due to the energy of the flywheel when it stops.

6 V/3 W generators at a load of 12 Ω, 6 V/2,4 W generators at a load of 15 Ω and 6 V/1,5 W LED generators at an electronic load in accordance with Annex A shall then be applied or at a load of 24 Ω. 6 V/3 W LED generators shall be applied at an electronic load in accordance with Annex A.

Before the measurement, the generator thus loaded shall be operated at an ambient temperature of (23 ± 5) °C without forced cooling for 20 min at a number of revolutions corresponding with a speed of 30 km/h. After cooling of the generator to ambient temperature the voltage characteristics as well as the efficiency shall be determined.



Key

1 servomotor
2 torque meter
3 coupling
4 flywheel
5 clutch

Figure 2 — Test setup for positive drive generator

7.5.3.2 Test procedure

The measurements shall be carried out with the following procedure:

— determine output voltage and efficiency after 5 min of continuous operation at a speed of 15 km/h;

— determine output voltage after reduction of speed to 5 km/h;

— determine output voltage after raising speed up to, but not exceeding 30 km/h.

NOTE The electric load can be tested according to circuit in Annex C.

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7.6 Test methods for closed system

7.6.1 Power measurement

a) Measure the output voltage of the generator by driving at a speed of between 5 km/h and 15 km/h every 1 km/h to check 6.2, or at a speed of 15 km/h to check 6.3. If the generator output decreases at speeds above 15 km/h, also measure the voltage at the speed where the generator output is lowest.

If a stand light is available, the system shall be operated for 2 min at 15 km/h, then stop and test.

b) Reproduce the output signal (U_{rms} at the same frequency as sinusoidal shape) to lighting devices to check the photometrical performances.

It could be necessary to supply several samples in order to test the product.

7.6.2 High speed endurance test

Endurance test shall be conducted first at 30 km/h for 30 min. Then speed shall be increased to 50 km/h in 5 s, and held at 50 km/h for 10 s. Then steadily reduce speed down to 0 km/h.

If the system could be switched on and off while cycle is being ridden, switch it on and off 10 times at 30 km/h.

Then, check for conformity with the requirements of 6.3.

8 Instructions

Instructions shall comply with the requirements of ISO 6742-3:2023, Clause 7.

Additional information may be provided at the discretion of the manufacturer.

In addition, the following information shall be included:

a) type of lamp;

b) maximum and minimum wheel diameter of the cycle intended for use.

9 Marking

9.1 Requirement

Both lamp and power sources shall be durably marked with:

a) the manufacturer's name, abbreviation or trade-mark;

b) the model name, production number, symbol or other identification;

c) the rated input, output power, or anything to describe compatibility for open system, especially, a note that generators whose characteristics were measured only with an electronic load are dedicated to LED lights.

Marking a) shall appear on the surfaces which is visible after assembled on the cycle, in characters not less than 1 mm in height.

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9.2 Durability test

9.2.1 Requirement

When tested by the method described in 9.2.2, the marking shall remain easily legible. It shall not be easily possible to remove any label nor shall any label show any sign of curling.

9.2.2 Test method

Rub the marking by hand for 15 s with a piece of cloth soaked in water and again for 15 s with a piece of cloth soaked in petroleum spirit.

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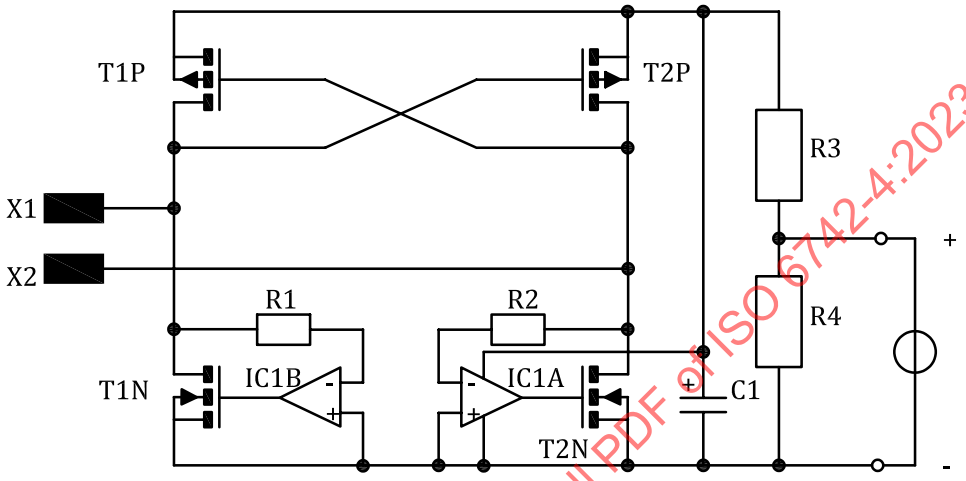
Annex A
(normative)

Electronic load for power-measurement of LED generators



Key

Components

C1	capacitor C = 1 000 µF
IC1A	operational amplifier
IC1B	operational amplifier
T1N	N-Channel MOSFET
T2N	N-Channel MOSFET
T1P	P-Channel MOSFET
T2P	P-Channel MOSFET
R1	resistor R = 1 MΩ
R2	resistor R = 1 MΩ
R3	resistor, see Table A.1
R4	resistor, see Table A.1

Connections and supplies

X1, X2 terminal for generator

Figure A.1 — Electronic load for power-measurement of LED generators

The following components are needed for the measurement:

a) T1P, T2P: P-Channel MOSFET [e.g. SI 4562 DY (one by one N- and P-Channel MOSFET)]

b) T1N, T2N: N-Channel MOSFET [e.g. SI 4562 DY (one by one N- and P-Channel MOSFET)]

   1) Total Gate Charge: Q_q < 50 nC

   2) Drain-Source Voltage: U_{DS} > 30 V

   3) Drain-Source On-State resistance: $R_{DS(on)}$ < 50 mΩ

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4) Gate Threshold Voltage: $U_{GS(th)}$ < 1,6 V

c) IC1A, IC1B: Operational amplifier (e.g. LM 2904)

1) Input Bias Current: I_{inBias} < 50 nA

2) Input Offset Current: $I_{inOffset}$ < 5 nA

3) Supply Voltage: U_{supply} = 3 V to 30 V

4) Offset Voltage: U_{offset} < 10 mV

5) Output Voltage Swing U_{outH} > V_{oc} - 1,4 V, U_{outL} < 0,3 V

d) R1 – R4: Resistor

1) R1, R2: 1 MΩ

2) R3: See Table A.1

3) R4: See Table A.1

e) C1: Capacitor

1) 1 000 µF 25 V (20 %)

f) Power supply: 3 V ± 30 mV, 1,5 A DC

The MOSFETs shall be enough cooled.

Table A.1 — Resistor

System	6 V/1,5 W	6V/3 W
R3	12 Ω (1 %)	6 Ω (1 %)
R4	4,7 Ω (10 %)	2,4 Ω (10 %)

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Annex B
(informative)

Efficiency calculation

The efficiently, η, shall be calculated using the Formula (B.1):

$$\eta = \frac{P_{out}}{P_{in}} \times 100\,\% \tag{B.1}$$

where

P_{out} is the electrical energy output, in W;

P_{in} is the mechanical energy input, in W.

P_{out} when using fixed resister is calculated from Formula (B.2):

$$P_{out} = \frac{U^2}{R} \tag{B.2}$$

where

U is the measured TRMS voltage at speed, in V;

R is the resistance of the load, in Ω.

P_{out} when using electric load is measured by a digital power meter with a wide bandwidth and accurate strain waveform measurement is placed between the generator and the electronic load. The power meter should have basic accuracy 0,5 % or less, measurement bandwidth 0,1 Hz to 10 kHz or more, crest factor 3 or higher.

P_{in} is calculated from Formula (B.3):

$$P_{in} = \frac{2\pi}{60} \times T_M \times N_M \tag{B.3}$$

where

T_M is the torque measured by the torque meter, in Nm;

N_M is the number of revolutions per minute of the servomotor, in r/min.

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