IEC 60598-2-14

Edition 1.0 2009-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Luminaires –
Part 2-14: Particular requirements – Luminaires for cold cathode tubular discharge lamps (neon tubes) and similar equipment

Luminaires –
Partie 2-14: Règles particulières – Luminaires pour lampes à décharge tubulaire à cathode froide (tubes néons) et équipements similaires

IEC 60598-2-14:2009

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INTERNATIONAL
ELECTROTECHNICAL
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INTERNATIONALE

PRICE CODE
CODE PRIX

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ICS 29.140.40

ISBN 978-2-88910-209-9

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LUMINAIRES –

Part 2-14: Particular requirements – Luminaires for cold cathode tubular discharge lamps (neon tubes) and similar equipment

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International Standard IEC 60598-2-14 has been prepared by subcommittee 34D: Luminaires, of IEC technical committee 34: Lamps and related equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
34D/907/FDIS	34D/910/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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This publication is intended to be read in conjunction with IEC 60598-1: *Luminaires – Part 1: General requirements and tests*. It was established on the basis of the seventh edition (2008) of that standard.

A list of all parts of the IEC 60598 series, under the general title: *Luminaires*, can be found on the IEC website

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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LUMINAIRES –

Part 2-14: Particular requirements – Luminaires for cold cathode tubular discharge lamps (neon tubes) and similar equipment

14.1 Scope

This part of IEC 60598 applies to luminaires for cold cathode tubular discharge lamps and similar equipment, operating on a no-load rated output voltage over 1 000 V but not exceeding 10 000 V, mainly used for general lighting, for indoor or outdoor applications and for supply voltages up to 1 000 V.

NOTE In Japan, the output voltage of 15 000 V is acceptable.

It covers luminaires incorporating luminous-discharge tubes and supply units, of fixed or portable type, supplied by high, mains or ELV voltages by transformers, inverters or converters.

This standard does not cover luminaires for luminous-discharge tubes operating at rated voltages not exceeding 1 000 V (pre-heated cathodes), for which reference is made to the relevant part 2 of IEC 60598, and luminous discharge tube luminaires to be assembled in site as an electrical lighting system, for which regional wiring rules apply.

This standard is read in conjunction with those sections of Part 1 to which reference is made.

14.2 Normative references

The following referenced documents are indispensable for the application 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.

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

IEC 61050:1991, *Transformers for tubular discharge lamps having a no-load output voltage exceeding 1 000 V (generally called neon-transformers) – General and safety requirements*

IEC 61347-2-10:2000, *Lamp controlgear – Part 2-10: Particular requirements for electronic invertors and convertors for high-frequency operation of cold start tubular discharge lamps (neon tubes)*

IEC 60417, *Graphical symbols for use on equipment*

14.3 General test requirements

The provisions in Section 0 of IEC 60598-1 apply.

NOTE This section of IEC 60598-1 covers complete products, on which routine tests according to Annex Q of Part 1 can be made.

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14.4 Definitions

For the purposes of this document, the definitions given in Section 1 of IEC 60598-1 apply, together with the following.

14.4.1
luminous-discharge tube
tube, or other vessel or device, which is constructed of translucent material, hermetically sealed, and designed for the emission of light arising from the passage of an electric current through a gas or vapour contained within it

NOTE The tube may be with or without a fluorescent coating.

14.4.2
no-load rated output voltage
maximum rated voltage between the terminals of the output winding(s) of the transformer, as in 2.8 of IEC 61050, or maximum rated voltage between output terminals of inverters/converters as in 3.2 of IEC 61347-2-10

14.4.3
insulating sleeve
envelope designed to be placed over the exposed high-voltage connections at tube electrodes or over cable-end insulators

14.4.4
earth leakage protective device
device which will remove the output power from one or more control gear(s) in the event of a short circuit between any relevant part of the output circuit and earth

NOTE The device may be in two parts, a sensor and a protective switch (see 14.7.3), or may be combined in units (either inside or outside control gears).

14.4.5
open-circuit protective device
device which will remove the output power from one or more control gear(s) in the event of an interruption of the secondary high voltage circuit

NOTE The device may be in two parts, a sensor and a protective switch (see 14.7.4), or may be combined in one unit.

14.4.6
open-circuit condition
a disconnection or lamp fault in the output circuit that causes either the load current of, or the mains supply current to, the control gear feeding the lamp circuit to fall below the respective shut-down current limit

14.4.7
shut-down current limit
secondary load current of a transformer at which an open-circuit protective device operates

NOTE Although the shut-down current limit is specified in terms of the current flowing in the output circuit, the manufacturer of the device may measure this by other than direct means. Such means might include, e.g. measuring the current reflected into the primary winding of the transformer or measuring a change in circuit power factor.

14.4.8
sensor
part of a protective device which detects the presence of a secondary earth fault and/or an open circuit condition and provides a signal to operate the protective device

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14.4.9
protective switch
part of a protective device which disconnects the mains supply to the control gear or otherwise removes the output power

It is operated by an electrical signal provided by the associated sensor.

14.4.10
flasher
device for automatically switching one or more output circuits on and off continuously

NOTE The sequence of switching of the various output circuits may be suitably arranged to provide the impression of movement and other animated effects.

14.4.11
luminous-discharge tube luminaire
luminaire incorporating light source(s) which operate with no-load voltage over 1 000 V but not exceeding 10 000 V, manufactured in factory (pre-assembled products)

14.4.12
portable cold cathode luminaire
luminaire designed for cold cathode lamp/s which may be easily moved during normal operation and supplied with a non-detachable flexible cable and incorporating a transformer, inverter or converter

NOTE It is designed to be installed and connected to the mains socket by the user.

14.4.13
boxed cold cathode luminaire
luminaire designed for cold cathode lamp/s with a translucent plate on which the wording may be printed

14.5 Classification

Luminaires covered by this standard shall be classified in accordance with the provisions of Section 2 of IEC 60598-1. In addition, the following applies.

- In accordance with the protection against electric shock: Class I or Class II only.

NOTE Portable cold cathode luminaires are classified as suitable to be mounted on normally flammable surfaces.

14.6 Marking

The provisions of Section 3 of IEC 60598-1 apply together with the following.

14.6.1 The warning symbol “caution, risk of electric shock”, in accordance with the symbol IEC 60417-5036 (2002-10), shall be placed at points of access to any luminaire, luminous-discharge tubes or enclosure of high voltage control gears.

NOTE 1 In order to make the symbol visible after installation with the luminous-discharge tube in position, it is possible to increase the symbol dimensions or to place it in different points.

NOTE 2 In US, the following warnings are also required “Caution - risk of shock. Hazardous voltage will cause shock, burn or death.”; “Caution - risk of fire. Do not connect any part of the output circuit to any ground metal.”

14.6.2 To facilitate maintenance of the luminous-discharge tube luminaire, the manufacturer shall make available to the user the information from 14.6.2.1 to 14.6.3 on the product and/or on the instructions; in particular:

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14.6.2.1 Simplified diagram of the circuit, identifying luminous-discharge tubes, control gears.

14.6.2.2 Lamp maximum current, type of gas mixture + Hg or pure neon or other - and luminous-discharge tubes length - linear length without electrodes.

14.6.2.3 No load output voltage, short circuit current of control gears for luminaires without supply units.

14.6.2.4 Additional information as given in 7.2, item d) and e), of IEC 61050, if applicable.

14.6.2.5 For luminaires with transformers provided with open-circuit protective devices, information on the shut-down current limit.

14.6.3 Information on being “suitable or non-suitable for installation within the arm’s reach zone” (see 14.7.2).

14.7 Construction

The provisions of Section 4 of IEC 60598-1 apply together with the following requirements.

14.7.1 All the accessible high voltage connections of the luminous-discharge tubes shall be protected by means of insulating sleeves made of suitable insulating material.

Replace the requirements of 4.9.2 of Part 1 by the following.

Insulating sleeves shall be made from one of the following:

a) glass having a minimum wall thickness of 1 mm; or

b) silicone rubber, having a breakdown voltage certified by the supplier as not less than twice the no-load rated output voltage to earth of the control gear supplying the circuit, a wall thickness of not less than 1 mm and an operating temperature of not less than 180 °C; or

c) material with insulating, resistance to UV radiation and ozone and heat-resistance characteristics at least equivalent to those specified in b).

NOTE Silicon rubber suitability is checked with all the tests listed in this Part 2.

Compliance is checked by inspection.

14.7.2 The luminaire intended to be installed within the arm’s reach zones shall be provided with open circuit protection according to 14.4.5 if accessibility of live parts of the secondary circuit is possible in the event of a tube breakage.

Compliance is checked by inspection.

14.7.3 Earth leakage protections

14.7.3.1 The high voltage circuits supplied by inverters or converters other than type A, for Class I luminaires, shall be protected by a device sensitive to earth leakage according to IEC 61347-2-10. The high voltage circuits supplied by transformer, for Class I luminaires, shall be protected according to 14.7.3.2 and 14.7.3.3. Following an earth leakage which caused the protective devices operation, they shall remain live until the supply voltage circuit is removed. If the leakage is still present during the switching on, the protective device shall operate according to 14.7.3.2 and 14.7.3.3.

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The performance of the device sensible to earth leakage according to 14.7.3.4 shall be assured.

14.7.3.2 The device shall disconnect the mains supply to the luminaire or otherwise remove the output power, in case of accidental contact between the high voltage circuit and the earth. If the switching of a single pole of the supply voltage is provided, such switching shall be connected to the phase of the supply.

14.7.3.3 The fault condition detection (earth leakage) shall be made by means of suitable sensors connected to the output circuit, which shall operate means arranged to disconnect the supply circuit or remove the output power.

NOTE 1 Sensors and contacts of the device may be assembled in a single unit.

NOTE 2 The earth leakage device may be made in a way to protect more than one circuit of the luminaire.

14.7.3.4 The earth leakage protective device shall be as follows:

- If the sensor and/or the protective device which removes the output power is not placed within the enclosure of the control gear, it shall operate correctly over a temperature range –25° C to +65° C. In case the device is suitable to operate at different temperatures, these shall be indicated on the instructions sheet.
- If a part of the sensor and/or contact or the device switching the output power is installed within the control gear enclosure, such part shall operate correctly in the temperature range provided within the enclosure. The maximum ambient temperature of that part of the sensor and/or protective device shall not exceed the maximum temperature allowed during the tests of 12.4 and 12.5 of IEC 60598-1.
- The rated current to operate the device shall be not more than the nominal secondary load current of the transformer being protected and shall not exceed 25 mA.

NOTE 1 The effective current flowing through the sensor during earth discharge is determined by the circuit impedance and by the output characteristics which supply this discharge. It cannot depend on the current flowing in the protective device.

- The time for the device to remove the output shall be not more than 200 ms.
- The voltage across that part of a sensor which is detecting the earth-leakage current shall not exceed 50 V.

The earth leakage protective device shall be tested according to the manufacturer's instructions concerning such devices. These tests shall assure that the units operate correctly.

NOTE 2 The standards related to earth leakage protective devices should comply with the regional regulations.

NOTE 3 In the US and Canada, the operating current is equal to the rating of the control gear, if rated less than 15 mA, and must not otherwise exceed 15 mA. The time it takes the device to disable the output high voltage after the earth leakage has exceeded 15 mA does not exceed 500 ms.

14.7.3.5 If the protective device is designed to disconnect the mains supply in case of earth leakage, the relevant means shall have mechanical contacts. The use of switching by means of semiconductors (tyristors, triacs, etc.) is not allowed.

14.7.3.6 If the circuit includes a flasher, any protective switch and its reset circuit shall be installed on the mains-supply side of the flasher.

NOTE If the protective device and its reset circuit were placed on the load side of the flasher, the protective switch would keep resetting and re-tripping during fault conditions.

14.7.3.7 If the circuit includes a flasher and the device(s) to remove the output power is (are) incorporated within the housing of the control gear(s), either a protective switch shall be connected on the mains-supply side of the flasher and the incorporated sensor circuits shall

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be capable of operating this second switch, or other means shall be provided to prevent the protective device resetting every time the flasher switches the mains supply off and on again.

14.7.3.8 Sensors and protections shall be operationally compatible.

14.7.3.9 *Compliance with 14.7.3.1 to 14.7.3.8 is checked by inspection, measurements and tests as relevant.*

14.7.4 Open circuit protections

If the converter has no built-in provision for open circuit protection, the separate open circuit protection for the cases given in 14.7.2 shall comply with the tests according to 14.7.4.2 to 14.7.4.8

14.7.4.1 Following a switching of a secondary circuit which causes the operation of a protective device, they shall remain live until the supply voltage is removed. If the open circuit is still present during the switching on, the protective device shall operate according to 14.7.4.2 and 14.7.4.3. The operation of the open circuit device shall be assured according to 14.7.4.4.

14.7.4.2 In the event of either the load current or the mains-supply current falling below the shut-down current limit (as specified in 14.6.2.5), the open-circuit protective device shall remove the output voltage of the control gear. If the switching of a single supply voltage pole is provided, such switching shall be connected in the phase lead of the supply.

14.7.4.3 The detection of the abnormal condition shall be made by suitable sensor connected to the output circuit (or other similar devices), which shall operate the protective switch to disconnect the supply circuit or remove the output power.

NOTE 1 Sensors and contacts of the device may be assembled in a single unit.

NOTE 2 The open circuit sensible device may be realized in a way to protect more than one circuit of the luminaire.

14.7.4.4 The open circuit protective device shall comply with the following:

- If the sensor and/or the protective device which removes the output power is not placed within the enclosure of the control gear, it shall operate correctly in the temperature range between – 25 °C to + 65 °C. In case the device is suitable to operate at different temperatures, these shall be indicated on the instructions sheets.
- If a part of the sensor and/or contact or the device switching the output power is installed within the control gear enclosure, such part shall operate correctly in the temperature range provided within the enclosure. The maximum ambient temperature of that part of the sensor and/or protective device shall not exceed the maximum temperature allowed during the tests of 12.4 and 12.5 of IEC 60598-1.

a) If the luminaire is switched on with an open-circuit fault condition existing in any part of the output circuit or lamp load, the protective device shall start to operate in no more than 5 s for all types of control gears.

b) If an open circuit occurs in any part of the output circuit or lamp load whilst the installation is operating normally, the protective device shall start to operate in not more than 5 s. If the mains supply is then switched off and switched on again, with the open-circuit condition still persisting, the device shall start to operate as specified in a).

NOTE Attention is drawn to the fact that some types of transformers, having output capacitive/semi-resonant characteristics, are suitable to supply a greater load of luminous tubes than that of the transformer having the same no load voltage but inductive output characteristics. However, luminous tubes supplied by this type of transformers may be slow in the ignition, particularly at low temperatures. If the ignition is too slow, it may cause an undue operation of the open circuit protective circuit.

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The open circuit protective circuit shall be tested according to the manufacturer's instructions of such devices. Such tests shall assure that the units operate correctly and that they are correctly installed.

14.7.4.5 The sensor(s) shall be connected to the device(s) to remove the output power as follows:

- connecting each sensor to its own device, which can be built into the control gear enclosure, or
- connecting the sensors of some control gears to a single protective device connected to their supply. The number of sensors, which may be connected to a device, shall be according to the requirements of the protective device manufacturer.

14.7.4.6 If the circuit includes an intermittent device (flasher), suitable precautions intended to assure the correct operation of the protection shall be taken.

NOTE The scope is to avoid that the device continues to reset and to switch on the circuit in the fault conditions.

14.7.4.7 Sensors and protections shall be operationally compatible.

14.7.4.8 *Compliance with 14.7.4.1 to 14.7.4.7 is checked by inspection, measurements and tests as relevant.*

14.7.5 Inverters and converters

Inverters and converters shall comply with IEC 61347-2-10.

Compliance is checked by inspection.

14.7.6 Transformers

Transformers shall comply with IEC 61050.

Compliance is checked by inspection.

NOTE The no-load secondary rated voltage in Europe must not exceed 5 kV to earth and 10 kV between terminals.

14.7.7 Luminous-discharge tube supports

14.7.7.1 Supports for luminous-discharge tubes shall be insulated from earth to withstand the no-load rated output voltage of the control gear supplying those tubes.

NOTE They may be manufactured from metal which is mounted on an insulator or manufactured entirely from insulating material.

Compliance is checked by inspection.

14.7.7.2 The supports shall be installed in such a way that they hold the tube securely under normal service conditions without strain or damage to the tube.

NOTE Supports should include a means for adjustment to allow for manufacturing tolerance between the discharge tube and its mounting.

Compliance is checked by inspection.

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14.7.7.3 The insulating material shall not deteriorate when subjected to the UV radiation and ozone present in the vicinity of the tube. It shall have self-extinguishing flammability characteristics as specified in 13.3 of Part 1.

NOTE Examples of suitable materials include glass, glazed ceramics and polycarbonates.

Compliance is checked by inspection.

14.7.8 High voltage connections

14.7.8.1 In addition to the requirements of 4.11 of IEC 60598-1, the connection of the luminous-discharge tubes shall be made by terminals, wires or other means complying with 14.7.8.2.

14.7.8.2 The mechanical strength of the high voltage connections shall be adequate to the normal use conditions. A connection between high voltage conductors and an electrode may be:

- soldered;
- made by a proper device.

NOTE These systems cannot be required when the connection wires are twisted together with at least three complete turns, with the excess of the single conductors ends of 13 mm max. and bent over the plait.

Compliance is checked by inspection.

Figures 1, 2 and 3 show examples of assembling the luminous-discharge tubes and the relevant supports.

14.8 External and internal wiring

The provisions of Section 5 of IEC 60598-1 apply. In addition the following provisions apply for high voltage circuits.

14.8.1 High voltage cables shall be chosen from the list of cables given in Annex A.

NOTE The use of PVC insulated cables for outdoor use is allowed, provided they comply with the requirements of the relevant national standard or equivalent.

Compliance is checked by inspection.

14.8.2 All cables shall be appropriate to the environmental conditions intended for the installation of the luminaire.

Compliance is checked by inspection.

14.8.3 Cables can be used without additional mechanical protections according to the requirements of Table 1, taking care that they are not mechanically damaged.

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Table 1 – Type of cables relevant to Annex A

Type of cable	Cables to be used	
	Within the protective enclosure	Other situations
A	X	X
B	X	
C1 and C2	X	X
D1 and D2	X	X
E	X	X
F	X	X
G	X	
H	X	X
K	X	X
NOTE Examples of protective enclosures are luminaire enclosures boxes, steel tubes and flexible armoured conduits.		

Compliance is checked by inspection.

14.8.4 Cables of type 'K' shall be used only for continuous operation with voltages up to 2,5 kV to earth.

NOTE Cables from A to H can be used for voltages up to 5 kV to earth.

Compliance is checked by inspection.

14.8.5 High voltage cables shall be as short as possible.

Compliance is checked by measurement.

14.8.6 The cable between the output terminals of an inverter or converter and the luminous-discharge tube shall be of a type specified by the manufacturer and shall be suitable for operation:

- at high frequency;
- at the output voltage of the inverter or converter.

Compliance is checked by inspection.

14.8.7 Where control gears have only one high voltage terminal, the cable between the luminous-discharge tube and the earth, or return, terminal of the control gear shall comply to Table 1.

Compliance is checked by inspection.

14.9 Provision for earthing

The provisions of Section 7 of IEC 60598-1 apply together with the following.

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14.9.1 It is possible to use a high voltage screened cable, provided that the screen has a total cross-sectional area not less than 1,5 mm^2. The connections to the screen shall be made untwisting the plait and twisting it again to form a unique cable of adequate length to connect to the earth terminal. The connection shall not be made by the ring springs which wind the plait.

Compliance is checked by inspection.

14.9.2 The earthing terminals and contacts shall not be connected to the neutral terminal of the main supply of the luminous discharge tube luminaire.

Compliance is checked by inspection.

14.10 Protection against electric shock

The provisions of Section 8 of IEC 60598-1 apply.

14.11 Resistance to dust, solid objects and moisture

The provisions of Section 9 of IEC 60598-1 apply.

14.12 Insulation resistance and electric strength

The provisions of Section 10 of IEC 60598-1 do not apply.

Instead, the provisions of Clause 15 of IEC 61050 and Clause 12 of IEC 61347-2-10, as applicable, apply.

14.13 Creepage distances and clearances

The provisions of Section 11 of IEC 60598-1 apply. In addition, for the high voltage circuit, the following applies.

14.13.1 Creepage distances and clearances between:

a) current-carrying parts with different polarity,

b) current-carrying parts and the earth, or which can be touched by the standard test finger of IEC 60529,

shall comply with Tables 2, 3, 4 and 5 of this Part 2.

NOTE 1 The voltage given in Tables 2, 3, 4 and 5 are either the rated no-load output voltage between terminals or the rated no-load output voltage between terminals and earth, as appropriate, of the control gear supplying the high voltage circuit.

NOTE 2 In most situations, the manufacturer needs to consider the creepage distances and clearances between live parts and earth, so the voltage in Tables 2 to 5 is the no-load output voltage to earth. The total no-load output voltage has to be used only on the rare occasions when creepage distances and clearances between live terminals are being considered. For example, for a transformer rated at 5 kV – E – 5 kV, creepage distances and clearances for a voltage of 5 kV (not 10 kV) are taken from Tables 2 to 5, as applicable.

NOTE 3 An example of creepage distances and clearances is given in Figure 4.

The distances from an electrode connection to, for example, an earthed metal part, must be measured along the shortest path through creepage and clearance distances (see Figure 5).

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The creepage distance and clearance between the glass wall of the tube or any metal clip attached to the tube and earthed metalwork, in millimetres, shall be not less than the following:

creepage distance $D = U$

clearance $C = 0{,}75 \times U$

where

U is the no-load rated output voltage to earth of the control gear supplying the equipment, in kilovolts.

Table 2 – Creepage distances and clearances for circuits operating at rated mains frequency on ordinary luminaires

U kV	**Shortest creepage distances** mm	**Shortest clearances** mm
> 1,00 – 1,75	11	8
> 1,75 – 2,25	13	9
> 2,25 – 3,00	16	11
> 3,00 – 4,00	19	13
> 4,00 – 5,00	23	15
> 5,00 – 6,00	27	17
> 6,00 – 8,00	32	20
> 8,00 – 10,0	40	25

Table 3 – Creepage distances and clearances for circuits operating at a frequency exceeding 1 kHz on ordinary luminaires

U kV	**Shortest creepage distances** mm	**Shortest clearances** mm
> 1,00 – 1,75	13	10
> 1,75 – 2,25	16	11
> 2,25 – 3,00	19	13
> 3,00 – 4,00	23	16
> 4,00 – 5,00	28	18
> 5,00 – 6,00	32	20
> 6,00 – 8,00	38	24
> 8,00 – 10,0	48	30

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