IEC 60364-7-721

Edition 2.0 2017-06

INTERNATIONAL STANDARD

Low-voltage electrical installations – Part 7-721: Requirements for special installations or locations – Electrical installations in caravans and motor caravans

IEC 60364-7-721:2017-06(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.020; 91.140.50

ISBN 978-2-8322-4425-8

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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LOW-VOLTAGE ELECTRICAL INSTALLATIONS –

Part 7-721: Requirements for special installations or locations – Electrical installations in caravans and motor caravans

FOREWORD

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International Standard IEC 60364-7-721 has been prepared by IEC technical committee 64: Electrical installations and protection against electrical shock.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) A minimum height of not less than 500 mm above the base of the cylinders is now required for cables passing through the gas cylinder compartment. Where cables have to run through a compartment such cables shall be protected against mechanical damage by installation within a continuous conduit or duct passing through the compartment (721.528.3.1).

b) It is now required that each independent installation shall be provided with its own main isolating switch which shall disconnect all live conductors and which shall be suitably placed in a readily accessible location in the caravan.(721.536.2.1.1)

c) The clause numbers for the protective measures not permitted (obstacles, placing out of reach, non-conducting locations and earth-free local equipotential bonding) have been changed.

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

FDIS	Report on voting
64/2200/FDIS	64/2210/RVD

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

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

A list of all parts in the IEC 60364 series, published under the general title *Low-voltage electrical installations*, can be found on the IEC website.

The reader's attention is drawn to the fact that Annex D lists all of the “in-some-country” clauses on differing practices of a less permanent nature relating to the subject of this standard.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

For the purpose of this part (IEC 60364-7-721) the requirements of the general Parts 1 to 6 of IEC 60364 apply.

The IEC 60364-7-7XX parts of IEC 60364 contain particular requirements for special installations or locations which are based on the requirements of the general parts of IEC 60364 (IEC 60364-1 to IEC 60364-6). These IEC 60364-7-7XX parts are considered in conjunction with the requirements of the general parts.

The particular requirements of this part of IEC 60364 supplement, modify or replace certain of the requirements of the general parts of IEC 60364 being valid at the time of publication of this part. The absence of reference to the exclusion of a part or a clause of a general part means that the corresponding clauses of the general part are applicable (undated reference).

Requirements of other 7XX parts being relevant for installations covered by this part also apply. This part may therefore also supplement, modify or replace certain of these requirements valid at the time of publication of this part.

The clause numbering of this part follows the pattern and corresponding references of IEC 60364. The numbers following the particular number of this part are those of the corresponding parts, or clauses of the other parts of the IEC 60364 series, valid at the time of publication of this part, as indicated in the normative references of this document (dated reference).

If requirements or explanations additional to those of the other parts of the IEC 60364 series are needed, the numbering of such items appears as 721.101, 721.102, 721.103 etc.

In the case where new or amended general parts with modified numbering were published after this part was issued, the clause numbers referring to a general part in this 721 part may no longer align with the latest edition of the general part. Dated references should be observed.

LOW-VOLTAGE ELECTRICAL INSTALLATIONS –

Part 7-721: Requirements for special installations or locations – Electrical installations in caravans and motor caravans

721 Electrical installations in caravans and motor caravans

721.1 Scope

The particular requirements of this part of IEC 60364 apply to electrical installations in caravans and motor caravans.

They apply to those electrical circuits and equipment intended for the use of the caravan for habitation purposes.

They do not apply to those electrical circuits and equipment for automotive purposes.

They do not apply to the electrical installations of mobile homes, residential park homes and transportable units.

NOTE 1 For mobile homes and residential park homes the general requirements apply.

NOTE 2 For transportable units see IEC 60364-7-717.

NOTE 3 For the purposes of this document, caravans and motor caravans are referred to as “caravans”

The particular requirements of some parts from the IEC 60364-7 series can also apply to such installations in caravans, for example IEC 60364-7-701.

721.2 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

IEC 60038, *IEC standard voltages*

IEC 60309-2, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

IEC 60332-1-2, *Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame*

IEC 60947-2, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

IEC 61084 (all parts), *Cables trunking and ducting systems for electrical installations*

IEC 61386 (all parts), *Conduit systems for cable management*

IEC 62423*, Type F and Type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses*

721.3 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

721.3.1
leisure accommodation vehicle
unit of living accommodation for temporary or seasonal occupation that may meet the requirements for the construction and use of road vehicles

721.3.1.1
caravan
trailer leisure accommodation vehicle, used for touring, that meets the requirements for the construction and use of road vehicles

721.3.1.2
motor caravan
self-propelled leisure accommodation vehicle, used for touring, that meets the requirements for the construction and use of road vehicles

Note 1 to entry: A motor caravan is either adapted from a series production vehicle, or designed and built on an existing chassis, with or without the driving cab, the accommodation being either fixed or dismountable.

721.3.1.3
mobile home
transportable leisure accommodation vehicle that includes means for mobility but does not meet the requirements for the construction and use of road vehicles

721.3.1.4
residential park home
factory produced relocatable dwelling

721.31 Purposes, supplies and structure

721.313 Supplies

721.313.1 General

721.313.1.101 The nominal supply system voltage shall be selected from IEC 60038.

The nominal AC supply voltage of the installation of the caravan shall not exceed 230 V single-phase, or 400 V three-phase.

The nominal DC supply voltage of the installation of the caravan shall not exceed 48 V.

721.4 Protection for safety

721.41 Protection against electric shock

721.410.3.5

Add the following:

The protective measures of obstacles and placing out of reach as specified in Annex B of IEC 60364-4-41:2005 shall not be used.

721.410.3.6

Add the following:

The protective measures of non-conducting locations and earth-free local equipotential bonding as specified in Annex C of IEC 60364-4-41:2005 shall not be used.

NOTE This precludes the use of class 0 equipment.

721.411 Protective measure: automatic disconnection of supply

721.411.3.1.2 Protective equipotential bonding

Metal frame parts or thereto connected construction parts shall be connected through main protective bonding conductors to the main earthing terminal within the caravan.

721.413 Protective measure: electrical separation

The protective measure: electrical separation shall not be used, except for a shaver socket-outlet.

721.414 Protective measure: extra-low voltage provided by SELV and PELV

Any part of a caravan installation operating at extra-low voltage shall comply with the requirements of Clause 414.

For extra-low voltage DC power sources, a maximum of 48 V are allowed. In exceptional cases, when AC extra-low voltage is required, the voltage (rms) is not allowed to exceed 48 V.

The requirements of Part 721 are also applicable to extra low-voltage DC installation. See Annex B for recommendations that can be applied in addition.

721.415 Additional protection

721.415.101 Additional protection: residual current protective devices (RCDs)

Addition:

Where protection by automatic disconnection of supply is used, a residual current device with a rated residual operating current not exceeding 30 mA, complying with IEC 60947-2, IEC 61008-1, IEC 61009-1 or IEC 62423 breaking all live conductors, shall be provided. Each supply inlet shall be directly connected to its associated RCD.

NOTE This implies that there cannot be any taps or junctions in this connection.

Consideration should be given to the characteristics of the load in selection of the type of RCD.

721.43 Protection against overcurrent

721.43.101 Final circuits

Each final circuit shall be protected by an overcurrent protective device which disconnects all live conductors of that circuit.

721.5 Selection and erection of equipment

721.51 Common rules

721.510 Introduction

721.510.3 General

Where there is more than one electrically independent installation, each independent installation shall be supplied by a separate connecting device and shall be segregated (in accordance with general rules) such that supplies at different voltages cannot be interconnected.

NOTE Independent installations. An installation is an assembly of associated electrical equipment having co-ordinated characteristics to fulfil specific purposes.

721.512 Operational conditions and external influences

721.512.2 External influences

Consideration shall be given to the foreseeable external influences to which the caravan will be subjected.

721.514 Identification

721.514.1 General

Instructions for use shall be provided with the caravan so that the caravan can be used safely.

The instructions shall comprise:

– a description of the installation;
– a description of the function of the RCD(s) and the use of the test button;
– a description of the function of the main isolating switch(es);
– the text of the instructions of Annex A.
– additional instructions necessary for user maintenance.

721.52 Wiring systems

721.521 Types of wiring systems

721.521.2 The wiring system shall use one or more of the following:

– insulated single-core cables, with flexible class 5 conductors, in non-metallic conduit or non-metallic trunking system;
– insulated single-core cables, with stranded class 2 conductors (minimum of seven strands), in non-metallic conduit or non-metallic trunking system;
– sheathed flexible cables.

All cables shall as a minimum meet the requirements of IEC 60332-1-2.

Non-metallic conduit systems shall comply with the relevant part of IEC 61386 (all parts).

Cable trunking systems and cable ducting systems shall comply with the relevant part of IEC 61084 (all parts).

721.522 Selection and erection of wiring systems in relation to external influences

721.522.7 Vibration (AH)

721.522.7.1 As the wiring will be subjected to vibration, all wiring shall be protected against mechanical damage either by location or by enhanced mechanical protection. Wiring passing through metalwork shall be protected by means of suitable bushes or grommets, securely fixed in position. Precautions shall be taken to avoid mechanical damage due to sharp edges or abrasive parts.

721.522.8 Other mechanical stresses (AJ)

721.522.8.1.3 All cables, unless enclosed in rigid conduit, trunking, or flexible conduit shall be supported at intervals not exceeding 0,4 m for vertical runs and 0,25 m for horizontal runs.

721.524 Cross-sectional areas of conductors

721.524.1 The cross-sectional area of every conductor shall be not less than 1,5 mm^2 copper or copper equivalent.

721.526 Electrical connections

721.526.1.101 *Addition:*

Connections between cables or conductors shall only be made in connecting boxes or by electrical equipment.

NOTE Connections also include junctions and taps.

721.528 Proximity of wiring systems to other services

721.528.3 Proximity to non-electrical services

721.528.3.1

Add the following at the end of 528.3.1:

No electrical equipment including wiring systems, except:

a) ELV (extra low voltage) equipment for gas supply control;
b) cables running through a gas compartment without connection shall be installed in any gas cylinder compartment.

Such electrical installations and components shall be constructed and installed so that they are not a potential source of ignition.

Where cables have to run through such a compartment such cables shall be protected against mechanical damage by installation within a continuous conduit or duct passing through the compartment at a height of not less than 500 mm above the base of the cylinders.

Where installed in a position where it is likely to be subject to mechanical damage this conduit or duct shall be able to withstand an impact equivalent to AG3.721.53 isolation, switching and control.

721.53 Isolation, switching and control

721.536 Isolation and switching

721.536.2 Isolation

721.536.2.1.1 Each independent installation shall be provided with its own main isolating switch which shall disconnect all live conductors and which shall be suitably placed in a readily accessible location in the caravan. In an installation consisting of only one final circuit, the isolating switch may be the overcurrent protection device providing such a device meets the requirements for isolation.

721.536.2.1.1.101 A notice in durable material shall be permanently fixed in the vicinity of the main isolating switch inside the caravan, bearing the text shown in Annex A in the official language(s) of the country in which the caravan is to be sold for the first time, in indelible and easily legible characters.

721.54 Earthing arrangements and protective conductors

721.543 Protective conductors

721.543.2 Types of protective conductors

721.543.2.1 Circuit protective conductors shall be incorporated in a multicore cable or in a conduit or trunking together with the live conductors.

721.544.1 Protective bonding conductors for connection to the main earthing terminal

721.544.1.101 The terminations of protective bonding conductors connecting the conductive structure of the unit shall be accessible and protected against corrosion.

721.55 Other equipment

721.55.2 General requirements

721.55.2.101 Inlets

721.55.2.101.1 Any AC electrical inlet on the caravan shall be an appliance inlet complying with IEC 60309-2.

721.55.2.101.2 The inlet, if any, shall be installed

a) not more than 1,8 m above ground level,

b) in a readily accessible position,

c) have a minimum protection of IP44 with or without a connector engaged, and

d) the inlet shall not protrude significantly beyond the body of the caravan.

721.55.2.102 Accessories

721.55.2.102.1 Every low-voltage socket-outlet, other than a shaver socket-outlet, shall incorporate an earth contact.

721.55.2.102.2 Every socket-outlet supplied at extra-low voltage shall have its voltage visibly marked.

721.55.2.102.3 Where an accessory is located in a position in which it is exposed to the effects of moisture it shall be constructed or enclosed so as to provide a degree of protection not less than IPX4.

721.55.2.102.4 Each luminaire in a caravan shall preferably be fixed directly to the structure or lining of the caravan. Where a pendant luminaire is installed in a caravan, provision shall be made for securing the luminaire to prevent damage when the caravan is moved.

Accessories for the suspension of pendant luminaires shall be suitable for the mass suspended and the forces associated with vehicle movement.

721.55.2.102.5 A luminaire intended for dual voltage operation shall comply with the appropriate standard.

721.55.2.102.6

Table 721.1 – Cross-sectional areas of flexible cords and cables for caravan connection

Rated current A	Minimum cross-sectional area mm^2
16	2,5
25	4
32	6
63	16
100	35

The appliance inlet installed under 721.55.2.101 shall comply with IEC 60309-2, and the means of connection to the caravan pitch socket-outlet shall comprise the following:

a) a plug complying with IEC 60309-2; and

b) a flexible cord or cable
   - of 25 m (±2 m) continuous length,
   - of harmonized code designation IEC 60245 (code 57) or equivalent,
   - incorporating a protective conductor, with a colour identification according to the appropriate IEC standard, and
   - with a cross-sectional area in accordance with Table 721.1, and

c) a connector complying with IEC 60309-2.

The means of connection to the caravan pitch socket-outlet need not be supplied with the caravan.

Annex A
(normative)

Instructions for electricity supply

A.721.1 Connection

a) Before connecting the caravan installation to the electricity supply, check that

   1) the supply available at the caravan pitch supply point is suitable for the caravan electrical installation and appliances, the voltage, frequency and current rating are suitable,

   2) the cable and means of connection are suitable, and

   3) the main isolating switch in the caravan is in the OFF position.

WARNING The caravan supply flexible cable should be fully uncoiled to avoid damage by overheating.

b) Check the cable, the plug and the connector for damage.

c) Open the cover of the appliance inlet provided at the caravan, if any, and insert the connector of the flexible cable.

d) Insert the plug of the flexible cable into the electricity outlet provided on the pitch supply point.

e) Switch on the caravan main isolating switch.

f) Check the operation of residual current devices fitted in the caravan by depressing the test buttons and reset.

In case of doubt or, if after carrying out the above procedure the supply does not become available, or if the supply fails, consult the caravan park operator.

A.721.2 Disconnection

Switch off at the caravan main isolating switch, unplug the cable, first on the caravan pitch supply point side and then at the caravan appliance inlet, if any.

A.721.3 Periodic inspection

Preferably not less than once every three years and annually if the caravan is used frequently, the caravan electrical installation and supply cable should be inspected and tested by a competent electrician and a report on their condition obtained.

Annex B
(informative)

Extra low-voltage DC installations

B.721.31 Purposes, supplies and structure

B.721.313 Supplies

B.721.313.101 Sources of supply

The supply should be obtained from one or more of the following sources:

a) the electrical installation of the towing vehicle;

b) an auxiliary battery mounted in the caravan;

c) a low-voltage DC supply via a transformer/rectifier unit complying with IEC 60335-1 and IEC 61558-2-6;

d) a DC generator that is driven by any form of energy;

e) solar photovoltaic (PV) power supply systems or similar.

B.721.51 Common rules

B.721.514 Identification

B.721.514.1 General

The following information should be provided in the instructions for use and should be in the official language(s) of the country in which the caravan is to be sold:

a) A warning worded as follows: “Any replacement of an auxiliary battery should be of the same type and specification as that originally specified by the caravan manufacturer”.

b) Instructions on the maintenance and recharging of an auxiliary battery where it is fitted. Where a battery charger is provided, instructions on its safe use should be included.

c) Instructions on selecting and installing an auxiliary battery in a compartment, if the caravan is intended for the installation of an auxiliary battery.

d) Details of the warning notice specified in B.721.55.3.5 and its importance for safety.

e) In order to ensure safe operation of the electrical installation, a simplified diagram of the wiring of the ELV and LV installation, with details of the cable colours and/or marking and the nominal values of the overcurrent protective devices should be provided.

f) Type of appliances that can be used and from what source of supply.

g) Instructions for the correct operation and maintenance of fitted appliances, as supplied by the appliance manufacturer.

h) A warning worded as follows: “Always disconnect the electrical connector between the towing vehicle and the caravan before connecting an LV supply to the caravan and before charging the caravan battery by any other means”.

B.721.515 Prevention of mutual detrimental influence

B.721.515.2 The ELV installation should be so installed that the protective measures of the LV installation against direct contact, or in case of indirect contact are not impaired.

It should be ensured that operating currents of the ELV installation do not flow in the protective conductors of the LV installation.

B.721.521 Types of wiring systems

B.721.521.2 Cables should be of stranded construction and should comply with IEC 60227 (all parts), IEC 60245 (all parts) or ISO 6722 (all parts).

B.721.523 Current-carrying capacities

B.721.523.1 The cross-sectional areas of the conductors selected for the fixed wiring should be in accordance with Annex C. Annex C does not apply to sensor and data lines.

B.721.525 Voltage drop in consumers' installations

Under normal service conditions, the voltage at the terminals of any fixed current-using equipment should be greater than the lower limit corresponding to the IEC standard relevant to the equipment. Where the equipment is not the subject of an IEC standard, the voltage at the terminals should be such as not to impair the safe functioning of that equipment. In the absence of precise data, a voltage drop of 0,8 V from the power supply to the equipment may be allowed.

The charging current I_C [A] to determine the voltage drop is established by Formula (B.1).

$$I_C = \frac{c \cdot 0{,}1}{t} \tag{B.1}$$

where

I_C is the charging current, in A;

c is the battery capacity, in Ah;

t is the period, in h.

B.721.528 Proximity of wiring systems to other services

B.721.528.3 Proximity to non-electrical services

B.721.528.3.5.101 Cable runs and LPG installations

Cables including those used for automotive purposes should not be run through a compartment or housing intended for liquefied petroleum gas storage cylinders. Where cables have to run through such a compartment or housing, they should be run at a height of not less than 500 mm above the base of the cylinders, and such cables should be protected against mechanical damage by installation within a continuous gas tight conduit or duct passing through the compartment.

Where installed, this conduit or duct should be able to withstand an impact equivalent to AG3 without visible physical damage.

ELV cables and electrical equipment are only to be installed within the LPG cylinder compartment or housing if the installation serves the operation of the gas cylinders (e.g. indication of empty gas cylinders) or is for use within the compartment or housing. Such electrical installations and components should be constructed and installed so that they are not a source of ignition and are in accordance with the relevant standards for any hazardous area classification of the compartment or housing.

B.721.53 Isolation, switching and control

B.721.533 Devices for protection against overcurrent

B.721.533.1 General requirements

B.721.533.1.101 The overcurrent protective device for the power supply from the towing vehicle should be installed as near as possible to the auxiliary battery, but in no case more than 1 000 mm away. The overcurrent protective device for the auxiliary battery should be fitted at the end of the battery cable and before the fixed installation. The ELV output of the transformer/rectifier unit and of the DC generator should be provided with an overcurrent protective device unless this is already incorporated within the unit or generator. The protective device should be installed as near as possible to the unit or generator and, in all cases, upstream of the distribution circuits.

B.721.533.1.102 Overcurrent protective devices should be either fuse links according to ISO 8820 (all parts) or suitable miniature circuit-breakers.

B.721.533.1.103 Fuses should be physically protected against accidental mechanical damage.

B.721.533.1.104 Overcurrent protective devices should not be fitted in a fuel storage compartment or fuel storage housing intended for the storage of liquefied petroleum gas cylinders or in the compartment for housing an auxiliary battery.

B.721.55 Other equipment

B.721.55.2 General requirements

B.721.55.2.101 Inlets

The inlet, when the plug is disconnected, should be protected against the ingress of water, foreign bodies and accidental damage.

B.721.55.2.102 Accessories

The means of connection to the towing vehicle should be supplied with the caravan and comprise the following:

a) a plug complying with ISO 1724 and ISO 3732 or ISO 11446 (all parts), and

b) a flexible cord or cable with the number of cores with the minimum cross-sectional area and the allocation according to Table B.721.1 and a length not exceeding 5 m, and

c) a connector complying with ISO 1724 and ISO 3732 or ISO 11446 (all parts).

Table B.721.1 – Functional allocation and cross-sectional areas of cores for caravan connectors

Core No.	Function	Contact numbers		Minimum cross-sectional area mm²
		ISO 11446	ISO 1724	
1	Left-hand direction – indicator light	1	1	1,5
2	Rear fog light	2	2	1,5
3	Common return for core nos. 1, 2, 4, 5, 6, 7 and 8	3[a]	3[a]	2,5
4	Right-hand direction – indicator light	4	4	1,5
5	Right hand-rear position and marker lights, and rear-registration-plate illumination device	5	5	1,5
6	Stop lights	6	6	1,5
7	Left-hand rear position and marker lights, and rear-registration-plate illumination device	7	7	1,5
			ISO 3732	
8	Reversing light	8	1	1,5
9	Continuous power supply	9	4	2,5
10	Power supply controlled by ignition switch	10	6	2,5
11	Return for core No. 10	11[a]	7[a]	2,5
12	Coding for coupled trailer	12	2	–
13	Return for core No. 9	13[a]	3[a]	2,5
14	No allocation	–	5	1,5

[a] These return circuits should not be electrically connected in the trailer.

B.721.55.2.103 Auxiliary batteries

B.721.55.2.103.1 Type of battery

An auxiliary battery should be of the rechargeable type.

NOTE Non-rechargeable batteries are not auxiliary batteries. They can be used in caravans, provided that they are used in circuits separated from other sources of electrical supply.

B.721.55.2.103.2 Capacity

An auxiliary battery should have a minimum capacity of 60 Ah at a 20 h discharge period.

It is recommended to use a battery designed to be discharged over long periods at a relatively low current.

B.721.55.2.103.3 Terminals

Auxiliary battery terminals should be clearly and durably marked “+” and “-”. Connections to auxiliary battery terminals should be securely clamped or bolted to ensure continuous contact and should be insulated unless the auxiliary battery is provided with an insulating device.

B.721.55.2.103.4 Location

An auxiliary battery should be placed in a separate compartment with easy access for maintenance or removal. The battery should be secured to prevent movement, for example when the caravan is in motion.

B.721.55.2.103.5 Auxiliary battery compartment

A tray should be installed under an auxiliary battery if the electrolyte of this battery is liquid. The tray should be sufficient to hold 20 % of the volume of the electrolyte.

The interior of an auxiliary battery compartment should be ventilated and protected against the corrosive effects of acid-laden gases, by one of the following methods:

a) installing a sealed auxiliary battery that incorporates an external ventilating kit that is taken to the exterior of the caravan or

b) installing an auxiliary battery in an enclosed battery compartment that is protected internally against corrosion and is ventilated to the exterior of the caravan by means of a suitable tube with a minimum inside diameter of 10 mm at the top of the auxiliary battery compartment in accordance with the battery manufacturer's instructions or as supplied by the manufacturer of the auxiliary battery or

c) ventilating the compartment at low-level and high-level to the exterior of the caravan and constructing the interior of the compartment, including the sides of the ventilator openings, of acid-resistant material or providing it with an anti-corrosive finish. If the compartment opens into the interior of the caravan, the lid should provide an air seal. The minimum size of ventilation should be not less than 80 mm^2 at low level and not less than 80 mm^2 at high level.

If an auxiliary battery is not provided, then the position and instructions for the installation of the battery and compartment, in accordance with a), b) or c) of this subclause, should be included in the instructions for use and a notice should be fixed in or near the proposed location stating: “For instructions on auxiliary battery installation, see the instructions for use”.

When the manufacturer makes no provision for the installation of an auxiliary battery, the following statement should be made in the instructions for use: “This caravan has not been designed to accommodate an auxiliary battery. Do not fit one.”

B.721.55.2.103.6 Auxiliary battery cables

Cables from an auxiliary battery should be protected by additional sheathing or taping up to the overcurrent protective device.

B.721.55.2.103.7 Warning notice

A warning notice should be fixed in a prominent position near the auxiliary battery or displayed on the lid of the auxiliary battery compartment. This warning should be in the official language(s) of the country in which the caravan is to be sold and should state: “Switch off all appliances and lamps before disconnecting the auxiliary battery.”

The auxiliary battery compartment should be additionally marked “Smoking prohibited” in accordance with ISO 7010:2011 and in the language(s) of the country in which the caravan is to be sold.

B.721.55.2.104 Other sources of supply

B.721.55.2.104.1 Generators and transformer/rectifier units

If a supply is obtained from a generator or from a low-voltage supply via a transformer/rectifier unit, the extra-low voltage at the output terminals of the supply unit should be maintained between 11 V minimum and 15 V maximum with applied loads varying from 0,5 A minimum up to the maximum rated load of the supply unit. Over the same load range, alternating voltage ripple should not exceed 1,2 V_{pp}.

B.721.55.2.104.2 Regenerative sources

Regenerative energy sources, such as wind energy, solar energy , should be installed only for charging batteries and such sources should only generate extra-low voltage.

Regenerative energy sources should only be operated with a device which prevents overcharging of the battery(ies).

B.721.55.2.105 Charging of auxiliary battery and operation of refrigerator

B.721.55.2.105.1 The circuit to charge an auxiliary battery should be separate from a circuit to operate a refrigerator.

B.721.55.2.105.2 The charging circuit for an auxiliary battery should be energized only when the engine of the towing vehicle is running.

B.721.55.2.106 Terminal block

If the connection between the connecting cable(s) and the caravan's fixed wiring is by means of a terminal block, it should have a protective cover. If the terminal block is positioned externally it should have a cover providing a degree of protection of not less than IP34 as given in IEC 60529.

B.721.55.2.107 Appliances

B.721.55.2.107.1 General

The caravan manufacturer's technical specification should state whether an ELV appliance is suitable for use with a supply obtained from a DC generator or a transformer/rectifier unit.

Appliances suitable for operation on both 12 V AC and 12 V DC are permitted provided that the AC and the DC systems are segregated and interconnection is prevented.

B.721.55.2.107.2 Selection and connection of appliances

All appliances should be fitted and connected in accordance with the appliance manufacturer's instructions. Where polarity-sensitive appliances are fitted and connected, only those that have terminals clearly marked “–” and “+”, or that have two conductors, indicating polarity by colour or by identification tags or sleeves marked “–” and “+”should be used.

B.721.55.2.108 Socket-outlets

ELV socket-outlets should be two pole non-reversible and should be of a different type from those provided for any low-voltage installation. The voltage and maximum power rating of the circuit should be stated on or adjacent to the socket-outlets.

B.721.55.2.109 Battery charger

If a battery charger is connected to a low-voltage AC supply, it should comply with the relevant clauses of IEC 60335-2-29. The DC output should either be electronically regulated or the maximum DC output of the charger in A should be limited to 10 % of the capacity of the auxiliary battery in Ah at 20 h discharge rate.

B.721.55.2.110 External lights

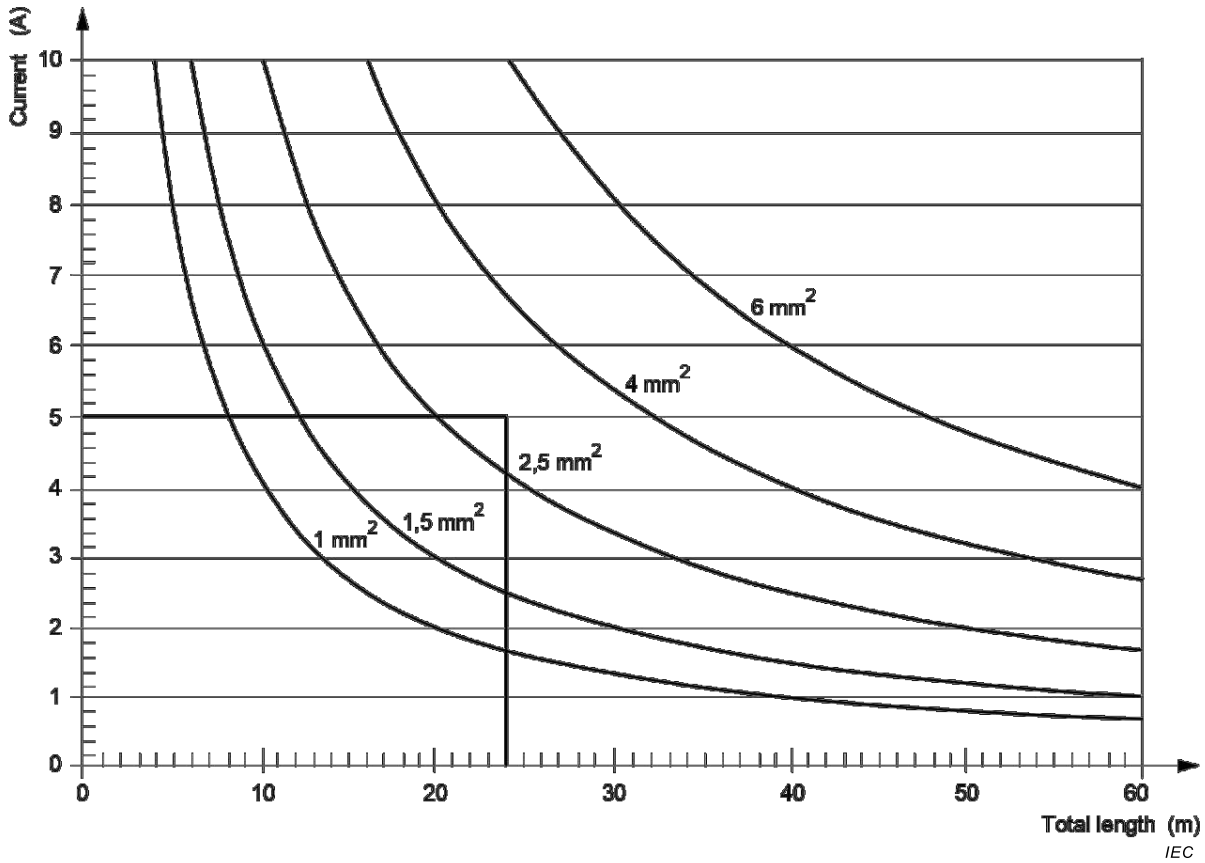
Lights, such as door lamps, fixed outside on a caravan should be constructed or enclosed to provide protection against the ingress of water with a degree of protection of not less than IP34 according to IEC 60529.

Annex C
(informative)

Current-carrying capacities

C.721.1 The minimum conductor cross-sectional areas are to be selected from graphs (see Figure C.721.1 and Figure C.721.2) or calculated according to Formula (C.1)

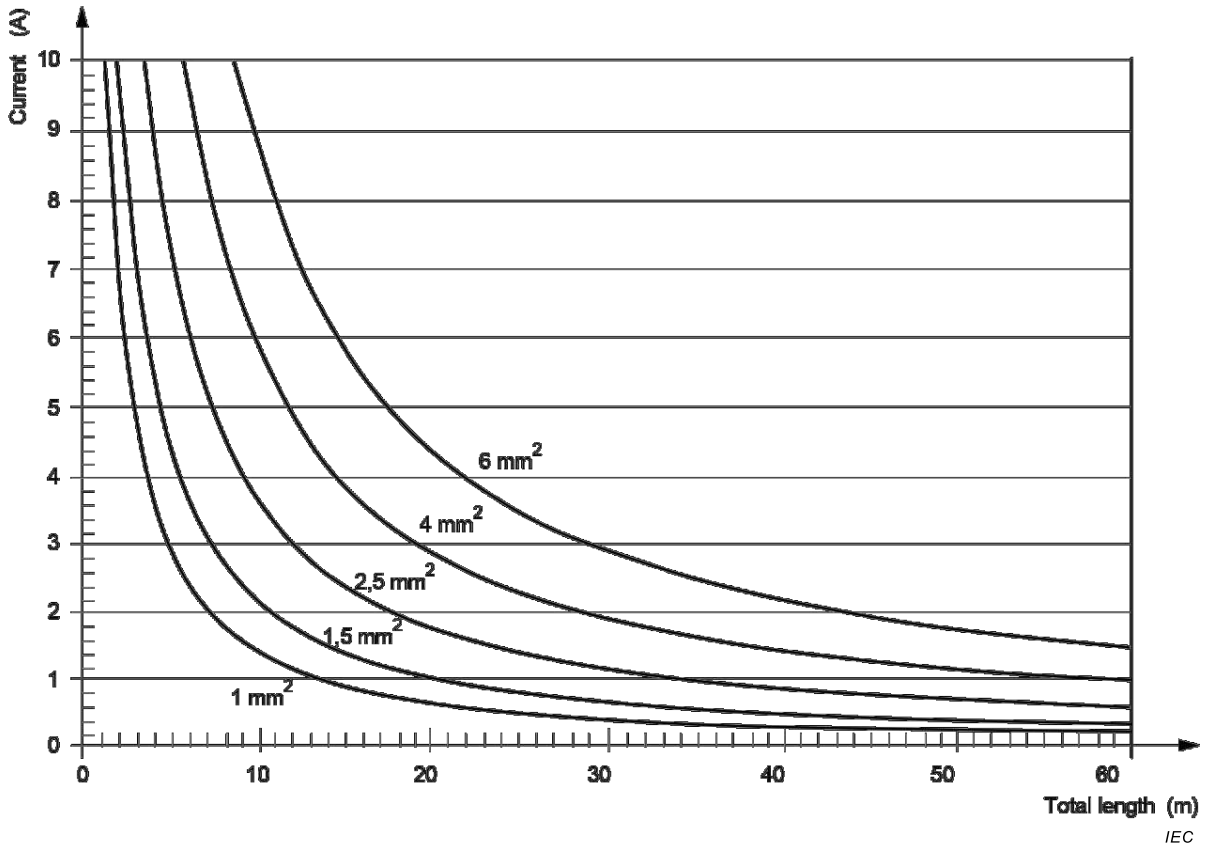
C.721.1.1 Graphs for obtaining minimum cross-sectional areas



Total length of both cables (positive and negative), in m
(route length is half above length)

To obtain the minimum cross-sectional area for a circuit with a design current of 5 A and a total cable length of 24 m (12 m route length), the cross-sectional area of the conductors of that circuit should not be less than 4 mm^2.

Figure C.721.1 – Graph for obtaining minimum cross-sectional area for conductors for fixed wiring installations with a voltage drop of 0,8 V



Total length of both cables (positive and negative), in m
(route length is half above length)

Figure C.721.2 – Graph for obtaining minimum cross-sectional area for conductors for battery cable installations with a voltage drop of 0,3 V

C.721.1.2 Calculation of the minimum cross-sectional areas

The cross-sectional areas may be calculated from the following formula:

$$A = \frac{\rho \cdot L \cdot I}{U_V} \quad \text{(C.1)}$$

where

A is the cross-sectional area of conductor, in mm^2;

ρ is the resistivity of copper (0,019 89 Ω mm^2/m at 50 °C);

L is the total length (feed and return cable) of the conductors, in m;

I is the total current, in A;

U_V is the permissible voltage drop
(0,3 V for auxiliary battery charging cables, 0,8 V for fixed wiring cables).

With intermediate values, the result of the calculation should be rounded to the next higher cross-sectional area.

C.721.2 The graphs in Figures C.721.1 and C.721.2 and Formula (C.1) are based on a conductor operating temperature of 50 °C.

If cables are installed for use under conditions of temperatures higher than 50 °C the minimum cross-sectional area of the conductors should be increased.

C.721.3 If the appliance manufacturer requires a voltage drop which is different from 0,3 V or 0,8 V, this value should be inserted for U_V in Formula (C.1).

Annex D
(informative)

List of notes concerning certain countries

Subclause	Text
721.313.1	Add the following note after the first paragraph of the subclause: NOTE In Norway, a 230 V IT-distribution system is commonly used.
721.313.1	Add the following note: NOTE In the US: – the nominal AC supply voltage of the installation of the caravan shall not exceed 120 V or 120/240 V single phase or 208Y/120 V, and – the nominal DC supply voltage of the installation of the caravan shall not exceed 24 V.

Bibliography

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60309-1, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*

IEC 60364-7-717, *Low-voltage electrical installations – Part 7-717: Requirements for special installations or locations – Mobile or transportable units*

IEC 61386-21:2002, *Conduit systems for cable management – Part 21: Particular requirements – Rigid conduit systems*

ISO 6722 (all parts) , *Road vehicles – 60 V and 600 V single-core cables*

IEC 60245 (all parts) *Rubber insulated cables – Rated voltages up to and including 450/750V*

IEC 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60335-2-29, *Household and similar electrical appliances – Safety – Part 2-29: Particular requirements for battery chargers*

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

IEC 61558 2-6, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*

ISO 1724, *Road vehicles – Connectors for the electrical connection of towing and towed vehicles – 7-pole connector type 12 N (normal) for vehicles with 12 V nominal supply voltage*

ISO 3732, *Road vehicles – Connectors for the electrical connection of towing and towed vehicles – 7-pole connector type 12 S (supplementary) for vehicles with 12 V nominal supply voltage*

ISO 7010:2011*, Graphical symbols – Safety colours and safety signs – Registered safety signs* (available at http://www.graphical-symbols.info/equipment)

ISO 8820 (all parts), *Road vehicles – Fuse-links*

ISO 11446 (all parts), *Road vehicles – Connectors for the electrical connection of towing and towed vehicles*

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