

# **Requirements for electrical installations**

## **Part 7: Special Installations or Locations**

PUBLIC REVIEW DRAFT MARCH 2026

# DKS 662-7: 2026

## TECHNICAL COMMITTEE REPRESENTATION

The following organizations were represented on the Technical Committee:

XXXXXX  
XXXXXX  
XXXXXX  
XXXXXX  
XXXXXX  
XXXXXX  
XXXXXX  
XXXXXX

Kenya Bureau of Standards — Secretariat

## REVISION OF KENYA STANDARDS

In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

© Kenya Bureau of Standards, 2026

*Copyright. Users are reminded that by virtue of Section 25 of the Copyright Act, Cap. 12 of 2001 of the Laws of Kenya, copyright subsists in all Kenya Standards and except as provided under Section 26 of this Act, no Kenya Standard produced by Kenya Bureau of Standards may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing from the Managing Director.*

# Requirements for electrical installations

## Part 7: Special Installations or Locations

**KENYA BUREAU OF STANDARDS (KEBS)**

**Head Office:** P.O. Box 54974, Nairobi-00200, Tel.: (+254 020) 605490, 602350, Fax: (+254 020) 604031  
E-Mail: [info@kebs.org](mailto:info@kebs.org), Web: <http://www.kebs.org>

**Coast Region**

P.O. Box 99376, Mombasa-80100  
Tel.: (+254 041) 229563, 230939/40  
Fax: (+254 041) 229448

**Lake Region**

P.O. Box 2949, Kisumu-40100  
Tel.: (+254 057) 23549, 22396

**Rift Valley Region**

P.O. Box 2138, Nakuru-20100  
Tel.: (+254 051) 210553, 210555  
Fax: (+254 057) 21814

## Foreword

This Kenya Standard was prepared by the **Electrical Installations and Distribution Systems** Technical Committee under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.

Kenya Bureau of Standards (KEBS) has established Technical Committees (TCs) mandated to develop Kenya Standards (KS). The Committees are composed of representatives from the public and private sector organizations in Kenya.

Kenya Standards are developed through Technical Committees that are representative of key stakeholders including government, academia, consumer groups, private sector and other interested parties. Draft Kenya Standards are circulated to stakeholders through the KEBS website and notifications to World Trade Organization (WTO). The comments received are discussed and incorporated before finalization of the standards, in accordance with the Procedures for Development of Kenya Standards.

Kenya Standards are subject to review, to keep pace with technological advances. Users of the Kenya Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

The development of the **First Edition** of this standard is based on BS 7671:2018 (18<sup>th</sup> Edition) with its several amendments and the different parts of IEC 60364 and is split into the following parts:

Part 1, Scope, object and fundamental principles.

Part 2. Definitions.

Part 3. Assessment of general characteristics. Part 4: Protection for safety.

Part 5. Selection and erection of electrical equipment.

Part 6. Verification.

Part 7. Requirements for special installations or locations.

These parts are in line with those of IEC 60364.

During the preparation of this standard, reference was made to the following documents:

IEC 60364 (All parts): Low-voltage installations.

BS 7671. (18th Edition) Requirements for electrical installations. Acknowledgement is hereby made for the assistance derived from these sources.

# Contents

KENYA BUREAU OF STANDARDS (KEBS)	3
Scope	2
Normative references	1
SECTION 700: GENERAL	3
SECTION 701: LOCATIONS CONTAINING A BATH OR SHOWER	4
SECTION 702: SWIMMING POOLS AND OTHER BASINS	9
SECTION 703: ROOMS AND CABINS CONTAINING SAUNA HEATERS	18
SECTION 704: CONSTRUCTION AND DEMOLITION SITE INSTALLATIONS	20
SECTION 705: AGRICULTURAL AND HORTICULTURAL PREMISES	22
SECTION 706: CONDUCTING LOCATIONS WITH RESTRICTED MOVEMENT	27
SECTION 708: ELECTRICAL INSTALLATIONS IN CARAVAN / CAMPING PARKS AND SIMILAR LOCATIONS	29
SECTION 709: MARINAS AND SIMILAR LOCATIONS	34
SECTION 710: MEDICAL LOCATIONS	39
<b>ANNEX A710 MEDICAL LOCATIONS</b>	48
SECTION 711: EXHIBITIONS, SHOWS AND STANDS	49
SECTION 712: SOLAR PHOTOVOLTAIC (PV) POWER SUPPLY SYSTEMS	52
SECTION 714: OUTDOOR LIGHTING INSTALLATIONS	57
SECTION 715: EXTRA-LOW VOLTAGE LIGHTING INSTALLATIONS	59
SECTION 717: MOBILE OR TRANSPORTABLE UNITS	62
SECTION 721: ELECTRICAL INSTALLATIONS IN CARAVANS AND MOTOR CARAVANS	70
ANNEX A721 (Informative)	75
<b>GUIDANCE FOR EXTRA-LOW VOLTAGE DC INSTALLATIONS</b>	75
SECTION 722: ELECTRIC VEHICLE CHARGING INSTALLATIONS	80
ANNEX A722 (Informative)	83
<b>GUIDANCE FOR TN SYSTEMS WHERE PME CONDITIONS APPLY</b>	83
SECTION 729: OPERATING AND MAINTENANCE GANGWAYS	84
<b>ANNEX A729</b>	88
<b>ADDITIONAL REQUIREMENTS FOR CLOSED RESTRICTED ACCESS AREAS</b>	88
SECTION 730: ONSHORE UNITS OF ELECTRICAL SHORE CONNECTIONS FOR INLAND NAVIGATION VESSELS	89
<b>ANNEX A730</b>	92
<b>Examples of methods of obtaining supply</b>	92
SECTION 740: TEMPORARY ELECTRICAL INSTALLATIONS	94
<b>FOR STRUCTURES, AMUSEMENT DEVICES AND BOOTHS AT FAIRGROUNDS, AMUSEMENT PARKS AND CIRCUSES</b>	94
SECTION 753: HEATING CABLES AND EMBEDDED HEATING SYSTEMS	99
APPENDIX 5 (Informative)	103
<b>CLASSIFICATION OF EXTERNAL INFLUENCES</b>	103

## Scope

This part of KS 662 provides additional guidance on safety for installations in environments where the usual risks are elevated, whether from water, heat, or other special conditions. It complements the general safety rules found in other parts of KS 662 but adds more stringent or tailored requirements for certain locations.

Some of the special installations covered include locations containing a bath or shower, swimming pools and similar locations, rooms or compartments containing a sauna heater, agricultural and horticultural locations, electrical installations in construction and demolition sites, caravan parks, campsites, and similar locations, marinas and boatyards and medical locations.

Key Themes covered include Protection against electric shock in environments with added risks (e.g., wet or conductive environments).

The standard also covers earthing and bonding requirements, to ensure that electrical installations are safe from the effects of earth faults and elaborates isolation of electrical circuits to prevent accidental electrocution.

The document also illustrates specific installation techniques for specialized locations (e.g., waterproof enclosures or restricted access).

PUBLIC REVIEW DRAFT MARCH 2026

## Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this 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 part of this 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.

*KS IEC 60335-2-41, Household and similar electrical appliances - Safety - Part 2-41: Particular requirements for pumps*

*KS IEC 60335-2-76, Household and similar electrical appliances - Safety, part 2-76: Particular requirements for electric fence energizers*

*KS IEC 61439-4, Low-voltage switchgear and controlgear assemblies Part 4: Particular requirements for assemblies for construction sites (ACS).*

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

*KS IEC 60598-2-18, Luminaires - Part 2-18: Particular requirements - Luminaires for swimming pools and similar applications*

*KS IEC 60598-2-1, Luminaires - Part 2-1: Particular requirements - Fixed general-purpose luminaires*

*KS IEC 60309-2, Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes - Part 2: Dimensional compatibility requirements for pin and contact-tube accessories*

*KS IEC 60309-2, Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes*

*KS IEC 60502, Power cables with extruded insulation and their accessories for rated voltages from 1 kV ( $U_m = 1,2 \text{ kV}$ ) up to 30 kV ( $U_m = 36 \text{ kV}$ ) - ALL PARTS*

*ISO 11446-1, Road vehicles — Connectors for the electrical connection of towing and towed vehicles*

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

*IEC 61558-2-4, Safety of transformers, reactors, power supply units and combinations thereof - Part 2-4: Particular requirements and tests for isolating transformers and power supply units incorporating isolating transformers for general applications*

*IEC 61439, Low-voltage switchgear and controlgear assemblies*

*IEC 62262, Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

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

*IEC 60721-3-3, Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use at weather protected locations*

*KS IEC 60309-1, Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes - Part 1: General requirements*

*KS IEC 60309-4, Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes - Part 4: Switched socket-outlets with or without interlock*

*KS IEC 60309-2, Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes*

*KS IEC 61386, Conduit systems for cable management*

*IEC 61537, Cable management - Cable tray systems and cable ladder systems*

*KS IEC 61558-2-6, Specification for safety of transformers, power supply units and similar apparatus - Part 2-6: Particular requirements for safety isolating transformers for general use.*

*IEC 62305-1, Protection against lightning - Part 1: General principles*

*KS IEC 61140, Protection against electric shock - Common aspects for installation and equipment*

*KS IEC 61558-2-5, Safety of power transformers, power supplies, reactors and similar products Part 2-5: Particular requirements and test for transformer for shavers, power supply units for shavers and shaver supply*

*KS IEC 60598-2-24, Luminaires - Part 2: Particular requirements*

*KS IEC 61439-7, Low-voltage switchgear and controlgear assemblies Part 7: Assemblies for specific*

*applications such as marinas, camping sites, market squares, electric vehicle charging stations*

*IEC 60092-507,Electrical installations in ships - Part 507: Small vessels*

*KS IEC 60601-2,Medical electrical equipment*

*KS IEC 61008-2-2,Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's)*

*KS IEC 61009-2-1,Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)*

*IEC 61347-1,Controlgear for electric light sources - Safety - Part 1: General requirements*

*KS IEC 61215-1,Terrestrial photovoltaic (PV) modules*

*KS IEC 61439-1,Low-voltage switchgear and controlgear assemblies*

*KS IEC 62930,Electric cables for photovoltaic systems with a voltage rating of 1,5 kV DC.*

*KS IEC 60309-5,Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes*

*KS IEC 60038,IEC standard voltages.*

*KS IEC 62196,ALL Parts, Plugs, socket-outlets, vehicle connectors and vehicle inlets Conductive charging of electric vehicles*

*KS IEC 61851,ALL Parts, Electric vehicle conductive charging system - Part 1: General requirements*

PUBLIC REVIEW DRAFT MARCH 2026

## **SECTION 700: GENERAL**

The particular requirements for each section (special installation or location) in Part 7 supplement or modify the general requirements contained in other parts of KS 662 Series.

The absence of reference to the exclusion of a part, a chapter, a section or a section means that the corresponding general sections are applicable.

The number appearing after a section number generally refers to the corresponding chapter, section or section within Parts 1 to 6. The numbering does not, therefore, necessarily follow sequentially and new numbers have been added as required. Numbering of figures and tables takes the number of the section followed by a sequential number.

PUBLIC REVIEW DRAFT MARCH 2026

## SECTION 701: LOCATIONS CONTAINING A BATH OR SHOWER

### 701.1 Scope

The particular requirements of this section apply to the electrical installations in locations containing a fixed bath (bath tub, birthing pool) or shower and to the surrounding zones as described in these sections.

This section does not apply to emergency facilities such as emergency showers used in industrial areas or laboratories.

### 701.3 Assessment of general characteristics

#### 701.32 Classification of external influences

##### 701.32.1 General

When applying this section, the zones specified in Sections 701.32.2 to 4 shall be taken into account. For fixed prefabricated bath or shower units, the zones are applied to the situation when the bath or shower basin is in its usable configuration(s).

Horizontal or inclined ceilings, walls with or without windows, doors, floors and fixed partitions may be taken into account where these effectively limit the extent of locations containing a bath or shower as well as their zones. Where the dimensions of fixed partitions are smaller than the dimensions of the relevant zones, e.g. partitions having a height lower than 2.25 m, the minimum distance in the horizontal and vertical directions shall be taken into account (see Figures 701.1 and 701.2).

For electrical equipment in parts of walls or ceilings limiting the zones specified in Sections 701.32.2 to 4, but being part of the surface of that wall or ceiling, the requirements for the respective zone apply.

##### 701.32.2 Description of zone 0

Zone 0 is the interior of the bath tub or shower basin (see Figures 701.1 and 2).

For showers without a basin, the height of zone 0 is 0.10 m and its surface extent has the same horizontal extent as zone 1 (see Figure 701.2(f)).

##### 701.32.3 Description of zone 1

Zone 1 is limited by:

- (i) the finished floor level and the horizontal plane corresponding to the highest fixed shower head or water outlet or the horizontal plane lying 2.25 m above the finished floor level, whichever is higher
- (ii) the vertical surface:
  - (a) circumscribing the bath tub or shower basin (see Figure 701.1)
  - (b) at a distance of 1.20 m from the centre point of the fixed water outlet on the wall or ceiling for showers without a basin (see Figure 701.1(e) and (f)).

Zone 1 does not include zone 0.

The space under the bath tub or shower basin is considered to be zone 1. However, if the space under the bath tub or shower basin is only accessible with a tool, it is considered to be outside the zones.

##### 701.32.4 Description of zone 2

Zone 2 is limited by:

- (i) the finished floor level and the horizontal plane corresponding to the highest fixed shower head or water outlet or the horizontal plane lying 2.25 m above the finished floor level, whichever is higher
- (ii) the vertical surface at the boundary of zone 1 and the parallel vertical surface at a distance of 0.60 m from the zone 1 border (see Figure 701.1).

For showers without a basin, there is no zone 2 but an increased zone 1 is provided by the horizontal dimension of 1.20 m mentioned in Section 701.32.3(ii)(b) (see Figure 701.1(e) and (f)).

## **701.41 Protection for safety: protection against electric shock**

### **701.410.3 General requirements**

**701.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**701.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

### **701.411.3.3 Additional protection by RCDs**

Additional protection by the use of one or more RCDs having the characteristics specified in Section 415.1.1 shall be provided for low voltage circuits:

- (i) serving the location
- (ii) passing through zones 1 and/or 2 not serving the location.

**NOTE:** See also Sections 314.1(iv) and 531.3.2 concerning the avoidance of unwanted tripping.

### **701.413 Protective measure: Electrical separation**

Protection by electrical separation shall only be used for:

- (i) circuits supplying one item of current-using equipment, or
- (ii) one single socket-outlet.

For electric floor heating systems, see Section 701.753.

### **701.414 Protective measure: Extra-low voltage provided by SELV or PELV**

#### **701.414.4.5 Requirements for SELV and PELV circuits**

Where SELV or PELV is used, whatever the nominal voltage, basic protection for equipment in zones 0, 1 and 2 shall be provided by:

- (i) basic insulation complying with Section 416.1, or
- (ii) barriers or enclosures complying with Section 416.2.

### **701.415 Additional protection**

#### **701.415.2 Supplementary protective equipotential bonding**

Local supplementary protective equipotential bonding according to Section 415.2 shall be established connecting together the terminals of the protective conductor of each circuit supplying Class I and Class II equipment to the accessible extraneous-conductive-parts, within a room containing a bath or shower, including the following:

- (i) metallic pipes supplying services and metallic waste pipes (e.g. water, gas)
- (ii) metallic central heating pipes and air conditioning systems
- (iii) accessible metallic structural parts of the building (metallic door architraves, window frames and similar parts are not considered to be extraneous-conductive-parts unless they are connected to metallic structural parts of the building).

Supplementary protective equipotential bonding may be installed outside or inside rooms containing a bath or shower, preferably close to the point of entry of extraneous-conductive-parts into such rooms.

Where the location containing a bath or shower is in a building with a protective equipotential bonding system in accordance with Section 411.3.1.2, supplementary protective equipotential bonding may be omitted where all of the following conditions are met:

- (iv) All final circuits of the location comply with the requirements for automatic disconnection according to Section 411.3.2
- (v) All final circuits of the location have additional protection by means of an RCD in accordance with Section 415.1.1
- (vi) All extraneous-conductive-parts of the location are effectively connected to the protective equipotential bonding according to Section 411.3.1.2.

**NOTE:** The effectiveness of the connection of extraneous-conductive-parts in the location to the main earthing terminal may be assessed, where necessary, by the application of Section 415.2.2.

## **701.5 Selection and erection of equipment**

### **701.512.2 External influences**

Installed electrical equipment shall have at least the following degrees of protection:

- (i) In zone 0: IPX7
- (ii) In zones 1 and 2: IPX4.

This requirement does not apply to shaver supply units complying with KS IEC 61558-2-5 installed in zone 2 and located where direct spray from showers is unlikely.

Electrical equipment exposed to water jets, e.g. for cleaning purposes, shall have a degree of protection of at least IPX5.

### **701.512.3 Erection of switchgear, controlgear and accessories according to external influences**

The following requirements do not apply to switches and controls which are incorporated in fixed current-using equipment suitable for use in that zone or to insulating pull cords of cord operated switches.

In zone 0:

switchgear or accessories shall not be installed.

In zone 1:

only switches of SELV circuits supplied at a nominal voltage not exceeding 12 V AC rms or 30 V ripple-free DC shall be installed, the safety source being installed outside zones 0, 1 and 2.

In zone 2:

switchgear, accessories incorporating switches or socket-outlets shall not be installed with the exception of:

- (i) switches and socket-outlets of SELV circuits, the safety source being installed outside zones 0, 1 and 2, and
- (ii) shaver supply units complying with KS IEC 61558-2-5.

Except for SELV socket-outlets complying with Section 414 and shaver supply units complying with KS IEC 61558-2-5, socket-outlets are prohibited within a distance of 3 m horizontally from the boundary of zone 1.

## **701.55 Current-using equipment**

In zone 0, current-using equipment shall only be installed provided that all the following requirements are met:

- (i) The equipment complies with the relevant standard and is suitable for use in that zone according to the manufacturer's instructions for use and mounting
- (ii) The equipment is fixed and permanently connected
- (iii) The equipment is protected by SELV at a nominal voltage not exceeding 12 V AC rms or 30 V ripple-free DC, the safety source being installed outside zones 0, 1 and 2.

In zone 1, only the following fixed and permanently connected current-using equipment shall be installed, provided it is suitable for installation in zone 1 according to the manufacturer's instructions:

- (iv) Whirlpool units
- (v) Electric showers
- (vi) Shower pumps
- (vii) Equipment protected by SELV or PELV at a nominal voltage not exceeding 25 V AC rms or 60 V ripple-free DC, the safety source being installed outside zones 0, 1 and 2
- (viii) Ventilation equipment
- (ix) Towel rails
- (x) Water heating appliances
- (xi) Luminaires.

### 701.753 Electric floor heating systems

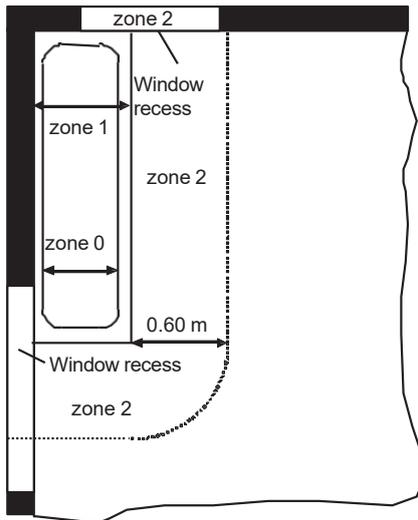
For electric floor heating systems, only heating cables according to relevant product standards or thin sheet flexible heating elements according to the relevant equipment standard shall be erected provided that they have either a metal sheath or a metal enclosure or a fine mesh metallic grid. The fine mesh metallic grid, metal sheath or metal enclosure shall be connected to the protective conductor of the supply circuit. Compliance with the latter requirement is not required if the protective measure SELV is provided for the floor heating system.

For electric floor heating systems the protective measure 'protection by electrical separation' shall not be used.

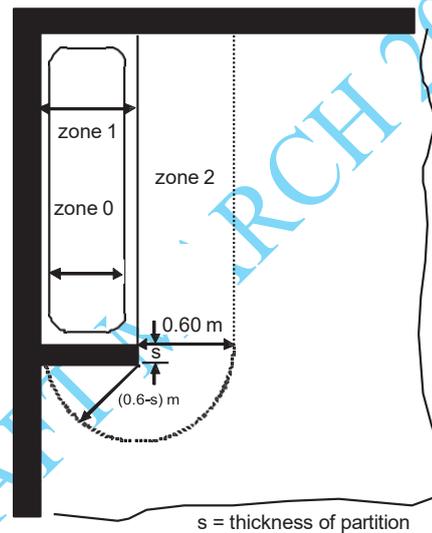
**Fig 701.1 – Examples of zone dimensions (plan)**

NOT TO SCALE (See Section 701.32 for definitions of zones)

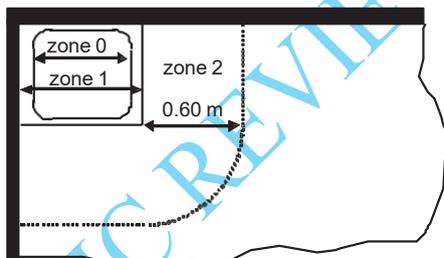
a) Bath tub



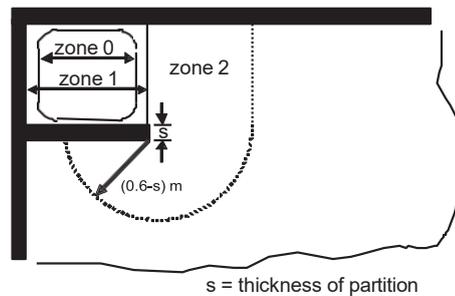
b) Bath tub, with permanent fixed partition



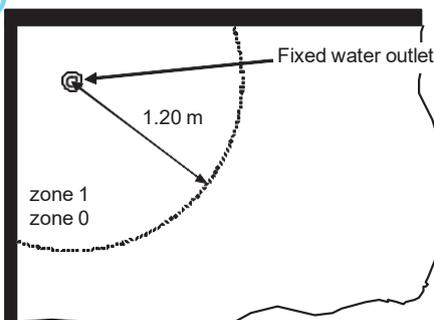
c) Shower basin



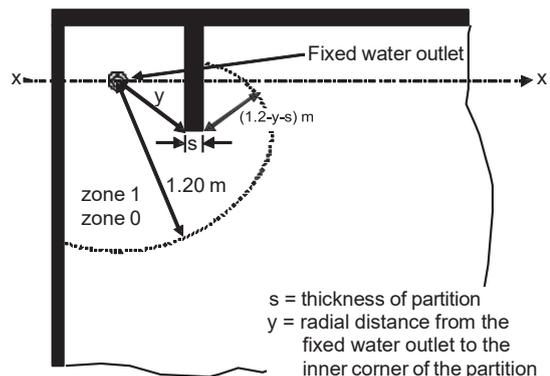
d) Shower basin with permanent fixed partition



e) Shower, without basin



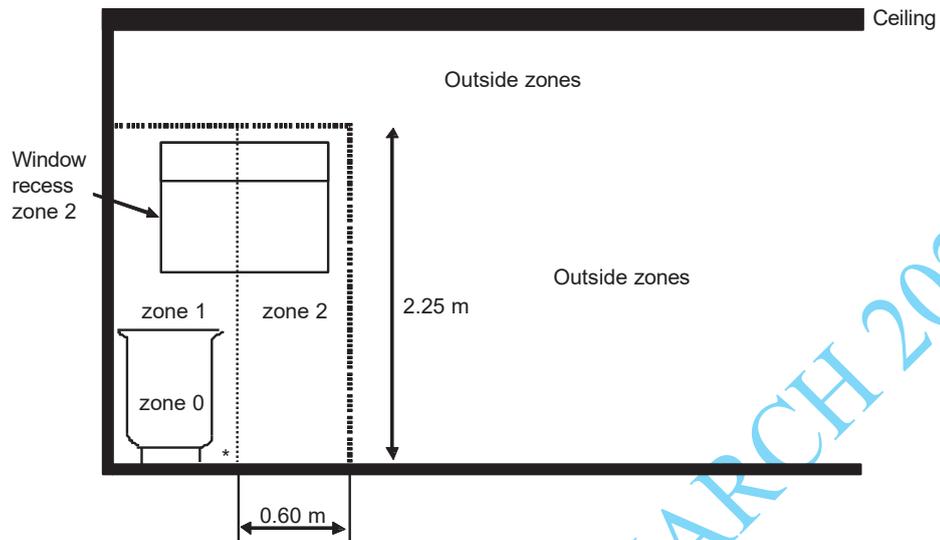
f) Shower, without basin, but with permanent fixed partition



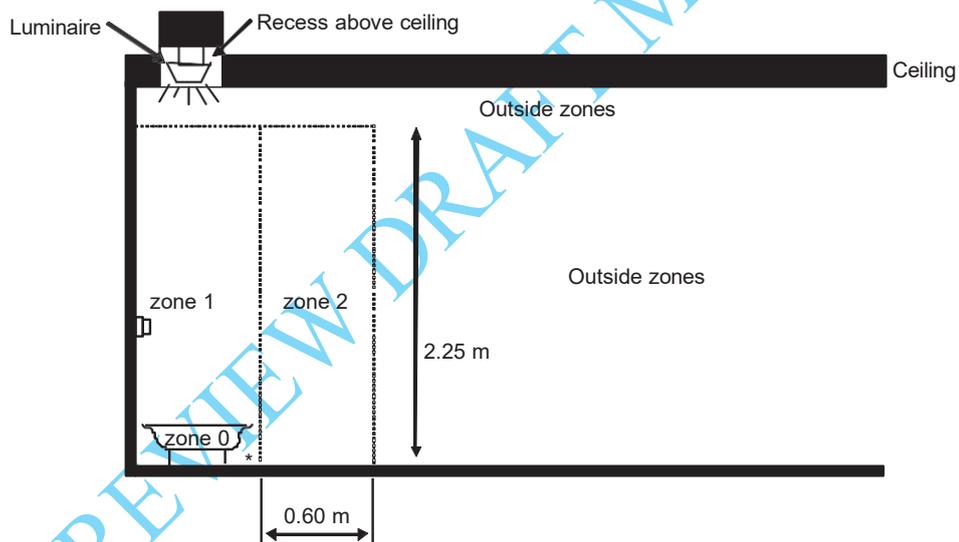
### Fig 701.2 – Examples of zone dimensions (elevation)

NOT TO SCALE (See Section 701.32 for definitions of zones)

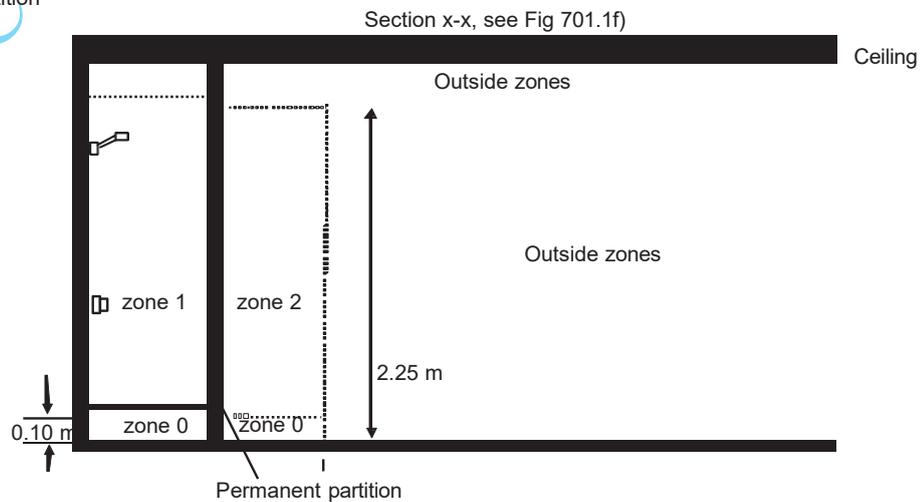
a) Bath tub



c) Shower basin



f) Shower without basin, but with permanent fixed partition



\* Zone 1 if the space is accessible without the use of a tool.  
Spaces under the bath accessible only with the use of a tool are outside the zones.

## SECTION 702: SWIMMING POOLS AND OTHER BASINS

### 702.1 Scope, object and fundamental principles

#### 702.11 Scope

The particular requirements of this section apply to the basins of swimming pools, the basins of fountains and the basins of paddling pools. The particular requirements also apply to the surrounding zones of these basins.

In these areas, in normal use, the risk of electric shock is increased by a reduction in body resistance and contact of the body with Earth potential. Swimming pools within the scope of an equipment standard are outside the scope of these sections.

Except for areas especially designed as swimming pools, the requirements of this section do not apply to natural waters, lakes in gravel pits, coastal areas and the like.

#### 702.3 Assessment of general characteristics

##### 702.32 Classification of external influences

These requirements are based on the dimensions of three zones (examples are given in Figures 702.1 to 4).

Zones 1 and 2 may be limited by fixed partitions having a minimum height of 2.5 m.

##### (i) Zone 0

This zone is the interior of the basin of the swimming pool or fountain including any recesses in its walls or floors, basins for foot cleaning and waterjets or waterfalls and the space below them.

##### (ii) Zone 1

This zone is limited by:

- zone 0
- a vertical plane 2 m from the rim of the basin
- the floor or surface expected to be occupied by persons
- the horizontal plane 2.5 m above the floor or the surface expected to be occupied by persons.

Where the swimming pool or fountain contains diving boards, springboards, starting blocks, chutes or other components expected to be occupied by persons, zone 1 comprises the zone limited by:

- a vertical plane situated 1.5 m from the periphery of the diving boards, springboards, starting blocks, chutes and other components such as accessible sculptures, viewing bays and decorative basins
- the horizontal plane 2.5 m above the highest surface expected to be occupied by persons.

##### (iii) Zone 2

This zone is limited by:

- the vertical plane external to zone 1 and a parallel plane 1.5 m from the former
- the floor or surface expected to be occupied by persons
- the horizontal plane 2.5 m above the floor or surface expected to be occupied by persons.

There is no zone 2 for fountains.

### 702.4 Protection for safety

#### 702.410.3 General requirements

##### 702.410.3.4 Application of protective measures against electric shock

###### 702.410.3.4.1 Zones 0 and 1

Except for fountains as stated in Section 702.410.3.4.2, in zone 0 only protection by SELV at a nominal voltage not exceeding 12 V AC rms or 30 V ripple-free DC is permitted, the source for SELV being installed outside zones 0, 1 and 2.

Except for fountains as stated in Section 702.410.3.4.2, in zone 1 only protection by SELV at a nominal voltage not exceeding 25 V AC rms or 60 V ripple-free DC is permitted, the source for SELV being installed outside zones 0, 1 and 2.

Equipment for use in the interior of basins which is only intended to be in operation when people are not inside zone 0 shall be supplied by a circuit protected by:

- (i) SELV (Section 414), the source for SELV being installed outside zones 0, 1 and 2. However, it is permitted to install the source for SELV in zone 2 if its supply circuit is protected by an RCD having the characteristics specified in Section 415.1.1, or
- (ii) Automatic disconnection of supply (Section 411), using an RCD having the characteristics specified in Section 415.1.1, or
- (iii) Electrical separation (Section 413), the source for electrical separation supplying only one item of current-using equipment and being installed outside zones 0, 1 and 2. However, it is permitted to install the source in zone 2 if its supply circuit is protected by an RCD having the characteristics specified in Section 415.1.1.

The socket-outlet of a circuit supplying such equipment and the control device of such equipment shall have a notice in order to warn the user that this equipment shall be used only when the swimming pool is not occupied by persons.

#### **702.410.3.4.2 Zones 0 and 1 of fountains**

In zones 0 and 1, one or more of the following protective measures shall be employed:

- (i) SELV (Section 414), the source for SELV being installed outside zones 0 and 1
- (ii) Automatic disconnection of supply (Section 411), using an RCD having the characteristics specified in Section 415.1.1
- (iii) Electrical separation (Section 413), the source for electrical separation supplying only one item of current-using equipment and being installed outside zones 0 and 1.

#### **702.410.3.4.3 Zone 2**

One or more of the following protective measures shall be employed:

- (i) SELV (Section 414), the source for SELV being installed outside zones 0, 1 and 2. However, it is permitted to install the source for SELV in zone 2 if its supply circuit is protected by an RCD having the characteristics specified in Section 415.1.1
- (ii) Automatic disconnection of supply (Section 411), using an RCD having the characteristics specified in Section 415.1.1  
**NOTE:** Where a PME earthing facility is used as the means of earthing for the electrical installation of a swimming pool or other basin, it is recommended that an earth mat or earth electrode of suitably low resistance, e.g. 20 ohms or less, be installed and connected to the supplementary protective equipotential bonding.
- (iii) Electrical separation (Section 413), the source for electrical separation supplying only one item of current-using equipment and being installed outside zones 0, 1 and 2. However, it is permitted to install the source in zone 2 if its supply circuit is protected by an RCD having the characteristics specified in Section 415.1.1.

There is no zone 2 for fountains.

**702.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**702.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

### **702.414 Protective measure: Extra-low voltage provided by SELV or PELV**

#### **702.414.4 Requirements for SELV and PELV circuits**

**702.414.4.5** Where SELV is used, whatever the nominal voltage, basic protection shall be provided by:

- (i) basic insulation complying with Section 416.1, or
- (ii) barriers or enclosures complying with Section 416.2.

#### **702.415 Additional protection**

##### **702.415.2 Additional protection: Supplementary protective equipotential bonding**

All extraneous-conductive-parts in zones 0, 1 and 2 shall be connected by supplementary protective bonding conductors to the protective conductors of exposed-conductive-parts of equipment situated in these zones, in accordance with Section 415.2.

**NOTE:** The connection with the protective conductor may be provided in the proximity of the location, e.g. in an accessory or in a local distribution board.

## **702.5 Selection and erection of equipment**

### **702.51 Common rules**

#### **702.512 Operational conditions and external influences**

##### **702.512.2 External influences**

Electrical equipment shall have at least the following degree of protection according to IEC 60529:

- (i) zone 0: IPX8
- (ii) zone 1: IPX4, IPX5 where water jets are likely to occur for cleaning purposes
- (iii) zone 2: IPX2 for indoor locations, IPX4 for outdoor locations, IPX5 where water jets are likely to occur for cleaning purposes.

### **702.52 Wiring systems**

#### **702.520 General**

The following sections apply to surface wiring systems and to wiring systems embedded in the walls, ceilings or floors at a depth not exceeding 50 mm.

#### **702.522 Selection and erection in relation to external influences**

##### **702.522.21 Erection according to the zones**

In zones 0, 1 and 2, any metallic sheath or metallic covering of a wiring system shall be connected to the supplementary protective equipotential bonding.

**NOTE:** Cables should preferably be installed in conduits made of insulating material.

##### **702.522.22 Limitation of wiring systems according to the zones**

In zones 0 and 1, a wiring system shall be limited to that necessary to supply equipment situated in these zones.

##### **702.522.23 Additional requirements for the wiring of fountains**

For a fountain, the following additional requirements shall be met:

- (i) A cable for electrical equipment in zone 0 shall be installed as far outside the basin rim as is reasonably practicable and run to the electrical equipment inside zone 0 by the shortest practicable route
- (ii) In zone 1, a cable shall be selected, installed and provided with mechanical protection to medium severity (AG2) and the relevant submersion in water depth (AD8). The cable type H07RN8-F (IEC 60502-2-21) is suitable up to a depth of 10 m of water. For depths of water greater than 10 m the cable manufacturer shall be consulted.

##### **702.522.24 Junction boxes**

A junction box shall not be installed in zones 0 or 1, except that for SELV circuits it is permitted to install junction boxes in zone 1.

## **702.53 Protection, isolation, switching, control and monitoring**

In zones 0 or 1, switchgear or controlgear shall not be installed.

In zones 0 or 1, a socket-outlet shall not be installed.

In zone 2, a socket-outlet or a switch is permitted only where the supply circuit is protected by one of the following protective measures:

- (i) SELV (Section 414), the source of SELV being installed outside zones 0, 1 and 2. However, it is permitted to install the source of SELV in zone 2 if its supply circuit is protected by an RCD having the characteristics specified in Section 415.1.1
- (ii) Automatic disconnection of supply (Section 411), using an RCD having the characteristics specified in Section 415.1.1

- (iii) Electrical separation (Section 413), the source for electrical separation supplying only one item of current-using equipment, or one socket-outlet, and being installed outside zones 0, 1 and 2. However, it is permitted to install the source in zone 2 if its supply circuit is protected by an RCD having the characteristics specified in Section 415.1.1.

For a swimming pool where it is not possible to locate a socket-outlet or switch outside zone 1, a socket-outlet or switch, preferably having a non-conductive cover or coverplate, is permitted in zone 1 if it is installed at least 1.25 m horizontally from the border of zone 0, is placed at least 0.3 m above the floor, and is protected by:

- (iv) SELV (Section 414), at a nominal voltage not exceeding 25 V AC rms or 60 V ripple-free DC, the source for SELV being installed outside zones 0 and 1, or
- (v) Automatic disconnection of supply (Section 411), using an RCD having the characteristics specified in Section 415.1.1, or
- (vi) Electrical separation (Section 413) for a supply to only one item of current-using equipment, the source for electrical separation being installed outside zones 0 and 1.

## **702.55 Other equipment**

### **702.55.1 Current-using equipment of swimming pools**

In zones 0 and 1, it is only permitted to install fixed current-using equipment specifically designed for use in a swimming pool, in accordance with the requirements of Sections 702.55.2 and 702.55.4.

Equipment which is intended to be in operation only when people are outside zone 0 may be used in all zones provided that it is supplied by a circuit protected according to Section 702.410.3.4.

It is permitted to install an electric heating unit embedded in the floor, provided that it:

- (i) is protected by SELV (Section 414), the source of SELV being installed outside zones 0, 1 and 2. However, it is permitted to install the source of SELV in zone 2 if its supply circuit is protected by an RCD having the characteristics specified in Section 415.1.1, or
- (ii) incorporates an earthed metallic sheath connected to the supplementary protective equipotential bonding specified in Section 702.415.2 and its supply circuit is additionally protected by an RCD having the characteristics specified in Section 415.1.1, or
- (iii) is covered by an embedded earthed metallic grid connected to the supplementary protective equipotential bonding specified in Section 702.415.2 and its supply circuit is additionally protected by an RCD having the characteristics specified in Section 415.1.1.

### **702.55.2 Underwater luminaires for swimming pools**

A luminaire for use in the water or in contact with the water shall be fixed and shall comply with KS IEC 60598-2-18.

Underwater lighting located behind watertight portholes, and serviced from behind, shall comply with the appropriate part of KS IEC 60598 and be installed in such a way that no intentional or unintentional conductive connection between any exposed-conductive-part of the underwater luminaires and any conductive parts of the portholes can occur.

### **702.55.3 Electrical equipment of fountains**

Electrical equipment in zones 0 or 1 shall be provided with mechanical protection to medium severity (AG2), e.g. by use of mesh glass or by grids which can only be removed by the use of a tool.

A luminaire installed in zones 0 or 1 shall be fixed and shall comply with KS IEC 60598-2-18.

An electric pump shall comply with the requirements of KS IEC 60335-2-41.

### **702.55.4 Special requirements for the installation of electrical equipment in zone 1 of swimming pools and other basins**

Fixed equipment designed for use in swimming pools and other basins (e.g. filtration systems, jet stream pumps) and supplied at low voltage is permitted in zone 1, subject to all the following requirements being met:

- (i) The equipment shall be located inside an insulating enclosure providing at least Class II or equivalent insulation and providing protection against mechanical impact of medium severity (AG2)

This section applies irrespective of the classification of the equipment.

- (ii) The equipment shall only be accessible via a hatch (or a door) by means of a key or a tool. The opening of the hatch (or door) shall disconnect all live conductors. The supply cable and the main disconnecting means shall be installed in a way which provides protection of Class II or equivalent insulation
- (iii) The supply circuit of the equipment shall be protected by:
  - SELV at a nominal voltage not exceeding 25 V AC rms or 60 V ripple-free DC, the source of SELV being installed outside zones 0, 1 and 2, or
  - an RCD having the characteristics specified in Section 415.1.1, or
  - electrical separation (Section 413), the source for electrical separation supplying a single fixed item of current-using equipment and being installed outside zones 0, 1 and 2.

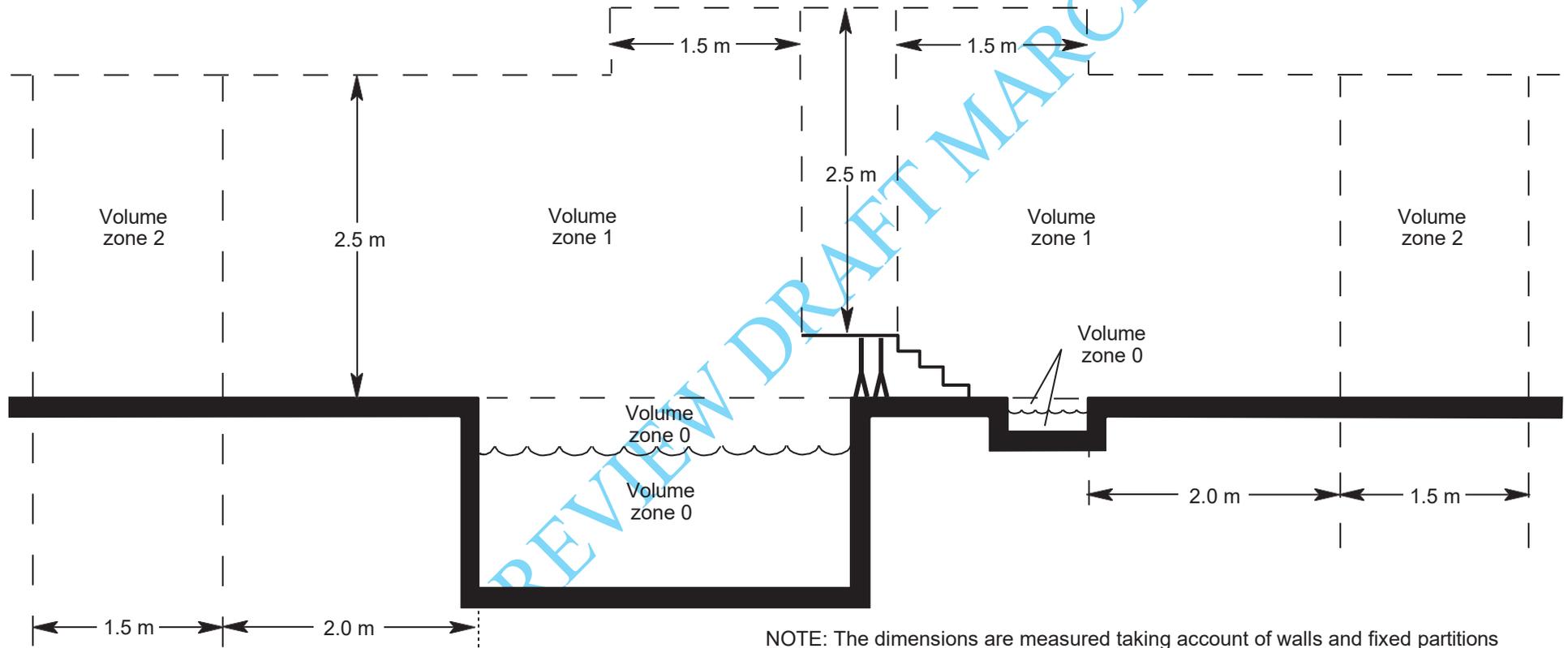
For swimming pools where there is no zone 2, lighting equipment supplied by other than a SELV source at 12 V AC rms or 30 V ripple-free DC may be installed in zone 1 on a wall or on a ceiling, provided that the following requirements are fulfilled:

- The circuit is protected by automatic disconnection of the supply and additional protection is provided by an RCD having the characteristics specified in Section 415.1.1
- The height from the floor is at least 2 m above the lower limit of zone 1.

In addition, every luminaire shall have an enclosure providing Class II or equivalent insulation and providing protection against mechanical impact of medium severity.

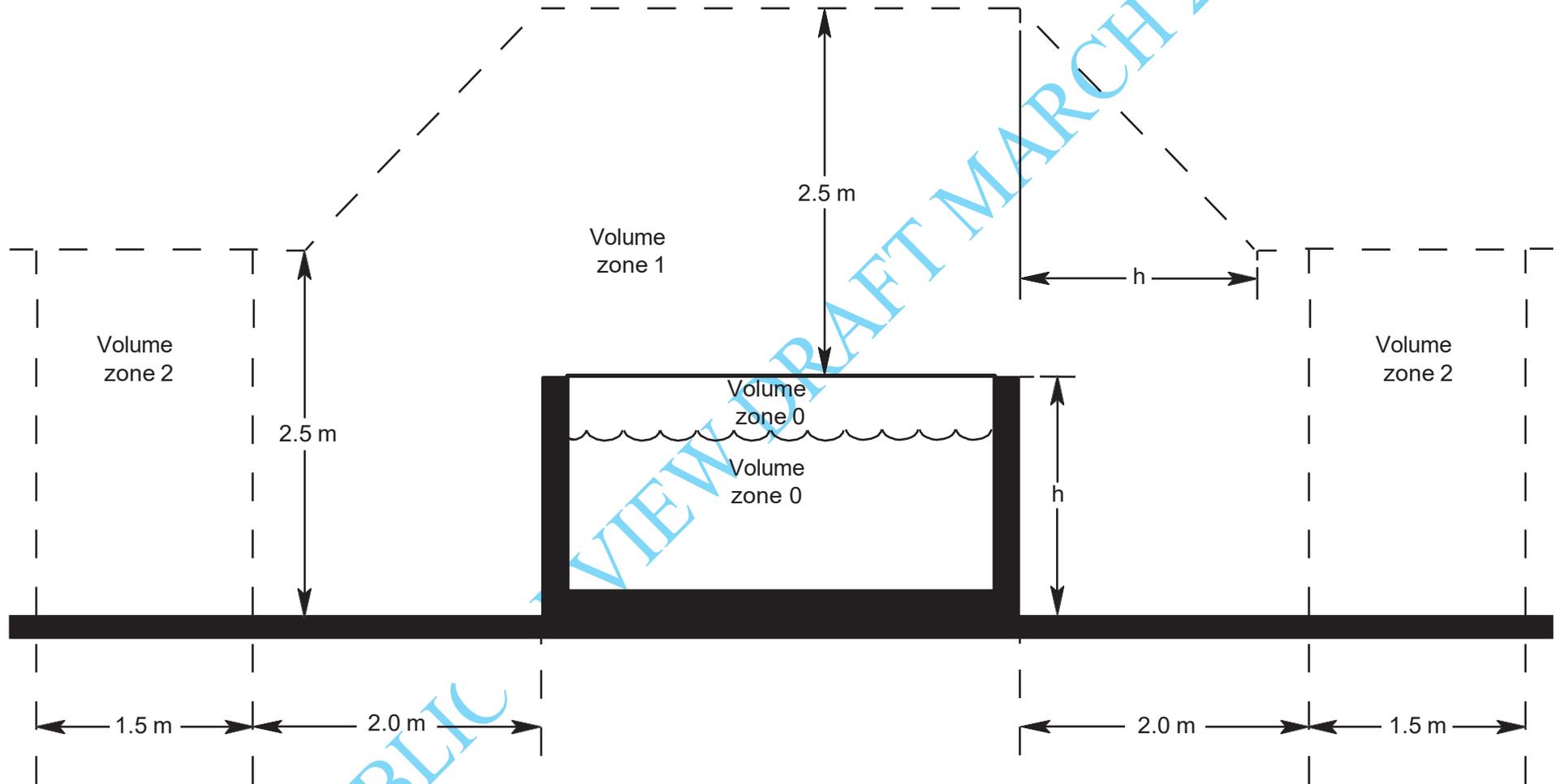
PUBLIC REVIEW DRAFT MARCH 2016

Fig 702.1 – zone dimensions for swimming pools and paddling pools



PUBL

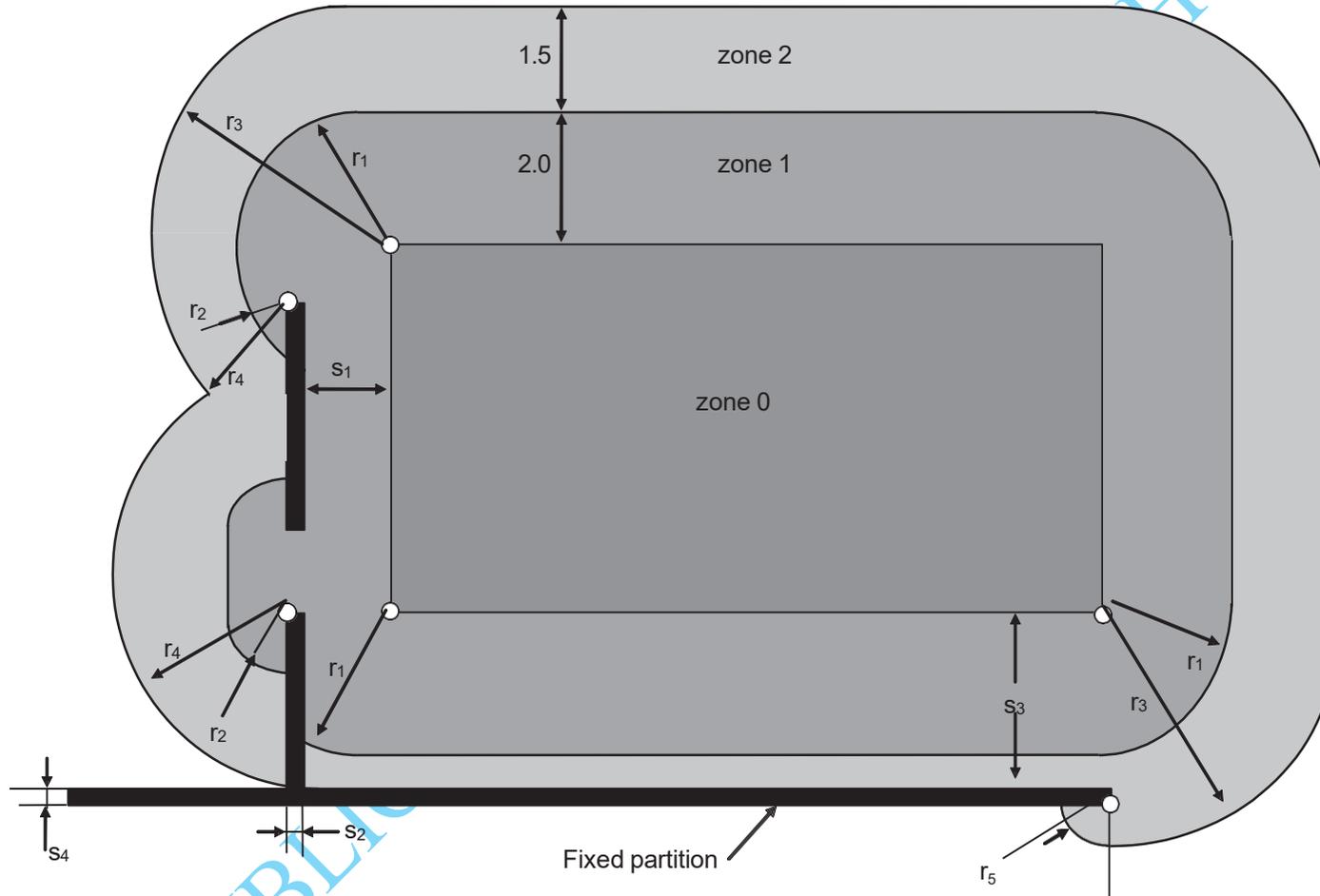
Fig 702.2 – zone dimensions for basin above ground level



NOTE: The dimensions are measured taking account of walls and fixed partitions

PUBLIC

Fig 702.3 – Example of zone dimensions (plan) with fixed partitions of height at least 2.5 m



Dimensions in metres

$$r_1 = 2$$

$$r_2 = r_1 - (s_1 + s_2)$$

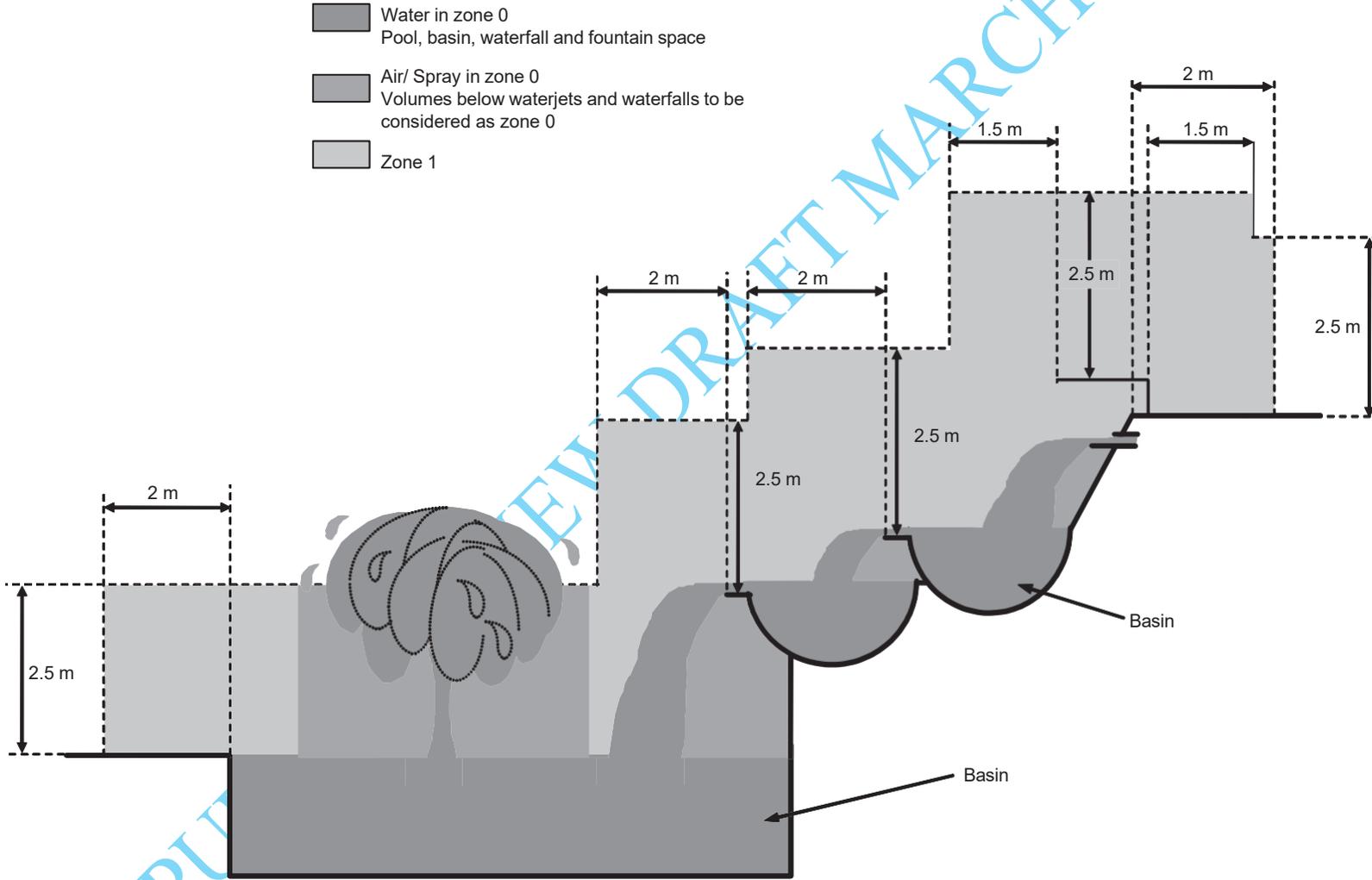
$$r_3 = 3.5$$

$$r_4 = r_3 - (s_1 + s_2)$$

$$r_5 = r_3 - (s_3 + s_4)$$

PUBLIC

Fig 702.4 – Example of determination of the zones of a fountain



## SECTION 703: ROOMS AND CABINS CONTAINING SAUNA HEATERS

### 703.1 Scope

The particular requirements of this section apply to:

- (i) sauna cabins erected on site, e.g. in a location or in a room
- (ii) the room where the sauna heater is, or the sauna heating appliances are installed. In this case the whole room is considered as the sauna.

The requirements of this section do not apply to prefabricated sauna cabins complying with a relevant equipment standard.

Where facilities such as showers etc. are installed, the requirements of Section 701 also apply.

### 703.3 Assessment of general characteristics

#### 703.32 Classification of external influences

When applying these sections, the zones specified in Sections 703.32.1 to 3 shall be taken into account (see also Figure 703).

##### 703.32.1 Description of zone 1

Zone 1 is the volume containing the sauna heater, limited by the floor, the cold side of the thermal insulation of the ceiling and a vertical surface circumscribing the sauna heater at a distance 0.5 m from the surface of the heater. If the sauna heater is located closer than 0.5 m to a wall, then zone 1 is limited by the cold side of the thermal insulation of that wall.

##### 703.32.2 Description of zone 2

Zone 2 is the volume outside zone 1, limited by the floor, the cold side of the thermal insulation of the walls and a horizontal surface located 1.0 m above the floor.

##### 703.32.3 Description of zone 3

Zone 3 is the volume outside zone 1, limited by the cold side of the thermal insulation of the ceiling and walls and a horizontal surface located 1.0 m above the floor.

### 703.41 Protection against electric shock

#### 703.410.3 General requirements

**703.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**703.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

#### 703.411.3.3 Additional protection by RCDs

Additional protection shall be provided for all circuits of the sauna, by the use of one or more RCDs having the characteristics specified in Section 415.1.1. RCD protection need not be provided for the sauna heater unless such protection is recommended by the manufacturer.

#### 703.414 Protective measure: Extra-low voltage provided by SELV or PELV

**703.414.4.5** Where SELV or PELV is used, whatever the nominal voltage, basic protection shall be provided by:

- (i) basic insulation complying with Section 416.1, or
- (ii) barriers or enclosures complying with Section 416.2.

### 703.51 Selection and erection of equipment: Common rules

#### 703.512.2 External influences

The equipment shall have a degree of protection of at least IPX4.

Where cleaning by use of water jets may be reasonably expected, electrical equipment shall have a degree of protection of at least IPX5.

Three zones are defined as shown in Figure 703:

- (i) In zone 1: only the sauna heater and equipment belonging to the sauna heater shall be installed
- (ii) In zone 2: there is no special requirement concerning heat-resistance of equipment
- (iii) In zone 3: the equipment shall withstand a minimum temperature of 125 °C and the insulation and sheaths of cables shall withstand a minimum temperature of 170 °C (see also Section 703.52 for wiring).

#### 703.52 Selection and erection of equipment: Wiring systems

The wiring system should be preferably installed outside the zones, i.e. on the cold side of the thermal insulation. Where the wiring system is installed on the warm side of the thermal insulation in zones 1 or 3, it shall be heat-resisting. Metallic sheaths and metallic conduits shall not be accessible in normal use.

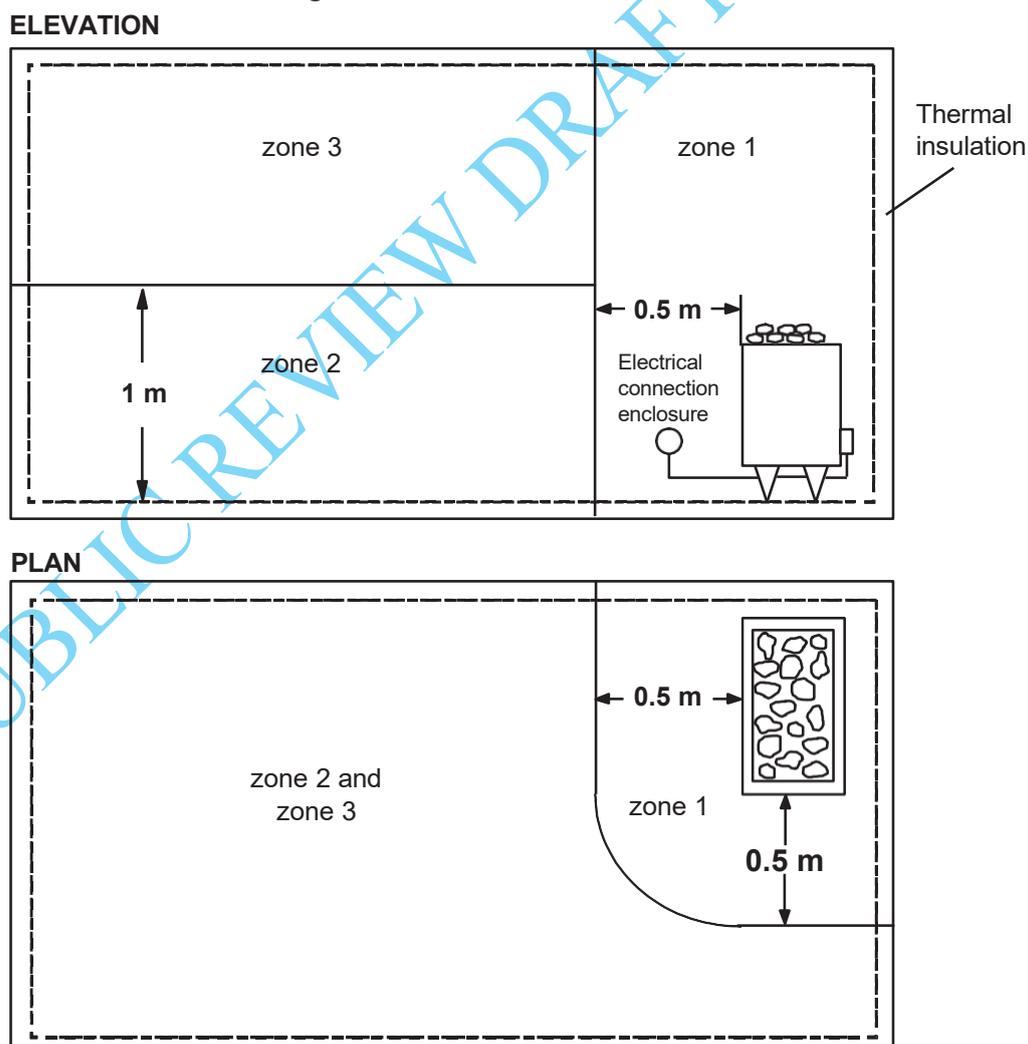
#### 703.53 Selection and erection of equipment: Isolation, switching, control and accessories

**703.537.5** Switchgear and controlgear which forms part of the sauna heater equipment or of other fixed equipment installed in zone 2, may be installed within the sauna room or cabin in accordance with the manufacturer's instructions. Other switchgear and controlgear, e.g. for lighting, shall be placed outside the sauna room or cabin. Socket-outlets shall not be installed within the location containing the sauna heater.

#### 703.55 Other equipment

Sauna heating appliances shall comply with IEC 60335-2-53 and be installed in accordance with the manufacturer's instructions.

Fig 703 – zone dimensions for a sauna



## SECTION 704: CONSTRUCTION AND DEMOLITION SITE INSTALLATIONS

**NOTE:** If the PME earthing facility is considered for use, see also IEC 60364-1.

### 704.1 Scope

**704.1.1** The particular requirements of this section apply to temporary installations for construction and demolition sites during the period of the construction or demolition work, including, for example, the following:

- (i) construction work of new buildings
- (ii) repair, alteration, extension or demolition of existing buildings or parts of existing buildings
- (iii) engineering works
- (iv) earthworks
- (v) work of similar nature.

The requirements apply to fixed and movable installations.

This section does not apply to installations in administrative locations of construction sites (e.g. offices, cloakrooms, meeting rooms, canteens, restaurants, dormitories, toilets), where the general requirements of Parts 1 to 6 apply.

**704.1.2** For special situations, further particular requirements apply, e.g. Section 706 for conducting locations with restricted movement.

### 704.31 Purposes, supplies and structure

#### 704.313 Supplies

**704.313.3** Equipment shall be identified with and be compatible with the particular supply from which it is energized and shall contain only components connected to one and the same installation, except for control or signalling circuits and inputs from standby supplies.

**NOTE:** A single construction site may be served by several sources of supply, e.g. public supply and generating set.

### 704.4 Protection for safety

#### 704.41 Protection against electric shock

##### 704.410 Introduction

##### 704.410.3 General requirements

**704.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**704.410.3.6** The protective measures of:

- non-conducting location,
- earth-free equipotential bonding, and
- electrical separation for the supply of more than one current-using equipment as specified in Section 418.3 shall

not be used.

**704.410.3.10** A circuit supplying a socket-outlet with a rated current up to and including 32 A and any other circuit supplying hand-held electrical equipment with rated current up to and including 32A shall be protected by:

- (i) Reduced low voltage (Section 411.8), or
- (ii) automatic disconnection of supply (Section 411) with additional protection provided by an RCD having the characteristics specified in Section 415.1.1, or
- (iii) electrical separation of circuits (Section 413), each socket-outlet and item of hand-held electrical equipment being supplied by an individual transformer or by a separate winding of a transformer, or
- (iv) SELV or PELV (Section 414).

Where electrical separation is used, special attention should be paid to the requirements of Section 413.3.4.

**NOTE 1:** The reduced low voltage system is strongly preferred for the supply to portable handlamps for general use and portable hand tools and local lighting up to 2 kW.

**NOTE 2:** The SELV system is strongly preferred for portable handlamps in confined or damp locations.

## **704.411 Protective measure: Automatic disconnection of supply**

### **Requirements for fault protection**

A PME earthing facility shall not be used for the means of earthing for an installation falling within the scope of this section unless all extraneous-conductive-parts are reliably connected to the main earthing terminal in accordance with Section 411.3.1.2.

**NOTE:** If the PME earthing facility is considered for use, see also IEC 60364-1.

### **Automatic disconnection in case of a fault**

For any circuit supplying one or more socket-outlets with a rated current exceeding 32 A, Section 411.3.2.5 is not applicable. For any circuit supplying one or more socket-outlets with a rated current exceeding 32 A, an RCD having a rated residual operating current not exceeding 500 mA shall be provided to automatically interrupt the supply to the line conductors of a circuit or equipment in the event of a fault of negligible impedance between a line conductor and an exposed-conductive-part or a protective conductor in the circuit or equipment within the disconnection time required in Section 411.3.2.3 or 411.3.2.4 as appropriate.

## **704.414 Protective measure: Extra-low voltage provided by SELV or PELV**

### **704.414.4 Requirements for SELV and PELV circuits**

**704.414.4.5** Irrespective of the nominal voltage, in AC and DC circuits, the requirement for basic protection shall be provided by the following:

- (i) basic insulation complying with Section 416.1, or
- (ii) barriers or enclosures complying with Section 416.2.

## **704.5 Selection and erection of equipment**

### **704.51 Common rules**

### **704.511 Compliance with standards**

**704.511.1** All assemblies on construction and demolition sites for the distribution of electricity shall be in compliance with the requirements of KS IEC 61439-4.

A plug or socket-outlet with a rated current equal to or greater than 16 A shall comply with the requirements of KS IEC 60309-2.

### **704.512 Operational conditions and external influences**

#### **704.512.2 External influences**

Consideration shall be given to the risk of damage to electrical equipment by corrosive substances, movement of structures and vehicles, wear and tear, tension, flexing, impact, abrasion, severing and ingress of liquids or solids.

### **704.52 Wiring systems**

#### **704.522.8 Other mechanical stresses (AJ)**

**704.522.8.10** Cable shall not be installed across a site road or a walkway unless adequate protection of the cable against mechanical damage is provided.

**704.522.8.11** For reduced low voltage systems, low temperature 3182/3/4/5A thermoplastic cable (IEC 60227-3) or equivalent flexible cable shall be used. For applications exceeding reduced low voltage, flexible cable shall be H07RN-F (IEC 60502-2-21) type or equivalent heavy duty flexible cable.

**704.522.8.101** Surface-run and overhead cables shall be protected against mechanical damage, taking into account the environment and activities of a construction site.

### **704.53 Protection, isolation, switching, control and monitoring**

#### **704.537.2 Devices for isolation**

Each Assembly for Construction Sites (ACS) shall incorporate suitable devices for the switching and isolation of the incoming supply.

A device for isolating the incoming supply shall be suitable for securing in the off position (see Section 537.2.4), for example, by providing a padlocking facility on the device or by locating the device inside a lockable enclosure.

Current-using equipment shall be supplied by ACSs, each ACS comprising:

- (i) overcurrent protective devices, and
- (ii) devices affording fault protection, and
- (iii) socket-outlets, if required.

Safety and standby supplies shall be connected by means of devices arranged to prevent interconnection of the different supplies.

## **SECTION 705: AGRICULTURAL AND HORTICULTURAL PREMISES**

### **705.1 Scope**

The particular requirements of this section apply to fixed electrical installations indoors and outdoors in agricultural and horticultural premises. Some of the requirements are also applicable to other locations that are in common buildings belonging to the agricultural and horticultural premises. Where special requirements also apply to residences and other locations in such common buildings this is stated in the text of the relevant sections.

Rooms, locations and areas for household applications and similar are not covered by this section.

**NOTE:** Section 705 does not cover electric fence installations. Refer to KS IEC 60335-2-76.

### **705.41 Protection against electric shock**

#### **705.410.3 General requirements**

**705.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**705.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

#### **705.411 Protective measure: Automatic disconnection of supply**

##### **705.411.1 General**

In circuits, whatever the type of earthing system, the following disconnection devices shall be provided:

- (i) In final circuits supplying socket-outlets with rated current not exceeding 32 A, an RCD having the characteristics specified in Section 415.1.1
- (ii) In final circuits supplying socket-outlets with rated current more than 32 A, an RCD with a rated residual operating current not exceeding 100 mA
- (iii) In all other circuits, RCDs with a rated residual operating current not exceeding 300 mA.

##### **705.411.4 TN system**

A TN-C system shall not be used. This requirement applies also to residences and other locations belonging to agricultural or horticultural premises according to the definition of "Residences and other... premises" (see KS 662-2).

#### **705.414 Protective measure: Extra-low voltage provided by SELV or PELV**

##### **705.414.4 Requirements for SELV and PELV circuits**

**705.414.4.5** Where SELV or PELV is used, whatever the nominal voltage, basic protection shall be provided by:

- (i) basic insulation complying with Section 416.1, or
- (ii) barriers or enclosures complying with Section 416.2.

### **705.415.2.1 Additional protection: Supplementary equipotential bonding**

In locations intended for livestock, supplementary bonding shall connect all exposed-conductive-parts and extraneous-conductive-parts that can be touched by livestock. Where a metal grid is laid in the floor, it shall be included within the supplementary bonding of the location (Figure 705 shows an example of this, other suitable arrangements of a metal grid are not precluded).

Extraneous-conductive-parts in, or on, the floor, e.g. concrete reinforcement in general or reinforcement of cellars for liquid manure, shall be connected to the supplementary equipotential bonding.

It is recommended that spaced floors made of prefabricated concrete elements be part of the supplementary equipotential bonding. The supplementary equipotential bonding and the metal grid, if any, shall be erected so that it is durably protected against mechanical stresses and corrosion.

**NOTE:** Unless a metal grid is laid in the floor, the use of a PME earthing facility as the means of earthing for the electrical installation is not recommended.

### **705.42 Protection against thermal effects**

#### **705.422 Measures for protection against fire**

**705.422.6** Electrical heating appliances used for the breeding and rearing of livestock shall comply with IEC 60335-2-71 and shall be fixed so as to maintain an appropriate distance from livestock and combustible material, to minimize any risks of burns to livestock and of fire. For radiant heaters the clearance shall be not less than 0.5 m or such other clearance as recommended by the manufacturer.

**705.422.7** For additional fire protection purposes in some circumstances, RCDs shall be installed with a rated residual operating current not exceeding 300 mA. RCDs shall disconnect all live conductors. Where improved continuity of service is required, RCDs not protecting socket-outlets shall be of the type S or have a time delay.

**705.422.8** In locations where a fire risk exists conductors of circuits supplied at extra-low voltage shall be protected either by barriers or enclosures affording a degree of protection of IPXXD or IP4X or, in addition to their basic insulation, by an enclosure of insulating material.

**NOTE:** For example, cables of the type H07RN-F (IEC 60502-2-21) for outdoor use are in compliance with this requirement.

### **705.51 Selection and erection of equipment: Common rules**

#### **705.512 Operational conditions and external influences**

##### **705.512.2 External influences**

In agricultural or horticultural premises, electrical equipment shall have a minimum degree of protection of IP44, when used under normal conditions. Where equipment of IP44 rating is not available, it shall be placed in an enclosure complying with IP44.

Socket-outlets shall be installed in a position where they are unlikely to come into contact with combustible material.

Where there are conditions of external influences >AD4, >AE3 and/or >AG1, socket-outlets shall be provided with the appropriate protection.

Protection may also be provided by the use of additional enclosures or by installation in building recesses.

These requirements do not apply to residential locations, offices, shops and locations with similar external influences belonging to agricultural and horticultural premises where, for socket-outlets, KS 495 applies.

Where corrosive substances are present, e.g. in dairies or cattle sheds, the electrical equipment shall be adequately protected.

#### **705.513 Accessibility**

##### **705.513.2 Accessibility by livestock**

Electrical equipment generally shall be inaccessible to livestock. Equipment that is unavoidably accessible to livestock such as equipment for feeding and basins for watering, shall be adequately constructed and installed to avoid damage by, and to minimize the risk of injury to, livestock.

## **705.514 Identification**

### **705.514.9 Diagrams and documentation**

**705.514.9.3** The following documentation shall be provided to the user of the installation:

- (i) A plan indicating the location of all electrical equipment
- (ii) The routing of all concealed cables
- (iii) A single-line distribution diagram
- (iv) An equipotential bonding diagram indicating locations of bonding connections.

### **705.52 Selection and erection of equipment: Wiring systems**

#### **705.522 Selection and erection of wiring systems in relation to external influences**

In locations accessible to, and enclosing, livestock, wiring systems shall be erected so that they are inaccessible to livestock or suitably protected against mechanical damage.

Overhead lines shall be insulated.

In areas of agricultural premises where vehicles and mobile agricultural machines are operated, the following methods of installation shall be applied:

- (i) Cables shall be buried in the ground at a depth of at least 0.6 m with added mechanical protection
- (ii) Cables in arable or cultivated ground shall be buried at a depth of at least 1 m
- (iii) Self-supporting suspension cables shall be installed at a height of at least 6 m.

**705.522.10** Special attention shall be given to the presence of different kinds of fauna, e.g. rodents.

#### **705.522.16 Conduit systems, cable trunking systems and cable ducting systems**

For locations where livestock is kept, external influences shall be classified AF4, and conduits shall have protection against corrosion of at least Class 2 (medium) for indoor use and Class 4 (high protection) outdoors according to KS IEC 61386-21.

For locations where the wiring system may be exposed to impact and mechanical shock due to vehicles and mobile agricultural machines, etc, the external influences shall be classified AG3 and:

- (i) conduits shall provide a degree of protection against impact of 5 J according to KS IEC 61386-21
- (ii) cable trunking and ducting systems shall provide a degree of protection against impact of 5 J according to IEC 61084-2-2-1.

### **705.53 Selection and erection of equipment: Isolation, switching and control**

Only electrical heating appliances with visual indication of the operating position shall be used.

#### **705.537 Isolation and switching**

##### **705.537.2 Isolation**

The electrical installation of each building or part of a building shall be isolated by a single isolation device according to Chapter 46.

Means of isolation of all live conductors, including the neutral conductor, shall be provided for circuits used occasionally, e.g. during harvest time.

The isolation devices shall be clearly marked according to the part of the installation to which they belong.

Devices for isolation and switching and devices for emergency stopping or emergency switching shall not be erected where they are accessible to livestock or in any position where access may be impeded by livestock.

### **705.54 Selection and erection of equipment: Earthing arrangements and protective conductors**

#### **705.544 Protective bonding conductors**

##### **705.544.2 Supplementary bonding conductors**

Protective bonding conductors shall be protected against mechanical damage and corrosion, and shall be selected to avoid electrolytic effects.

For example, the following may be used:

- (i) Hot-dip galvanized steel strip with dimensions of at least 30 mm × 3 mm
- (ii) Hot-dip galvanized round steel of at least 8 mm diameter
- (iii) Copper conductor having a minimum cross-sectional area of 4 mm<sup>2</sup>.

Other suitable materials may be used.

## **705.55 Selection and erection of equipment: Other equipment**

### **705.553.1 Socket-outlets**

Socket-outlets of agricultural and horticultural premises shall comply with:

- (i) KS IEC 60309-1, or
- (ii) KS IEC 60309-2 where interchangeability is required, or
- (iii) KS 495 provided the rated current does not exceed 13 A.

## **705.56 Safety services**

### **705.560.6 Automatic life support for high density livestock rearing**

For high density livestock rearing, systems operating for the life support of livestock shall be taken into account as follows:

- (i) Where the supply of food, water, air and/or lighting to livestock is not provided in the event of power supply failure, a secure source of supply shall be provided, such as an alternative or back-up supply (see also Section 551). For the supply of ventilation and lighting units separate final circuits shall be provided. Such circuits shall only supply electrical equipment necessary for the operation of the ventilation and lighting
- (ii) Selectivity of the main circuits supplying the ventilation shall be provided in case of any overcurrent and/or short-circuit to Earth
- (iii) Where electrically powered ventilation is necessary in an installation one of the following shall be provided:
  - a) A standby electrical source ensuring sufficient supply for ventilation equipment, or  
**NOTE:** A notice should be placed adjacent to the standby electrical source, indicating that it should be tested periodically according to the manufacturer's instructions.
  - b) temperature and supply voltage monitoring. This can be achieved by one or more monitoring devices. The device(s) shall provide a visual or audible signal that can be readily observed by the user and shall operate independently from the normal supply.

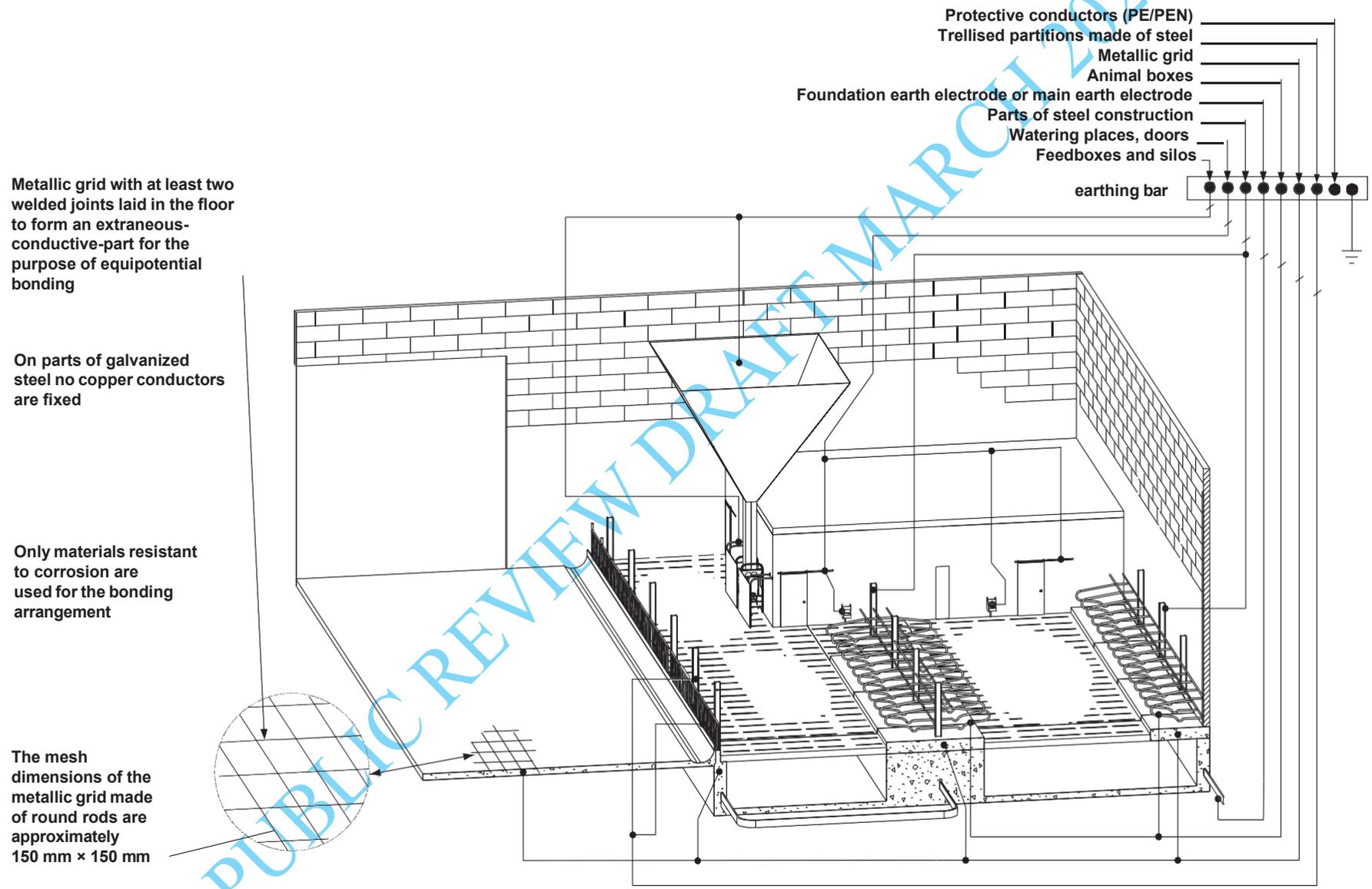


Fig 705 – Example of supplementary equipotential bonding within a cattle shed

## SECTION 706: CONDUCTING LOCATIONS WITH RESTRICTED MOVEMENT

### 706.1 Scope

The particular requirements of this section apply to:

- (i) fixed equipment in conducting locations where movement of persons is restricted by the location, and
- (ii) supplies for mobile equipment for use in such locations.

A conducting location with restricted movement is comprised mainly of metallic or other conductive surrounding parts, within which it is likely that a person will come into contact through a substantial portion of the body with the metallic or other conductive surrounding parts and where the possibility of interrupting this contact is limited.

The particular requirements of this section do not apply to locations which allow a person freedom of bodily movement to work, enter and leave the location without physical constraint. For installation and use of arc welding equipment, see IEC 60974-9.

This section does not apply to electrical systems used in structures, sets, mobile units etc as used for public or private events, touring shows, theatrical, radio, TV or film productions and similar activities of the entertainment industry.

### 706.41 Protection against electric shock

**706.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**706.410.3.10** In a conducting location with restricted movement the following protective measures apply to circuits supplying the following current-using equipment:

- (i) For the supply to a hand-held tool or an item of mobile equipment:
  - (a) electrical separation (Section 413), subject to only one item of equipment being connected to a secondary winding of the transformer, or  
**NOTE:** The transformer may have two or more secondary windings.
  - (b) SELV (Section 414).
- (ii) For the supply to handlamps:
  - (a) SELV (Section 414). It is permissible for the SELV circuit to supply a fluorescent luminaire with a built-in step-up transformer with electrically separated windings.
- (iii) For the supply to fixed equipment:
  - (a) automatic disconnection of supply (Section 411) with supplementary protective equipotential bonding (Section 415.2). The supplementary protective equipotential bonding shall connect exposed-conductive-parts of fixed equipment and the conductive parts of the location, or
  - (b) by use of Class II equipment or equipment having equivalent insulation (Section 412), provided the supply circuits have additional protection by the use of RCDs having the characteristics specified in Section 415.1.1, or
  - (c) electrical separation (Section 413), subject to only one item of equipment being connected to a secondary winding of the isolating transformer, or
  - (d) SELV (Section 414), or
  - (e) PELV (Section 414), where supplementary protective equipotential bonding is provided between all exposed-conductive-parts, all extraneous-conductive-parts inside the location, and the connection of the PELV system to Earth.

**706.411 Protective measure: Automatic disconnection of supply**

**706.411.1 General**

**706.411.1.1** Only circuits and the protective measures for supplying equipment indicated in Section 706.410.3.10 are permitted.

**706.411.1.2** If a functional earth is required for certain equipment, for example measuring and control equipment, supplementary protective equipotential bonding shall be provided between all exposed-conductive-parts and extraneous-conductive-parts inside the location and the functional earth.

**706.413 Protective measure: Electrical separation**

**706.413.1.2** The unearthed source shall have simple separation and shall be situated outside the conducting location with restricted movement, unless the source is part of the fixed installation within the location as provided by item(iii) of Section 706.410.3.10.

**706.414 Protective measure: Extra-low voltage provided by SELV or PELV**

**Sources for SELV and PELV**

**706.414.3(ii)** A source for SELV or PELV shall be situated outside the conducting location with restricted movement, unless it is part of the fixed installation within the location as provided by item (iii) of Section 706.410.3.10.

**Requirements for SELV and PELV circuits**

**706.414.4.5** Where SELV or PELV is used, whatever the nominal voltage, basic protection shall be provided by:

- (i) basic insulation complying with Section 416.1, or
- (ii) barriers or enclosures complying with Section 416.2.

PUBLIC REVIEW DRAFT MARCH 2026

## SECTION 708: ELECTRICAL INSTALLATIONS IN CARAVAN / CAMPING PARKS AND SIMILAR LOCATIONS

**NOTE:** In order not to mix requirements on different subjects, such as those for electrical installations of caravan parks with those for electrical installations inside caravans, refer to:

- Section 708, which concerns electrical installations in caravan parks, camping parks and similar locations and
- Section 721, which concerns electrical installations in caravans and motor caravans.

### 708.1 Scope

The particular requirements contained in this section apply only to circuits intended to supply leisure accommodation vehicles, tents or residential park homes in caravan parks, camping parks and similar locations.

This section does not apply to the internal electrical installations of leisure accommodation vehicles or mobile or transportable units.

**NOTE 1:** For installations in caravans and motor caravans which are operated at 12 V DC, IEC 60364-7-721 apply.

**NOTE 2:** For installations in caravans and motor caravans which are operated at voltages other than 12 V DC, Section 721 applies.

**NOTE 3:** The electrical installations of residential park homes are covered by the general requirements of KS 662 series, together with the relevant particular requirements of KS 662-7.

### 708.3 Assessment of general characteristics

#### 708.31 Purposes, supplies and structure

#### 708.312 Conductor arrangement and system earthing

##### 708.312.2 Types of system earthing

#### 708.313 Supplies

The nominal supply voltage of the installation for the supply of leisure accommodation vehicles shall not exceed 230 V AC single-phase or 400 V AC three-phase or 48 V DC.

### 708.4 Protection for safety

#### 708.41 Protection against electric shock

##### 708.410.3 General requirements

**708.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**708.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

##### 708.411.4 TN system

The connection of a PME earthing facility to any metalwork in a leisure accommodation vehicle (including a caravan).

This does not preclude the use of a PME earthing facility as the means of earthing for other purposes, such as to the installations of permanent buildings.

**NOTE:** The requirements of other sections of Part 7 may also apply.

## **708.415 Additional protection**

### **708.415.1 Residual current protective devices (RCDs)**

Every socket-outlet shall be individually protected by an RCD having a rated residual operating current not exceeding 30 mA. Devices selected shall disconnect all live conductors.

A final circuit intended for the fixed connection of a supply to a mobile home or a residential park home shall be individually protected by an RCD having a rated residual operating current not exceeding 30 mA accessible to the consumer. Devices selected shall disconnect all live conductors.

**NOTE:** This final circuit will be from the connection/metering point to the consumer and not the distribution circuit to the connection/metering point.

## **708.5 Selection and erection of equipment**

### **708.512 Operational conditions and external influences**

#### **708.512.1.1 Presence of water (AD)**

Equipment shall be selected with a degree of protection of at least IPX4 in order to protect against water splashes (AD4).

#### **708.512.1.2 Presence of solid foreign bodies (AE)**

Equipment shall be selected or provided with a degree of protection of at least IP4X in order to protect against the ingress of very small objects (AE3).

#### **708.512.2 External influences**

**NOTE:** In a caravan park or camping park, special consideration is given to the protection of people, due to the fact that the human body may be in contact with earth potential, to the protection of wiring due to tent pegs or ground anchors and to the movement of heavy or high vehicles.

##### **708.512.2.1.3 Impact (AG)**

Equipment installed in a campsite shall be protected against mechanical damage (impact of high severity AG3). Protection of the equipment shall be afforded by one or more of the following:

- the position or location shall be selected to avoid damage by any reasonably foreseeable impact
- local or general mechanical protection shall be provided
- equipment shall be installed that complies with a minimum degree of protection against external mechanical impact of IK08 (see IEC 62262).

### **708.521 Types of wiring system**

#### **Wiring systems in caravan parks**

The preferred method of supply for feeding the caravan pitch or tent pitch electrical supply equipment is by means of underground distribution circuits.

##### **Underground cables**

An underground distribution circuit shall, unless provided with additional mechanical protection, be buried at a sufficient depth to avoid being damaged, e.g. by tent pegs or ground anchors or by the movement of vehicles.

**NOTE 1:** A depth of 0.6 m is generally considered as a minimum depth to fulfil this requirement. Alternatively, the cable may be installed outside the pitch or other area where tent pegs or ground anchors may be driven.

**NOTE 2:** For conduit systems buried underground, see KS IEC 61386-24.

##### **708.521.7.3 Overhead cables and overhead insulated conductors**

Every overhead conductor shall be insulated.

Poles and other supports for overhead wiring shall be located or protected so that they are unlikely to be damaged by any foreseeable movement of vehicles.

Every overhead conductor shall be at a height above ground of not less than 6 m in all areas subject to the movement of vehicles and 3.5 m in all other areas.

## **708.53 Protection, isolation, switching, control and monitoring**

### **708.533 Devices for protection against overcurrent**

Every socket-outlet shall be individually protected by an overcurrent protective device, in accordance with the requirements of Chapter 43.

A fixed connection for a supply to a mobile home or residential park home shall be individually protected by an overcurrent protective device, in accordance with the requirements of Chapter 43.

### **708.537 Isolation and switching**

#### **708.537.2 Isolation**

##### **708.537.2.1 General**

**708.537.2.1.1** At least one means of isolation shall be installed in each distribution enclosure. This device shall disconnect all live conductors.

### **708.55 Other equipment**

#### **708.55.1 Socket-outlets**

**708.55.1.1** Every socket-outlet or connector shall either comply with:

- KS IEC 60309-2 and shall be interlocked and classified to clause 6.1.5 of KS IEC 60309-1 to prevent the socket contacts being live when accessible, or
- be part of an interlocked self-contained product complying with KS IEC 60309-4 and classified to clauses 6.1.101 and 6.1.102 of KS IEC 60309-4 to prevent the socket contacts being live when accessible.

**708.55.1.2** Caravan pitch electrical supply equipment shall be located adjacent to the pitch and not more than 20 m from the connection facility on the leisure accommodation vehicle or tent when on its pitch.

**708.55.1.3** In order to avoid any hazard due to long connection cables, no more than 4 socket-outlets shall be grouped together in any one enclosure.

**708.55.1.4** Every caravan pitch or tent pitch shall be supplied by at least one socket-outlet.

**708.55.1.5** The current rating of socket-outlets shall be not less than 16 A.

**708.55.1.6** The lowest part of any socket-outlet shall be placed at a height between 0.5 m and 1.5 m from the ground. In special cases of extreme environmental conditions, it is permitted to exceed the stated maximum height of 1.5 m. In such cases, special measures shall be taken to allow the safe insertion and withdrawal of plugs.

**NOTE:** This can be necessary if the caravan park or camping park is at risk of being flooded or if either location is used during winter after heavy snow falls.

**708.55.1.7** Switchgear and controlgear assemblies used in caravan/tent pitch supplies shall comply with the requirements of KS IEC 61439-7.

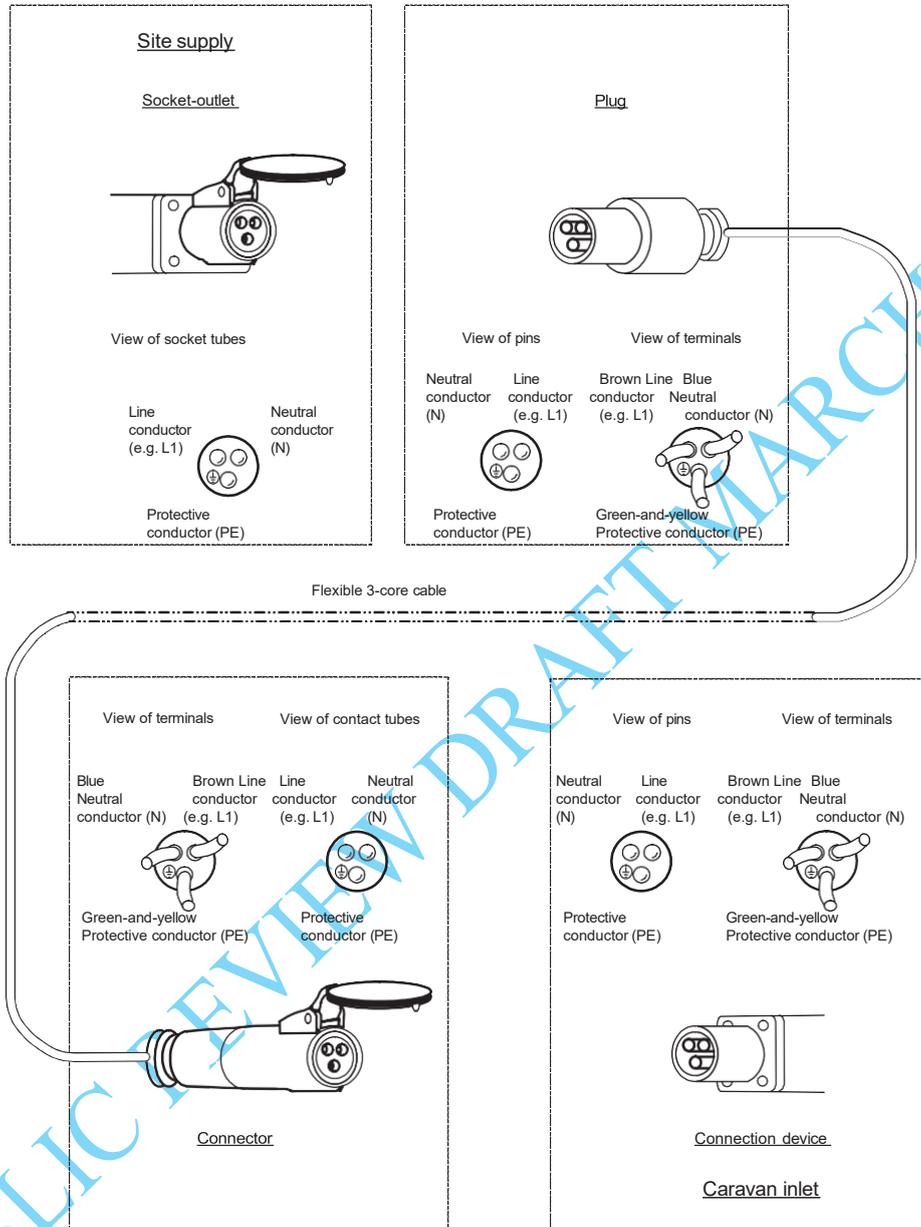
#### **708.553.1 Plugs and socket-outlets**

**708.553.1.8** Each socket-outlet and its enclosure forming part of the caravan pitch electrical supply equipment shall comply with KS IEC 60309-2 and meet the degree of protection of at least IP44 in accordance with IEC 60529.

**708.553.1.14** Socket-outlet protective conductors shall not be connected to a PME earthing facility.

**Fig 708 – Example of a 2-pole and protective conductor supply system between the caravan pitch supply equipment and the caravan or motor caravan**

**NOTE:** See also Section 721.55.2.6



**NOTE 1:** See Section 708.55.1.1 for interlocking requirements.

**NOTE 2:** Typical requirements for cable extension sets.

The means of connection between the caravan pitch socket-outlet and the leisure accommodation vehicle should be an assembly of the following:

- a plug complying with KS IEC 60309-2
- a flexible cable type to H05RN-F or H07RN-F (IEC 60502-2-21) or equivalent, with a protective conductor and having the following characteristics:
  - continuous length 25 m ( $\pm 2$  m)
  - for current rating 16A, minimum cross-sectional area: 2.5 mm<sup>2</sup>. For a higher current rating, the cross-sectional area must be chosen so that secure tripping of the overcurrent protective device is achieved at the lowest fault current calculated at the end of the cable extension set
  - conductors to be identified in accordance with Table 51
- a connector complying with KS IEC 60309-2.

PUBLIC REVIEW DRAFT MARCH 2026

## SECTION 709: MARINAS AND SIMILAR LOCATIONS

### 709.1 Scope

The particular requirements of this section are applicable only to circuits intended to supply pleasure craft or houseboats in marinas and similar locations.

**NOTE 1:** In this section 'marina' means 'marina and similar locations'.

The particular requirements do not apply to the supply to houseboats if they are supplied directly from the public network.

The particular requirements do not apply to the internal electrical installations of pleasure craft or houseboats.

**NOTE 2:** For electrical installations of pleasure craft see IEC 60092-507.

The electrical installations of houseboats shall comply with the general requirements of these Sections together with the relevant particular requirements of Part 7.

For the remainder of the electrical installation of marinas and similar locations the general requirements of these Sections together with the relevant particular requirements of Part 7 apply.

### 709.3 Assessment of general characteristics

#### 709.313 Supplies

**709.313.1.2** The nominal supply voltage of the installation for the supply to pleasure craft or houseboats shall be 230 V AC single-phase or 400 V AC three-phase.

#### 709.41 Protection against electric shock

##### 709.410.3 General requirements

**709.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**709.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

##### 709.411.4 TN system

Connection of a PME earthing facility to any metalwork in a boat is prohibited.

This does not preclude the use of a PME earthing facility as the means of earthing for other purposes, such as to the installations of permanent buildings.

**NOTE:** The requirements of other sections of KS 662-7 may also apply.

### 709.5 Selection and erection of equipment

#### 709.512 Operational conditions and external influences

##### 709.512.2 External influences

For marinas, particular attention is given in this section to the likelihood of corrosive elements, movement of structures, mechanical damage, presence of flammable fuel and the increased risk of electric shock due to:

- (i) presence of water
- (ii) reduction in body resistance
- (iii) contact of the body with Earth potential.

##### 709.512.2.1.1 Presence of water (AD)

In marinas, equipment installed on or above a jetty, wharf, pier or pontoon shall be selected as follows, according to the external influences which may be present:

- (i) Water splashes (AD4): IPX4
- (ii) Water jets (AD5): IPX5
- (iii) Water waves (AD6): IPX6.

#### **709.512.2.1.2 Presence of solid foreign bodies (AE)**

Equipment installed on or above a jetty, wharf, pier or pontoon shall be selected with a degree of protection of at least IP3X in order to protect against the ingress of small objects (AE2).

#### **709.512.2.1.3 Presence of corrosive or polluting substances (AF)**

Equipment installed on or above a jetty, wharf, pier or pontoon shall be suitable for use in the presence of atmospheric corrosive or polluting substances (AF2). If hydrocarbons are present, AF3 is applicable.

#### **709.512.2.1.4 Impact (AG)**

Equipment installed on or above a jetty, wharf, pier or pontoon shall be protected against mechanical damage (impact of medium severity AG2). Protection shall be afforded by one or more of the following:

- (i) The position or location selected to avoid being damaged by any reasonably foreseeable impact
- (ii) The provision of local or general mechanical protection
- (iii) Installing equipment complying with a minimum degree of protection for external mechanical impact IK08 (see IEC 62262).

### **709.521 Types of wiring system**

#### **709.521.1 Wiring systems of marinas**

**709.521.1.4** The following wiring systems are suitable for distribution circuits of marinas:

- (i) Underground cables
- (ii) Overhead cables or overhead insulated conductors
- (iii) Cables with copper conductors and thermoplastic or elastomeric insulation and sheath installed within an appropriate cable management system taking into account external influences such as movement, impact, corrosion and ambient temperature
- (iv) Mineral-insulated cables with a PVC protective covering
- (v) Cables with armouring and serving of thermoplastic or elastomeric material
- (vi) Other cables and materials that are no less suitable than those listed above.

**709.521.1.5** The following wiring systems shall not be used on or above a jetty, wharf, pier or pontoon:

- (i) Cables in free air suspended from or incorporating a support wire, e.g. as installation methods Nos. 35 and 36 in Table 4A2 (refer to Appendix 4 in KS 662-5)
- (ii) Non-sheathed cables in cable management systems
- (iii) Cables with aluminium conductors
- (iv) Mineral insulated cables.

**709.521.1.6** Cables shall be selected and installed so that mechanical damage due to tidal and other movement of floating structures is prevented.

Cable management systems shall be installed to allow the drainage of water by drainage holes and/or installation of the equipment on an incline.

#### **709.521.1.7 Underground cables**

Underground distribution cables shall, unless provided with additional mechanical protection, be buried at a sufficient depth to avoid being damaged, e.g. by heavy vehicle movement.

**NOTE:** A depth of 0.5 m is generally considered as a minimum depth to fulfil this requirement.

#### **709.521.1.8 Overhead cables or overhead insulated conductors**

All overhead conductors shall be insulated.

Poles and other supports for overhead wiring shall be located or protected so that they are unlikely to be damaged by any foreseeable vehicle movement.

Overhead conductors shall be at a height above ground of not less than 6 m in all areas subjected to vehicle movement and 3.5 m in all other areas.

## **709.531 Devices for fault protection by automatic disconnection of supply**

### **709.531.2 RCDs**

Socket-outlets shall be protected individually by an RCD having the characteristics specified in Section 415.1.1. Devices selected shall disconnect all poles, including the neutral.

Final circuits intended for fixed connection for the supply to houseboats shall be protected individually by an RCD having the characteristics specified in Section 415.1.1. The device selected shall disconnect all poles, including the neutral.

### **709.533 Devices for protection against overcurrent**

Each socket-outlet shall be protected by an individual overcurrent protective device, in accordance with the requirements of Chapter 43.

A fixed connection for supply to each houseboat shall be protected individually by an overcurrent protective device, in accordance with the requirements of Chapter 43.

### **709.537 Isolation and switching**

#### **709.537.2 Isolation**

##### **709.537.2.1 General**

**709.537.2.1.1** At least one means of isolation shall be installed in each distribution cabinet. This switching device shall disconnect all live conductors including the neutral conductor. One isolating switching device for a maximum of four socket-outlets shall be installed.

### **709.55 Other equipment**

#### **709.553.1 Plugs and socket-outlets**

**709.553.1.8** Socket-outlets shall comply with KS IEC 60309-1 above 63 A and KS IEC 60309-2 up to 63 A. Every socket-outlet shall meet the degree of protection of at least IP44 or such protection shall be provided by an enclosure.

Where the codes AD5 or AD6 are applicable the degree of protection shall be at least either IPX5 or IPX6 respectively.

**709.553.1.9** Every socket-outlet shall be located as close as practicable to the berth to be supplied.

Socket-outlets shall be installed in the distribution board or in separate enclosures.

**709.553.1.10** In order to avoid any hazard due to long connection cords, a maximum of four socket-outlets shall be grouped together in one enclosure.

**NOTE:** See Figure 709.3 regarding the recommended instruction notice to be placed in marinas adjacent to each group of socket-outlets.

**709.553.1.11** One socket-outlet shall supply only one pleasure craft or houseboat.

**709.553.1.12** In general, single-phase socket-outlets with rated voltage 200 V – 250 V and rated current 16 A shall be provided.

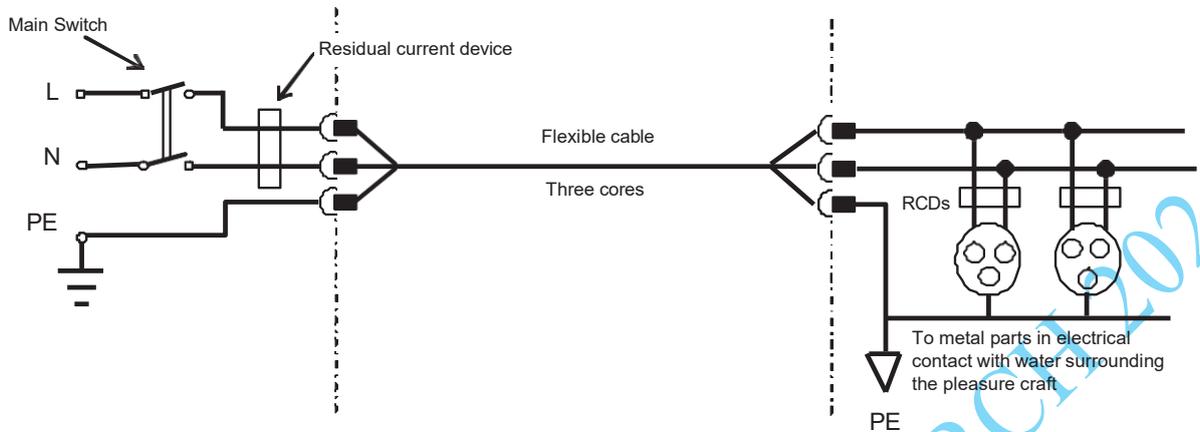
Where greater demands are envisaged socket-outlets with higher current ratings shall be provided.

**709.553.1.13** Socket-outlets shall be placed at a height of not less than 1 m above the highest water level. In the case of floating pontoons or walkways only, this height may be reduced to 300 mm above the highest water level provided that appropriate additional measures are taken to protect against the effects of splashing.

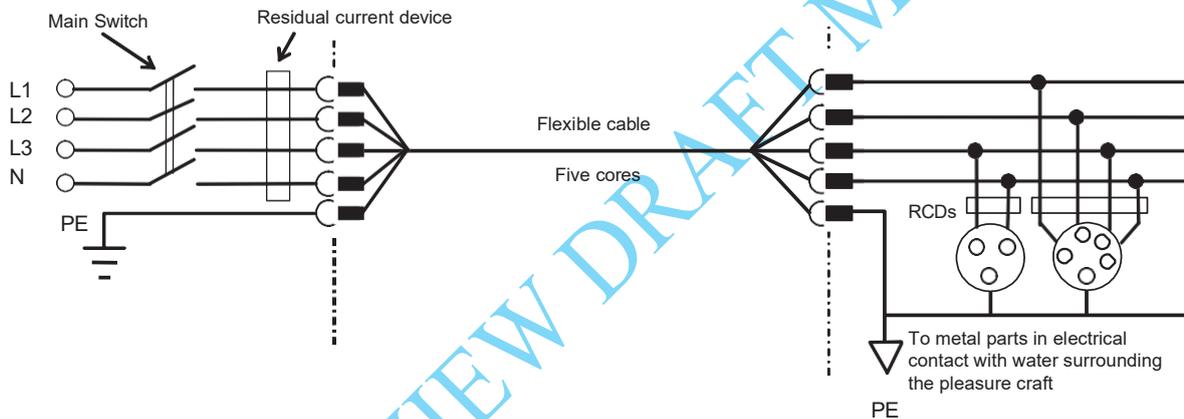
709.553.1.14 Socket-outlet protective conductors shall not be connected to a PME earthing facility.

**Figs 709.1 & 2 – Examples of methods of obtaining supply in marinas**

**Fig 709.1 – Connection to a single-phase mains supply with RCD**



**Fig 709.2 – Connection to a three-phase mains supply with RCD**



**Fig 709.3 – Example of an instruction notice to be placed in marinas**

**NOTE 1:** It is recommended that the marina operator provides every pleasure craft operator who wishes to connect a pleasure craft to an electrical supply with an up-to-date copy of this instruction notice.

**NOTE 2:** The instruction notice should contain, at least, the following:

## INSTRUCTIONS FOR ELECTRICITY SUPPLY

### BERTHING INSTRUCTIONS FOR CONNECTION TO SHORE SUPPLY

This marina provides power for use on your pleasure craft with a direct connection to the shore supply which is connected to Earth. Unless you have an isolating transformer fitted on board to isolate the electrical system on your craft from the shore supply system, corrosion through electrolysis could damage your craft or surrounding craft.

#### ON ARRIVAL

- (i) Ensure the supply is switched off and disconnect all current-using equipment on the craft, before inserting the craft plug. Connect the flexible cable **firstly** at the pleasure-craft inlet socket and **then** at the marina socket-outlet.
- (ii) The supply at this berth is \* V, \* Hz. The socket-outlet will accommodate a standard marina plug colour \* (technically described as KS IEC 60309-2, position 6 h).
- (iii) For safety reasons, your craft must not be connected to any other socket-outlet than that allocated to you and the internal wiring on your craft must comply with the appropriate standards.
- (iv) Every effort must be made to prevent the connecting flexible cable from falling into the water if it should become disengaged. For this purpose, securing hooks are provided alongside socket-outlets for anchorage at a loop of tie cord.
- (v) For safety reasons, only one pleasure-craft connecting cable supplying one pleasure craft may be connected to any one socket-outlet.
- (vi) The connecting flexible cable must be in one length, without signs of damage, and not contain joints or other means to increase its length.
- (vii) The entry of moisture and salt into the pleasure-craft inlet socket may cause a hazard. Examine carefully and clean the plug and socket before connecting the supply.
- (viii) It is dangerous to attempt repairs or alterations. If any difficulty arises, contact the marina management.

#### BEFORE LEAVING

- (i) Ensure that the supply is switched off and disconnect all current-using equipment on the craft, before the connecting cable is disconnected and any tie cord loops are unhooked.
- (ii) The connecting flexible cable should be disconnected **firstly** from the marina socket-outlet and **then** from the pleasure-craft inlet socket. Any cover that may be provided to protect the inlet from weather should be securely replaced. The connecting flexible cable should be coiled up and stored in a dry location where it will not be damaged.

\* appropriate figures and colours to be inserted:  
nominally 230 V 50 Hz blue - single-phase, and  
nominally 400 V 50 Hz red - three-phase.

Note: The voltage and frequency for the instruction shall be filled depending on the levels used in the installation.

## SECTION 710: MEDICAL LOCATIONS

### 710.1 Scope

The particular requirements of this section apply to patient healthcare facilities, such as, hospitals, private clinics, medical and dental practices, healthcare centres and dedicated medical rooms in the workplace to provide for the safety of patients and medical staff.

In these areas the risk to patients is increased due to:

- the reduction in body resistance, since the skin is often cut or broken, and
- the threat from failure of the supply, especially to life supporting equipment.

This section also applies to electrical installations in locations designed for medical research on patients.

The requirements of this section do not apply to medical electrical (ME) equipment.

**NOTE 1:** The requirements of other sections of KS 662-7 may also apply.

**NOTE 2:** It may be necessary to modify the existing electrical installation, in accordance with this Standard, when a change of utilization of the location occurs. Special care should be taken where intracardiac and/or life supporting procedures are performed in existing installations.

**NOTE 3:** Where applicable, this Standard can also be used in veterinary clinics.

**NOTE 4:** For ME equipment and ME systems, refer to the KS IEC 60601 series.

**NOTE 5:** Care should be taken so that other installations do not compromise the level of safety provided by installations meeting the requirements of this section.

### 710.3 Assessment of general characteristics

In order to determine the classification and Group number of a medical location, it is necessary that the relevant medical staff indicate which medical procedures will take place within the location. Based on the intended use, the appropriate classification for the location shall be determined.

**NOTE 1:** Classification of a medical location is related to the type of contact between applied parts and the patient, the threat to the safety of the patient owing to a discontinuity (failure) of the electrical supply, as well as the purpose for which the location is used. (Guidance on the allocation of a Group number and classification of safety services for medical locations is shown in Annex A710.)

**NOTE 2:** To provide protection of patients from possible electrical hazards, additional protective measures are applied in medical locations. The type and description of these hazards can vary according to the treatment being administered. The purpose for which a location is to be used may justify areas with different classifications (Group 0, 1 or 2) for different medical procedures.

**NOTE 3:** Applied parts are defined by the particular standards for ME equipment.

**NOTE 4:** Where a medical location may be used for different medical procedures the requirements of the higher Group classification should be applied; refer to Annex A710.

### 710.31 Purposes, supplies and structure

#### 710.312.2 Types of system earthing

PEN conductors shall not be used in medical locations and medical buildings downstream of the main distribution board.

#### 710.313 Supplies

##### 710.313.1 General

In medical locations, the distribution system shall be designed and installed to facilitate the automatic changeover from the main distribution network to the electrical safety source feeding essential loads, as required by Section 560.5 in KS 662-5.

## **710.4 Protection for safety**

### **710.41 Protection against electric shock**

#### **710.410.3 General requirements**

**710.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**710.410.3.6** The protective measures of non-conducting location (Section 418.1), earth-free local equipotential bonding (Section 418.2) and electrical separation for the supply to more than one item of current-using equipment (Section 418.3) shall not be used.

**NOTE:** A medical IT system does not use electrical separation as the sole means of protection against electric shock.

#### **710.411.3 Requirements for fault protection**

##### **710.411.3.2 Automatic disconnection in case of a fault**

**710.411.3.2.1** Care shall be taken so that simultaneous use of many items of equipment connected to the same circuit cannot cause unwanted tripping of the residual current protective device (RCD).

In medical locations of Group 1 and Group 2, where RCDs are required, only Type A according to KS IEC 61008 and KS IEC 61009 or Type B according to IEC 62423 shall be selected, depending on the possible fault current arising. Type AC RCDs shall not be used.

**710.411.3.2.5** In medical locations of Group 1 and Group 2, the voltage presented between simultaneously accessible exposed-conductive-parts and/or extraneous-conductive-parts shall not exceed 25 V AC or 60 V DC.

##### **710.411.4 TN system**

Additional protection by RCDs having the characteristics specified in Section 415.1.1 shall be used:

- (i) in final circuits of Group 1 with rated current not exceeding 32 A and below, and
- (ii) in final circuits of Group 2, except those of the medical IT system specified in Section 710.411.6.

**NOTE:** It is also permissible to use RCDs above 32 A in Group 1 locations.

##### **710.411.5 TT system**

In medical locations of Group 1 and Group 2, RCDs shall be used as protective devices, except for circuits of an IT system specified in Section 710.411.6.

##### **710.411.6 IT system**

In Group 2 medical locations of an IT system, including the measures of Section 710.411.6.3.1, 710.411.6.3.2 and 710.512.1.1.1, shall be used for final circuits of ME equipment and ME systems intended for life support and surgical applications within the patient environment, excluding:

- (i) equipment with a rated power greater than 5kVA
- (ii) X-ray equipment
- (iii) the supply of movements of fixed operating tables.

For each group of rooms serving the same function, at least one medical IT system is necessary.

**NOTE 1:** The list of circuits in (i) to (iii) above is not exhaustive.

**NOTE 2:** For illustration of a typical theatre layout refer to Figure 710.2.

**NOTE 3:** A system constructed to the requirements of Section 710.411.6 is known as a medical IT system.

**710.411.6.3.1** For each group of rooms serving the same function, at least one medical IT system is necessary. The IT system shall be equipped with an insulation monitoring device (MED-IMD) in accordance with Annex A and Annex B of KS IEC 61557-8.

For each medical IT system, an audible and visual alarm system, incorporating the following components, shall be provided so that it can be permanently monitored by the medical staff and any alarm reported to technical staff:

- (i) A green signal lamp to indicate normal operation
- (ii) A yellow signal lamp which lights when the minimum value set for the insulation resistance is reached. It shall not be possible for this light to be cancelled or disconnected

- (iii) An audible alarm which sounds when the minimum value set for the insulation resistance is reached. This audible alarm may be silenced
- (iv) The yellow signal shall extinguish on removal of the fault and when the normal condition is restored.

Documentation shall be easily readable in the medical location and it shall include:

- (v) the meaning of each type of signal, and
- (vi) the procedure to be followed in case of an alarm at first fault.

**710.411.6.3.2** Monitoring of overload and high temperature for the IT transformer is required.

**710.411.6.3.3** In addition to an insulation monitoring device, consideration shall be given to the installation of fault location systems which localize insulation faults in any part of the medical IT system.

The insulation fault location system shall be in accordance with KS IEC 61557-9.

#### **710.411.7 Functional extra-low voltage (FELV)**

In medical locations, functional extra-low voltage (FELV) shall not be used as a method of protection against electric shock.

#### **710.414 Protective measure: Extra-low voltage provided by SELV or PELV**

##### **710.414.1 General**

When using SELV and/or PELV circuits in medical locations of Group 1 and Group 2, the nominal voltage applied to current-using equipment shall not exceed 25 V AC rms or 60 V ripple-free DC. Protection by basic insulation of live parts as required by Section 416.1 or by barriers or enclosures as required by Section 416.2, shall be provided.

**710.414.4.1** In medical locations of Group 2, where PELV is used, exposed-conductive-parts of equipment, e.g. operating theatre luminaires, shall be connected to the circuit protective conductor.

##### **710.415.1 Additional protection: RCDs**

Where a medical IT system is used, additional protection by means of an RCD is not required.

##### **710.415.2 Additional protection: Supplementary protective equipotential bonding**

**710.415.2.1** In each medical location of Group 1 and Group 2, supplementary protective equipotential bonding shall be installed and the supplementary bonding conductors shall be connected to the equipotential bonding busbar for the purpose of equalizing potential differences between the following parts, which are located or that may be moved into the 'patient environment':

- (i) Protective conductors
- (ii) Extraneous-conductive-parts
- (iii) Screening against electrical interference fields, if installed
- (iv) Connection to conductive floor grids, if installed
- (v) Metal screens of isolating transformers, via the shortest route to the earthing conductor.

Supplementary equipotential bonding connection points for the connection of ME equipment shall be available in Group 2 and should also be considered in Group 1 medical locations.

The designer in consultation with the end user shall determine the appropriate number of supplementary equipotential bonding connections.

**NOTE 1:** In a Group 1 medical location, a minimum of one supplementary equipotential bonding connection point per patient location is recommended. In a Group 2 medical location, a minimum number of four supplementary equipotential bonding connection points but not less than 25 % of the total number of individual medical IT socket-outlets provided per patient location is recommended.

**NOTE 2:** Manufacturers of fixed conductive non-electrical patient supports such as operating theatre tables, physiotherapy couches and dental chairs may require the equipment to be connected to the equipotential bonding conductor.

**710.415.2.2** In medical locations of Group 1 and Group 2, the resistance of the protective conductors between the earth terminal of any socket-outlet (or fixed equipment) and any exposed-conductive-part and/or extraneous-conductive-part shall be such that the voltages given in 710.411.3.2.5 are not exceeded, and the measured resistance between the earth terminal of any socket-outlet (or fixed equipment) and any extraneous-conductive-part shall not exceed 0.2  $\Omega$ .

**NOTE:** In TN and TT systems, a value of 25 V AC or 60 V DC may be obtained by the provision of protective equipotential bonding in conjunction with circuit protective conductors for the particular circuit. In the case of TT systems a satisfactory value of RA will also be required.

**710.415.2.3** The equipotential bonding busbar shall be located in or near the medical location.

The equipotential bonding busbar shall be connected to the system earthing using a protective conductor having a cross-sectional area greater than or equal to the largest cross-sectional area of any conductor connected to the equipotential bonding busbar.

Connections shall be so arranged that they are accessible, labelled, clearly visible and can be individually disconnected.

**NOTE:** It is recommended that radial wiring patterns are used to avoid 'earth loops' that may exacerbate electromagnetic disturbances.

**710.421.1.201** In medical locations of Group 1 and 2 Arc Fault Detection Devices (AFDDs) are not required to be installed. In medical locations of Group 0 Arc Fault Detection Devices (AFDDs) shall be used subject to a risk assessment.

#### **710.444 Measures against electromagnetic disturbances**

Special considerations have to be made concerning electromagnetic interference (EMI) and electromagnetic compatibility (EMC).

#### **710.5 Selection and erection of equipment**

##### **710.51 Common rules**

##### **710.511.1 Distribution boards**

Distribution boards shall meet the requirements of IEC 61439 series.

Distribution boards for Group 2 locations shall be installed in close proximity to the areas they serve and be clearly labelled.

##### **710.512 Operational conditions and external influences**

##### **710.512.1 Operational conditions**

##### **710.512.1.1 Transformers for medical IT systems**

Transformers shall be in accordance with KS IEC 61558-2-15, installed in close proximity to the medical location and with the following additional requirements:

- (i) The leakage current of the output winding to earth and the leakage current of the enclosure, when measured in no-load condition and with the transformer supplied at rated voltage and rated frequency, shall not exceed 0.5 mA
- (ii) At least one single-phase transformer per room or functional group of rooms shall be used to form the medical IT systems for mobile and fixed equipment. The rated output shall be not less than 0.5 kVA and shall not exceed 10 kVA. Where several transformers are needed to supply equipment in one room, they shall not be connected in parallel
- (iii) If the supply of three-phase loads via a medical IT system is also required, a separate three-phase transformer shall be provided for this purpose.

For monitoring see Section 710.411.6.3.1.

Capacitors shall not be used in transformers for medical IT systems.

##### **710.512.1.2 Power supply for medical locations of Group 2**

In case of a fault or a failure of supply, a total loss of power in a Group 2 medical location shall be prevented.

##### **710.512.2.1 Explosion risk**

Electrical devices, e.g. socket-outlets and switches, installed below any medical-gas outlets for oxidizing or flammable gases shall be located at a distance of at least 0.2 m from the outlet (centre to centre), so as to minimize the risk of ignition of flammable gases.

**NOTE:** Requirements for ME equipment for use in conjunction with flammable gases and vapours are contained in KS IEC 60601.

### **710.514.9 Diagrams and documentation**

**710.514.9.1** Plans of the electrical installation together with records, drawings, wiring diagrams and modifications relating to the medical location, shall be provided.

Information provided shall include but not be limited to:

- (i) single-line overview diagrams showing the distribution system of the normal power supply and power supply for safety services in a single-line representation
- (ii) distribution board block diagrams showing switchgear and controlgear and distribution boards in a single-line representation
- (iii) schematic diagrams of controls
- (iv) the verification of compliance with the requirements of standards
- (v) functional description for the operation of the safety power supply services and of the safety power supply system.

### **710.52 Selection and erection of wiring systems**

Any wiring system within Group 2 medical locations shall be exclusively for the use of equipment and accessories within those locations.

### **710.53 Protection, isolation, switching, control and monitoring**

#### **710.531.2 Overcurrent protective devices - protection of wiring systems in medical locations of Group 2**

Overload current protection shall not be used in either the primary or secondary circuit of the transformer of a medical IT system.

Overcurrent protection against overload and short-circuit currents is required for each final circuit.

**NOTE 1:** Overcurrent protective devices (e.g. fuses) may be used in the primary circuit of the transformer for short-circuit protection only.

**NOTE 2:** Fig 710.3 shows a typical medical IT system arrangement.

#### **710.531.3 RCDs**

##### **710.531.3.2 Socket-outlets protected by RCDs**

For each circuit protected by an RCD having the characteristics specified in Section 415.1.1, consideration shall be given to reduce the possibility of unwanted tripping of the RCD due to excessive protective conductor currents produced by equipment during normal operation.

### **710.537 Isolation and switching**

#### **710.537.1 General**

Automatic changeover devices shall comply with KS IEC 60947-6-1 and shall be arranged so that safe separation between supply lines is maintained.

### **710.55 Other equipment**

#### **710.553.1 Socket-outlet circuits in the medical IT system for medical locations of Group 2**

Socket-outlets intended to supply ME equipment shall be unswitched.

At each patient's place of treatment, e.g. bedheads, the configuration of socket-outlets shall be as follows:

- (i) Each socket-outlet supplied by an individually protected circuit, or
- (ii) several socket-outlets separately supplied by a minimum of two circuits.

Socket-outlets used on medical IT systems shall be coloured blue and be clearly and permanently marked 'Medical Equipment Only'.

## **710.559      Luminaires and lighting installations**

In medical locations of Group 1 and Group 2, at least two different sources of supply shall be provided. One of the sources shall be connected to the electrical supply system for safety services.

## **710.56      Safety services**

A power supply for safety services is required which will maintain the supply for continuous operation for a defined period within a pre-set changeover time.

The safety power supply system shall automatically take over if the voltage of one or more incoming live conductors, at the main distribution board of the building, has dropped for more than 0.5 s and by more than 10 % in regard to the nominal voltage.

**NOTE:** A list of examples with suggested reinstatement times is given in Table A710 of Annex A710.

### **710.560.4      Classification**

Classification of safety services is given in Section 560.4.1 of KS 662-5.

**NOTE:** Safety services provided for locations having differing classifications should meet that classification which gives the highest security of supply.

### **710.560.5.5      General requirements for safety power supply sources of Group 1 and Group 2**

Primary cells are not allowed as safety power sources.

An additional main incoming power supply, from the general power supply, is not regarded as a source of the safety power supply.

The availability (readiness for service) of safety power sources shall be monitored and indicated at a suitable location.

**710.560.5.6** In case of a failure of the general power supply source, the power supply for safety services shall be energized to feed the equipment stated in Sections 710.560.6.1.1 to 3 with electrical energy for a defined period of time and within a predetermined changeover period.

**710.560.5.7** Where socket-outlets are supplied from the safety power supply source they shall be readily identifiable according to their safety services classification.

### **710.560.6      Electrical sources for safety services**

#### **710.560.6.1      Detailed requirements for safety power supply services**

**NOTE:** Also refer to Section 710.560.5.5.

##### **710.560.6.1.1      Power supply sources with a changeover period less than or equal to 0.5 s**

In the event of a voltage failure on one or more line conductors at the distribution board, a safety power supply source shall be used and be capable of providing power for a period of at least 3 h for the following:

- (i) Luminaires of operating theatre tables
- (ii) ME equipment containing light sources being essential for the application of the equipment, e.g. endoscopes, including associated essential equipment, e.g. monitors
- (iii) Life-supporting ME equipment.

The duration of 3 h may be reduced to 1 h for items (ii) and (iii) if a power source meeting the requirements of Section 710.560.6.1.2 is installed.

The normal power supply shall be restored within a changeover period not exceeding 0.5 s.

##### **710.560.6.1.2      Power supply sources with a changeover period less than or equal to 15 s**

Equipment meeting the requirements of Sections 710.560.9.1 and 710.560.11 shall be connected within 15 s to a safety power supply source capable of maintaining it for a minimum period of 24 h, when the voltage of one or more live conductors at the main distribution board for the safety services has decreased by more than 10 % of the nominal value of supply voltage and for a duration greater than 3 s.

### **710.560.6.1.3 Power supply sources with a changeover period greater than 15 s**

Equipment, other than that covered by Sections 710.560.6.1.1 and 710.560.6.1.2, which is required for the maintenance of healthcare installations, shall be connected either automatically or manually to a safety power supply source capable of maintaining it for a minimum period of 24 h. This equipment may include, for example:

- (i) Sterilization equipment
- (ii) Technical building installations, in particular air conditioning, heating and ventilation systems, building services and waste disposal systems
- (iii) Cooling equipment
- (iv) Catering equipment
- (v) Storage battery chargers.

### **710.560.7 Circuits of safety services**

The circuit which connects the power supply source for safety services to the main distribution board shall be considered a safety circuit.

### **710.560.9 Emergency lighting systems**

#### **710.560.9.1 Safety lighting**

In the event of mains power failure, the changeover period to the safety services source shall not exceed 15 s. The necessary minimum illuminance shall be provided for the following:

- (i) Emergency lighting and exit signs
- (ii) Locations for switchgear and controlgear for emergency generating sets, for main distribution boards of the normal power supply and for power supply for safety services
- (iii) Rooms in which essential services are intended. In each such room at least one luminaire shall be supplied from the power source for safety services
- (iv) Locations of central fire alarm and monitoring systems
- (v) Rooms of Group 1 medical locations; in each such room at least one luminaire shall be supplied from the power supply source for safety services
- (vi) Rooms of Group 2 medical locations; a minimum of 90 % of the lighting shall be supplied from the power source for safety services.

The luminaires of the escape routes shall be arranged on alternate circuits.

### **710.560.11 Other services**

Other services which may require a safety service supply with a changeover period not exceeding 15 s include, for example, the following:

- (i) Firefighters lifts
- (ii) Ventilation systems for smoke extraction
- (iii) Paging/communication systems
- (iv) ME equipment used in Group 2 medical locations which serves for surgical or other procedures of vital importance. Such equipment will be defined by responsible staff
- (v) Electrical equipment of medical gas supply including compressed air, vacuum supply and narcosis (anaesthetics) exhaustion as well as their monitoring devices
- (vi) Fire detection and fire alarms
- (vii) Fire extinguishing systems.

### **710.6 Inspection and testing**

**NOTE:** The testing of equipment connected to the electrical installation is outside the scope of this document. For ME equipment refer to IEC 62353.

#### **710.64 Initial verification**

#### **710.641 General**

The dates and results of each verification shall be recorded.

The tests specified below under items (i) to (iii), in addition to the requirements of Chapter 64 of KS 662-6, shall be carried out, both prior to commissioning and after alteration or repairs and before re-commissioning:

- (i) Complete functional tests of the insulation monitoring devices (IMDs) associated with the medical IT system including insulation failure, transformer high temperature, overload, discontinuity and the audible and/or visual alarms linked to them
- (ii) Measurements of leakage current of the output circuit and of the enclosure of the medical IT transformers in no-load condition, as specified by Section 710.512.1.1(i)
- (iii) Measurements to verify that the resistance of the supplementary equipotential bonding is within the limits stipulated by Section 710.415.2.2.

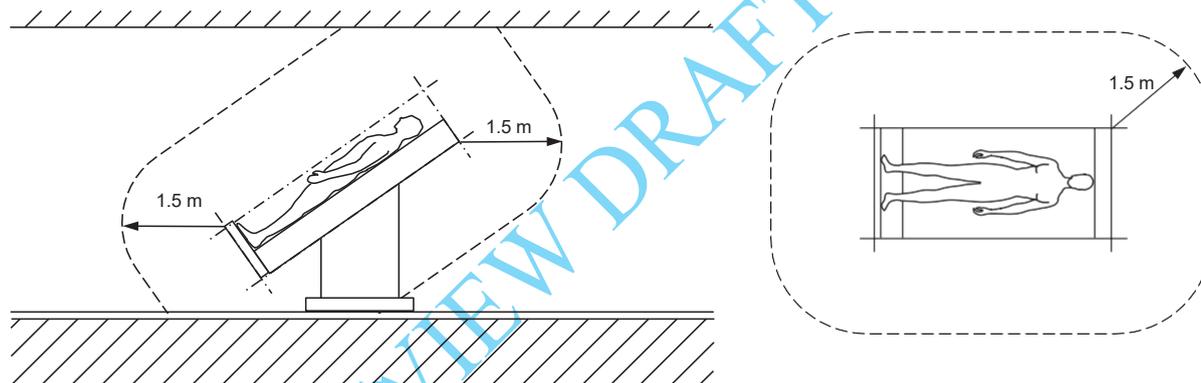
## 710.65 Periodic inspection and testing

### 710.651 General

**NOTE 1:** In addition to the requirements of Chapter 65, the following procedures are recommended at the given intervals:

- (i) Annually – Complete functional tests of the insulation monitoring devices (IMDs) associated with the medical IT system including insulation failure, transformer high temperature, overload, discontinuity and the audible/visual alarms linked to them
- (ii) Annually – Measurements to verify that the resistance of the supplementary protective equipotential bonding is within the limits stipulated by Section 710.415.2.2.
- (iii) Every 3 years – Measurements of leakage current of the output circuit and of the enclosure of the medical IT transformers in no-load condition, as specified by Section 710.512.1.1(i)

**Fig 710.1 – Example of patient environment (KS IEC 60601)**



**NOTE:** The dimensions in the figure show the minimum extent of the patient environment in a free surrounding. This applies where the patient's position is predetermined; if not, all possible patient positions should be considered (see Patient environment, KS 662-2, Definitions).

Fig 710.2 – Typical theatre layout

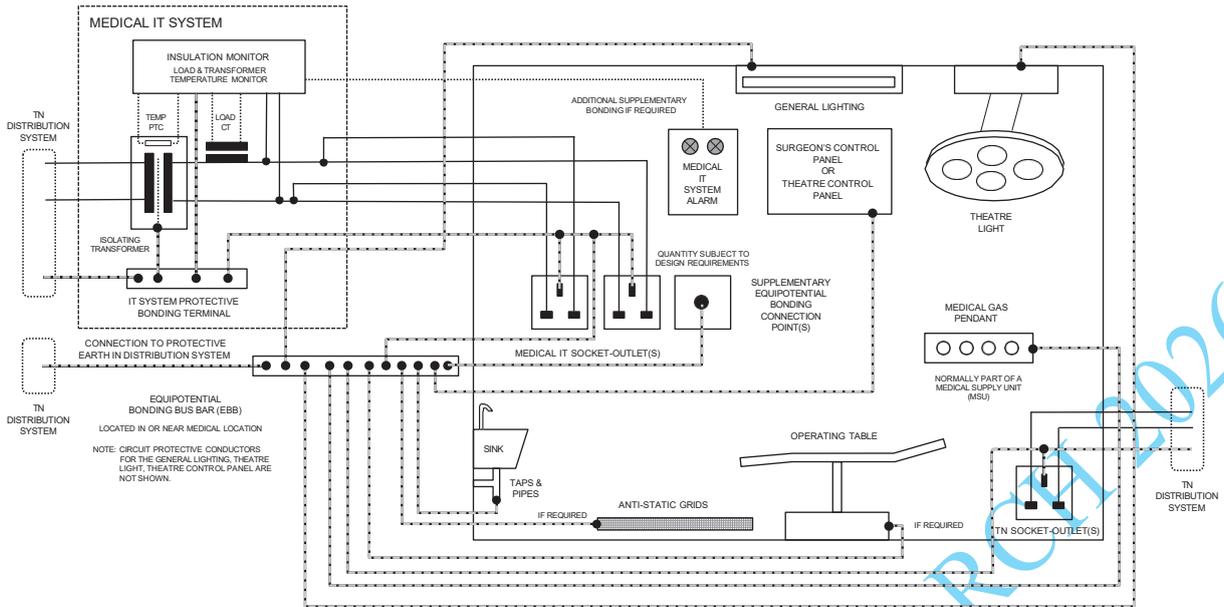
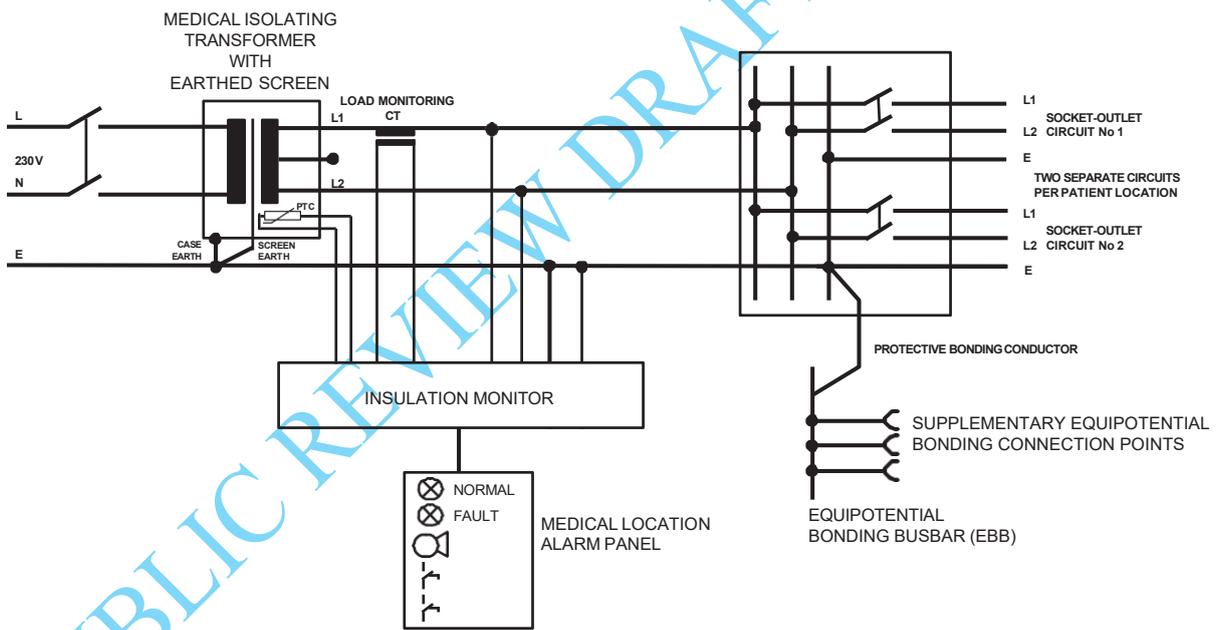


Fig 710.3 – Typical medical IT system arrangement



## ANNEX A710 MEDICAL LOCATIONS

### Examples for allocation of Group numbers and classification for safety services of medical locations

A definitive list of medical locations showing their assigned Groups is impracticable, as is the use to which locations (rooms) might be put. The accompanying list of examples is provided as a guide only and should be read in conjunction with Section 710.3. The requirements of Section 710.3 cannot be satisfied by using this table alone.

**TABLE A710 – List of examples**

Medical location	Group			Classification	
	0	1	2	≤ 0.5 s	> 0.5 s ≤ 15 s
1 Massage room	X	X			X
2 Bedrooms		X			X
3 Delivery room		X		X <sup>a</sup>	X
4 ECG, EEG, EHG room		X			X
5 Endoscopic room		X <sup>b</sup>		X	X <sup>b</sup>
6 Examination or treatment room		X		X	X
7 Urology room		X <sup>b</sup>		X	X <sup>b</sup>
8 Radiological diagnostic and therapy room		X	X	X	X
9 Hydrotherapy room		X			X
10 Physiotherapy room		X			X
11 Anaesthetic area			X	X <sup>a</sup>	X
12 Operating theatre			X	X <sup>a</sup>	X
13 Operating preparation room			X	X <sup>a</sup>	X
14 Operating plaster room			X	X <sup>a</sup>	X
15 Operating recovery room			X	X <sup>a</sup>	X
16 Heart catheterization room			X	X <sup>a</sup>	X
17 Intensive care room			X	X <sup>a</sup>	X
18 Angiographic examination room			X	X <sup>a</sup>	X
19 Haemodialysis room		X			X
20 Magnetic resonance imaging (MRI) room		X	X	X	X
21 Nuclear medicine		X			X
22 Premature baby room			X	X <sup>a</sup>	X
23 Intermediate Care Unit (IMCU)			X	X	X
a	Specific luminaires, such as operating or procedure lights, that require a power supply within 0.5 s and life-support medical electrical equipment that requires a power supply within 0.5 s.				
b	Not being an operating theatre.				

## SECTION 711: EXHIBITIONS, SHOWS AND STANDS

### 711.1 Scope

The particular requirements of this section apply to the temporary electrical installations in exhibitions, shows and stands (including mobile and portable displays and equipment) to protect users. Unless specifically stated, this section does not apply to exhibits for which requirements are given in the relevant standards.

This section does not apply to the fixed electrical installation of the building, if any, in which the exhibition, show or stand may take place.

This section does not apply to electrical systems as used in structures, sets, mobile units etc as used for public or private events, touring shows, theatrical, radio, TV or film productions and similar activities of the entertainment industry.

The requirements of other sections of Part 7 may also apply.

### 711.3 Assessment of general characteristics

#### 711.3.13 Supplies

The nominal supply voltage of a temporary electrical installation in an exhibition, show or stand shall not exceed 230/400 V AC or 500 V DC.

#### 711.3.2 Classification of external influences

The external influence conditions of the particular location where the temporary electrical installation is erected, e.g. the presence of water or mechanical stresses, shall be taken into account.

### 711.41 Protection against electric shock

#### 711.410.3 General requirements

**711.410.3.4** A cable intended to supply temporary structures shall be protected at its origin by an RCD whose rated residual operating current does not exceed 300 mA. This device shall provide a delay by using a device in accordance with KS IEC 60947-2, or be of the type S in accordance with IEC 61008-1 or IEC 61009-1 for selectivity with RCDs protecting final circuits.

**NOTE:** The requirement for cable protection relates to the increased risk of damage to cables in temporary locations.

**711.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**711.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

#### 711.411 Protective measure: Automatic disconnection of supply

##### 711.411.3.1.2 Protective equipotential bonding

Structural metallic parts which are accessible from within the stand, vehicle, wagon, caravan or container shall be connected through the main protective bonding conductors to the main earthing terminal within the unit.

##### 711.411.3.3 Additional protection

Each socket-outlet circuit not exceeding 32 A and all final circuits other than for emergency lighting shall be protected by an RCD having the characteristics specified in Section 415.1.1.

#### 711.411.4 TN system

Except for a part of an installation within a building, a PME earthing facility shall not be used as the means of earthing for an installation falling within the scope of this section except where:

- (i) the installation is continuously under the supervision of a skilled or instructed person(s), and
- (ii) the suitability and effectiveness of the means of earthing has been confirmed before the connection is made.

## **711.414 Protective measure: Extra-low voltage provided by SELV or PELV**

**711.414.4.5** Where SELV or PELV is used, whatever the nominal voltage, basic protection shall be provided by:

- (i) basic insulation complying with Section 416.1, or
- (ii) by barriers or enclosures complying with Section 416.2 and affording a degree of protection of at least IPXXD or IP4X.

## **711.42 Protection against thermal effects**

### **711.422 Protection against fire**

#### **711.422.4.2 Heat generation**

Lighting equipment such as incandescent lamps, spotlights and small projectors, and other equipment or appliances with high temperature surfaces, shall be suitably guarded, and installed and located in accordance with the relevant standard.

Showcases and signs shall be constructed of material having adequate heat-resistance, mechanical strength, electrical insulation and ventilation, taking into account the combustibility of exhibits in relation to the heat generation.

Stand installations containing a concentration of electrical equipment, luminaires or lamps liable to generate excessive heat shall not be installed unless adequate ventilation provisions are made, e.g. well ventilated ceiling constructed of incombustible material.

In all cases, the manufacturer's instructions shall be taken into account.

## **711.5 Selection and erection of equipment**

### **711.51 Common rules**

Switchgear and controlgear shall be placed in closed cabinets which can only be opened by the use of a key or a tool, except for those parts designed and intended to be operated by ordinary persons.

### **711.52 Wiring systems**

Armoured cables or cables protected against mechanical damage shall be used wherever there is a risk of mechanical damage.

Wiring cables shall be copper, have a minimum cross-sectional area of 1.5 mm<sup>2</sup>, and shall comply with an appropriate British or Harmonized Standard for either thermoplastic or thermosetting insulated electric cables.

Flexible cables shall not be laid in areas accessible to the public unless they are protected against mechanical damage.

#### **711.521 Types of wiring system**

Where no fire alarm system is installed in a building used for exhibitions etc. cable systems shall be either:

- (i) flame retardant to KS IEC 60332-1-2 or to a relevant part of the KS IEC 60332-3 series, and low smoke to IEC 61034-2, or
- (ii) single-core or multicore unarmoured cables enclosed in metallic or non-metallic conduit or trunking, providing fire protection in accordance with KS IEC 61386 series or IEC 61084-2 series and providing a degree of protection of at least IP4X.

### **711.526 Electrical connections**

**711.526.1** Joints shall not be made in cables except where necessary as a connection into a circuit. Where joints are made, these shall either use connectors in accordance with relevant standards or be in enclosures with a degree of protection of at least IPXXD or IP4X.

Where strain can be transmitted to terminals the connection shall incorporate suitable cable anchorage(s).

## **711.537.2 Devices for isolation**

**711.537.2.3** Every separate temporary structure, such as a vehicle, stand or unit, intended to be occupied by one specific user and each distribution circuit supplying outdoor installations shall be provided with its own readily accessible and properly identifiable means of isolation. The means of isolation shall be selected and erected in accordance with Section 462 and Section 537.2.

## **711.55 Other equipment**

### **711.55.4 Electric motors**

#### **711.55.4.1 Isolation**

Where an electric motor might give rise to a hazard, the motor shall be provided with an effective means of isolation on all poles and such means shall be adjacent to the motor which it controls (see KS IEC 60204-1).

#### **711.55.6 ELV transformers and electronic convertors**

A manual reset protective device shall protect the secondary circuit of each transformer or electronic convertor.

Particular care shall be taken when installing ELV transformers, which shall be mounted out of arm's reach of the public, e.g. in a panel or room with adequate ventilation that can only be accessed by skilled or instructed persons. Such access shall be provided only to facilitate inspection, testing and maintenance.

Electronic convertors shall conform with IEC 61347-1.

#### **711.55.7 Socket-outlets**

Where a floor mounted socket-outlet is installed, it shall be adequately protected from accidental ingress of water and have sufficient strength to be able to withstand the expected traffic load.

### **711.559 Luminaires and lighting installations**

#### **711.559.4.2 ELV lighting systems for filament lamps**

Extra-low voltage systems for filament lamps shall comply with KS IEC 60598-2-23.

#### **711.559.4.3 Lampholders**

Insulation piercing lampholders shall not be used unless the cables and lampholders are compatible, and providing the lampholders are non-removable once fitted to the cable.

#### **711.559.4.4 Electric discharge lamp installations**

Installations of any luminous tube, sign or lamp as an illuminated unit on a stand, or as an exhibit, with nominal power supply voltage higher than 230/400 V AC, shall comply with Sections 711.559.4.4.1 to 3.

##### **711.559.4.4.1 Location**

The sign or lamp shall be installed out of arm's reach or shall be adequately protected to reduce the risk of injury to persons.

##### **711.559.4.4.2 Installation**

The fascia or stand fitting material behind luminous tubes, signs or lamps shall be non-ignitable.

##### **711.559.4.4.3 Emergency switching device**

A separate circuit shall be used to supply signs, lamps or exhibits, which shall be controlled by an emergency switch. The switch shall be easily visible, accessible and clearly marked.

#### **711.559.5 Protection against thermal effects**

Luminaires mounted below 2.5 m (arm's reach) from floor level or otherwise accessible to accidental contact shall be firmly and adequately fixed, and so sited or guarded as to prevent risk of injury to persons or ignition of materials.

**NOTE:** In the case of outdoor lighting installations, Section 714 also applies, and a degree of protection of at least IP33 may be required.

## **711.6 Inspection and testing**

The temporary electrical installations of exhibitions, shows and stands shall be inspected and tested on site in accordance with Chapter 64 after each assembly on site.

## SECTION 712: SOLAR PHOTOVOLTAIC (PV) POWER SUPPLY SYSTEMS

### 712.1 Scope

The particular requirements of this section apply to the electrical installations of PV power supply systems including systems with AC modules.

**NOTE:** Requirements for PV power supply systems which are intended for stand-alone operation are under consideration.

### 712.3 Assessment of general characteristics

#### 712.31 Purposes, supplies and structure

#### 712.312 System earthing

##### 712.312.2 Type of earthing arrangement

Earthing of one of the live conductors of the DC side is permitted, if there is at least simple separation between the AC side and the DC side.

**NOTE:** Any connections with Earth on the DC side should be electrically connected so as to avoid corrosion.

### 712.4 Protection for safety

#### 712.41 Protection against electric shock

##### 712.410.3 General requirements

PV equipment on the DC side shall be considered to be energized, even when the system is disconnected from the AC side.

**712.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used on the DC side.

##### 712.411 Protective measure: Automatic disconnection of supply

**712.411.3.2.1.1** On the AC side, the PV supply cable shall be connected to the supply side of the overcurrent protective device for automatic disconnection of circuits supplying current-using equipment.

**712.411.3.2.1.2** Where an electrical installation includes a PV power supply system without at least simple separation between the AC side and the DC side, an RCD installed to provide either fault protection by automatic disconnection of supply or additional protection in accordance with Section 415.1.1, for the PV supply cable, shall be Type B according to IEC 62423.

Where the PV converter is, by construction, not able to feed DC fault currents into the electrical installation, an RCD of Type B according to IEC 62423 is not required.

##### 712.412 Protective measure: Double or reinforced insulation

Protection by the use of Class II or equivalent insulation shall preferably be adopted on the DC side.

##### 712.414 Protective measure: Extra-low voltage provided by SELV or PELV

###### 712.414.1 General

**712.414.1.1** For SELV and PELV systems,  $U_{oc\ STC}$  replaces  $U_0$  and shall not exceed 120 V DC.

##### 712.433 Protection against overload on the DC side

**712.433.1** Overload protection may be omitted to PV string and PV array cables when the continuous current-carrying capacity of the cable is equal to or greater than 1.25 times  $I_{sc\ STC}$  at any location.

**712.433.2** Overload protection may be omitted to the PV main cable if the continuous current-carrying capacity is equal to or greater than 1.25 times  $I_{sc\ STC}$  of the PV generator.

**NOTE:** The requirements of Sections 712.433.1 and 712.433.2 are only relevant for protection of the cables. See also the manufacturer's instructions for protection of PV modules.

#### **712.434 Protection against fault current**

**712.434.1** The PV supply cable on the AC side shall be protected against fault current by an overcurrent protective device installed at the connection to the AC mains.

#### **712.444 Protection against electromagnetic disturbances**

**712.444.4.4** To minimize voltages induced by lightning, the area of all wiring loops shall be as small as possible.

### **712.5 Selection and erection of equipment**

#### **712.51 Common rules**

#### **712.511 Compliance with standards**

**712.511.1** PV modules shall comply with the requirements of the relevant equipment standard, e.g. KS IEC 61215 for crystalline PV modules. PV modules of Class II construction or with equivalent insulation are recommended if  $U_{oc\ STC}$  of the PV strings exceeds 120 V DC.

The PV array junction box, PV generator junction box and switchgear assemblies shall be in compliance with KS IEC 61439-1.

#### **712.512 Operational conditions and external influences**

**712.512.1.1** Electrical equipment on the DC side shall be suitable for direct voltage and direct current.

PV modules may be connected in series up to the maximum allowed operating voltage of the PV modules ( $U_{oc\ STC}$  of the PV strings) and the PV convertor, whichever is lower. Specifications for this equipment shall be obtained from the equipment manufacturer.

If blocking diodes are used, their reverse voltage shall be rated for  $2 \times U_{oc\ STC}$  of the PV string. The blocking diodes shall be connected in series with the PV strings.

**712.512.2.1** As specified by the manufacturer, the PV modules shall be installed in such a way that there is adequate heat dissipation under conditions of maximum solar radiation for the site.

#### **712.513 Accessibility**

**712.513.1** The selection and erection of equipment shall facilitate safe maintenance and shall not adversely affect provisions made by the manufacturer of the PV equipment to enable maintenance or service work to be carried out safely.

### **712.52 Selection and erection of wiring systems**

#### **712.522 Selection and erection of wiring systems in relation to external influences**

**712.522.8.1** PV string cables, PV array cables and PV DC main cables shall be selected and erected so as to minimize the risk of earth faults and short-circuits.

**NOTE:** This may be achieved, for example, by reinforcing the protection of the wiring against external influences by the use of single-core sheathed cables complying with KS IEC 62930.

**712.522.8.3** Wiring systems shall withstand the expected external influences such as wind, ice formation, temperature and solar radiation.

### **712.53 Protection, isolation, switching, control and monitoring**

#### **712.537 Isolation and switching**

#### **712.537.2 Devices for isolation**

**712.537.2.1.1** To allow maintenance of the PV convertor, means of isolating the PV convertor from the DC side and the AC side shall be provided.

**NOTE:** Further requirements with regard to the isolation of a PV installation operating in parallel with the public supply system are given in Section 551.7.6.

**712.537.2.2.1** In the selection and erection of devices for isolation and switching to be installed between the PV installation and the public supply, the public supply shall be considered the source and the PV installation shall be considered the load.

**712.537.2.2.5** A switch-disconnector shall be provided on the DC side of the PV convertor. |

**712.537.2.2.5.1** All junction boxes (PV generator and PV array boxes) shall carry a warning label indicating that parts inside the boxes may still be live after isolation from the PV convertor.

**712.54 Earthing arrangements and protective conductors**

Where protective bonding conductors are installed, they shall be parallel to and in as close contact as possible with DC cables and AC cables and accessories. |

PUBLIC REVIEW DRAFT MARCH 2026 |

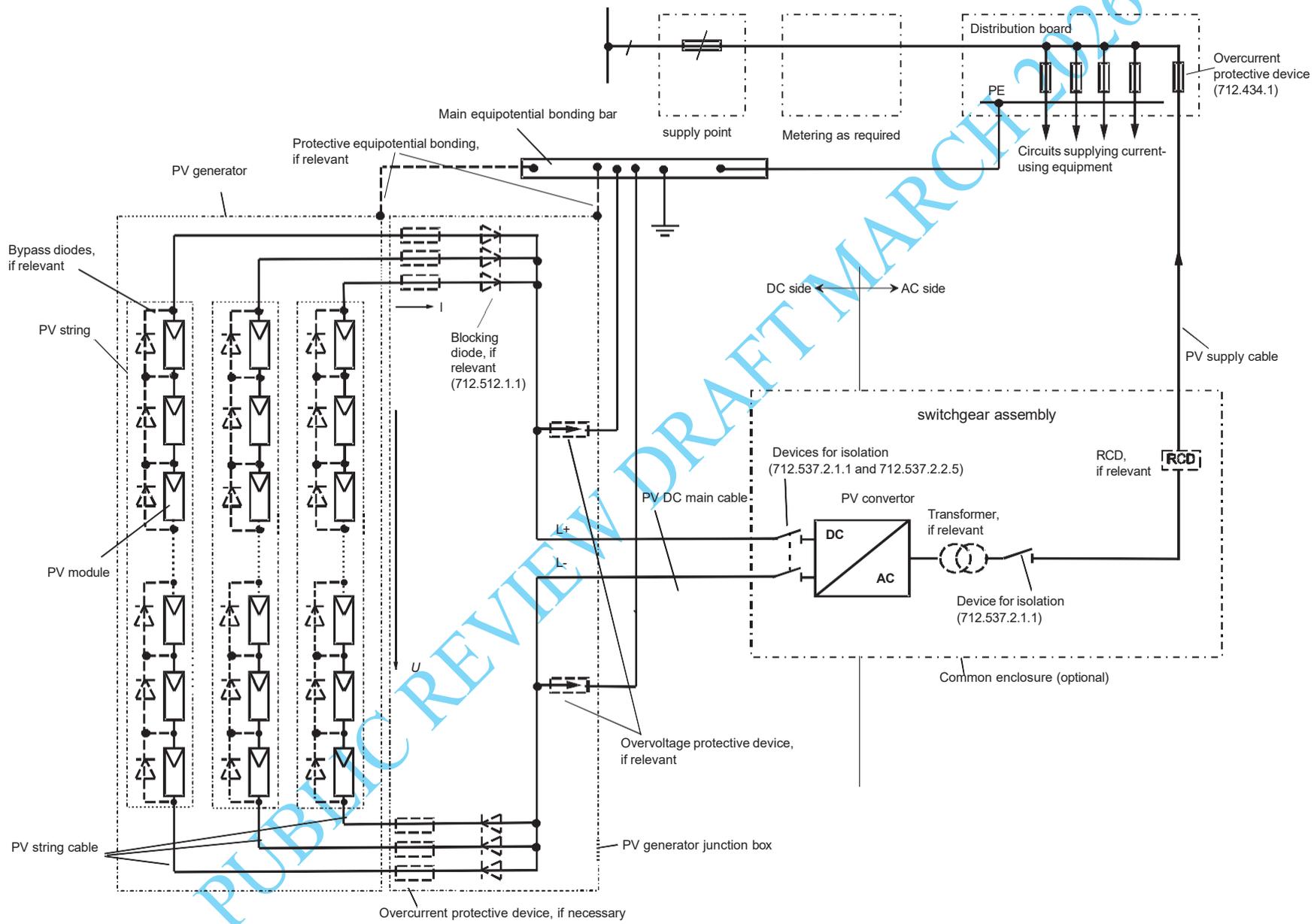


Fig 712.1 – PV installation - General schematic - One array

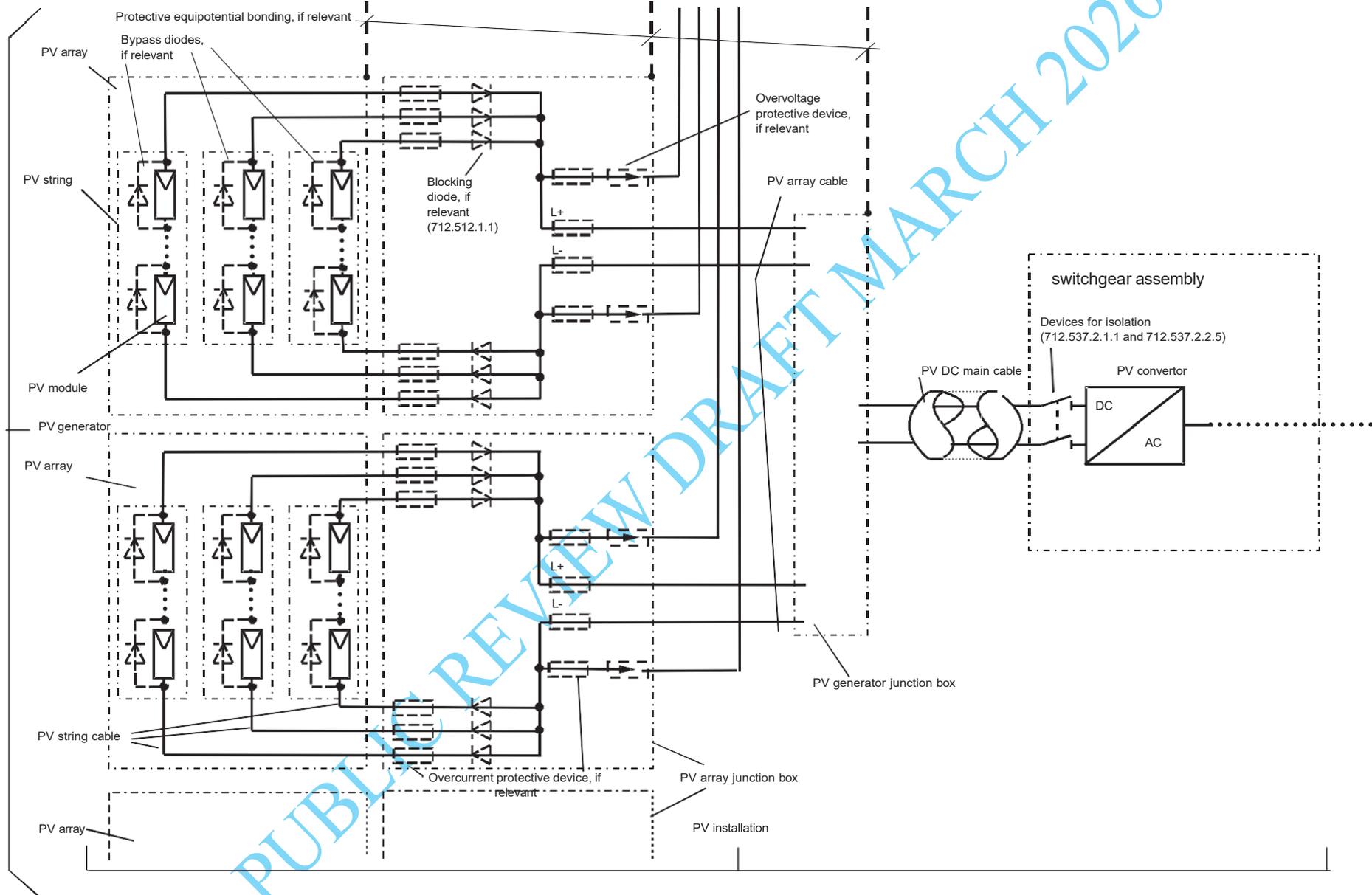


Fig 712.2 – PV installation - Example with two or more arrays

## SECTION 714: OUTDOOR LIGHTING INSTALLATIONS

### 714.1 Scope

This section applies to outdoor lighting installations comprising one or more luminaires, a wiring system and accessories, and to highway power supplies and street furniture.

The following are included in outdoor lighting installations:

- (i) Lighting installations such as those for roads, parks, car parks, gardens, places open to the public, sporting areas, illumination of monuments and floodlighting
- (ii) Other lighting arrangements in places such as telephone kiosks, bus shelters, advertising panels and town plans
- (iii) Road signs.

The following are excluded:

- (iv) Temporary festoon lighting
- (v) Luminaires fixed to the outside of a building and supplied directly from the internal wiring of that building
- (vi) Road traffic signal systems.

### 714.4 Protection for safety

#### 714.41 Protection against electric shock

##### 714.410.3 General requirements

**714.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

##### 714.411 Protective measure: Automatic disconnection of supply

Where the protective measure automatic disconnection of supply is used, all live parts of electrical equipment shall be protected by insulation or by barriers or enclosures providing basic protection. A door in street furniture, used for access to electrical equipment, shall not be used as a barrier or an enclosure.

A maximum disconnection time of 5 s shall apply to all circuits feeding fixed equipment used in highway power supplies for compliance with Section 411.3.2.3 (TN system) or 411.3.2.4 (TT system).

Where an earth connection to a distributor's PME network has been provided for a street electrical fixture, the earthing and bonding conductor of a street electrical fixture shall have a minimum copper equivalent cross-sectional area of 6 mm<sup>2</sup> for supply neutral conductors with copper equivalent cross-sectional areas up to 10 mm<sup>2</sup>. For larger sized supply neutral conductors the main bonding shall comply with Table 54.8.

##### 714.411.2.201 Provisions for basic protection

For every accessible enclosure live parts shall only be accessible with a key or a tool, unless the enclosure is in a location where only skilled or instructed person(s) have access.

A door giving access to electrical equipment and located less than 2.50 m above ground level shall be locked with a key or shall require the use of a tool for access. In addition, basic protection shall be provided when the door is open either by the use of equipment having at least a degree of protection IPXXB or IP2X by construction or by installation, or by installing a barrier or an enclosure giving the same degree of protection.

For a luminaire at a height of less than 2.80 m above ground level, access to the light source shall only be possible after removing a barrier or an enclosure requiring the use of a tool.

##### 714.411.3.1 Protective earthing and protective equipotential bonding

###### 714.411.3.1.2 Protective equipotential bonding

A metallic structure (such as a fence, grid etc.), which is in the proximity of but is not part of the outdoor lighting installation need not be connected to the main earthing terminal.

###### 714.411.3.3 Additional protection

Lighting in places such as telephone kiosks, bus shelters, advertising panels and town plans shall be provided with additional protection by an RCD having the characteristics specified in Section 415.1.1.

## **714.5 Selection and erection of equipment**

### **714.51 Common rules**

#### **714.512 Operational conditions and external influences**

##### **714.512.2 External influences**

**714.512.2.1** The following classes are generally recommended:

- (i) Ambient temperature: AA2 and AA4 (from  $-40\text{ }^{\circ}\text{C}$  to  $+40\text{ }^{\circ}\text{C}$ )
- (ii) Climatic conditions: AB2 and AB4 (relative humidity between 5 % and 100 %).

**714.512.2.105** Electrical equipment shall have, by construction or by installation, a degree of protection of at least IP33.

##### **714.514.12 Notices**

**714.514.12.201** The requirements for notices for:

- (i) periodic inspection and testing (Section 514.12.1) and
- (ii) the testing of RCDs (Section 514.12.2)

need not be applied where the installation is subject to a programmed inspection and testing procedure.

**714.514.12.202** On every temporary supply unit there shall be an externally mounted durable label stating the maximum sustained current to be supplied from that unit.

##### **714.537 Isolation and switching**

###### **714.537.2 Devices for isolation**

###### **714.537.2.1 General**

**714.537.2.1.1** Every circuit shall be capable of being isolated individually from each of the live supply conductors, except as detailed in Section 461.2.

**714.537.2.1.201** Where it is intended that isolation and switching is carried out only by instructed persons and subject to suitable provisions being made so that precautions can be taken to prevent any equipment from being inadvertently or unintentionally energized, for TN systems, the means of switching the supply on load and the means of isolation is permitted to be provided by a suitably rated fuse carrier.

**714.537.2.1.202** Where the distributor's cut-out is used as the means of isolation of a highway power supply the approval of the distributor shall be obtained.

## SECTION 715: EXTRA-LOW VOLTAGE LIGHTING INSTALLATIONS

### 715.1 Scope

This section applies to extra-low voltage lighting installations supplied from a source with a maximum rated voltage of 50 V AC or 120 V DC.

### 715.4 Protection for safety

#### 715.41 Protection against electric shock

##### 715.411.7.201 Functional extra-low voltage (FELV)

FELV shall not be used.

##### 715.414 Protective measure: Extra-low voltage provided by SELV or PELV

An extra-low voltage luminaire without provision for the connection of a protective conductor shall be installed only as part of a SELV system. Where bare conductors are used, the nominal voltage shall not exceed 25 V AC or 60 V DC according to Section 414.4.5.

A safety isolating transformer for an extra-low voltage lighting installation shall comply with KS IEC 61558-2-6 and shall meet at least one of the requirements of Section 715.422.106.

**NOTE 1:** For an explanation of symbols used see Table 55.3.

Parallel operation of transformers in the secondary circuit is allowed only if they are also paralleled in the primary circuit and the transformers have identical electrical characteristics.

An electronic convertor for an extra-low voltage lighting installation shall comply with IEC 61347-2-2, Annex 1 for incandescent lamps or IEC 61347-2-13, Annex 1 for LEDs.

**NOTE 2:** For an explanation of symbols used see Table 55.3.

Parallel operation of convertors to IEC 61347-2-2 or IEC 61347-2-13 is not permitted.

### 715.42 Protection against thermal effects

#### 715.422.106 Fire risk of transformers

Transformers shall be either:

- (i) protected on the primary side by a protective device complying with the requirements of Section 715.422.107.2, or
- (ii) short-circuit proof (both inherently and non-inherently).

**NOTE:** For an explanation of symbols used see Table 55.3.

#### 715.422.107 Fire risk due to short-circuit

Where both the live circuit conductors are uninsulated, either:

- (i) they shall be provided with a protective device complying with the requirements of Section 715.422.107.2, or
- (ii) they shall be supplied from a transformer or convertor, the power of which does not exceed 200 VA, or
- (iii) the system shall comply with KS IEC 60598-2-23.

A device providing protection against the risk of fire shall meet all the following requirements:

- (i) The device shall continuously monitor the power demand of the luminaires
- (ii) The device shall automatically disconnect the supply circuit within 0.3 s in the case of a short-circuit or failure which causes a power increase of more than 60 W
- (iii) The device shall provide automatic disconnection while the supply circuit is operating with reduced power (for example, by gating control or a regulating process or a lamp failure) if there is a failure which causes a power increase of more than 60 W
- (iv) The device shall provide automatic disconnection upon connection of the supply circuit if there is a failure which causes a power increase of more than 60 W
- (v) The device shall be fail-safe.

**NOTE:** Account needs to be taken of starting currents.

## **715.43 Protection against overcurrent**

### **715.430.104 Self-resetting overcurrent protective devices**

The use of self-resetting overcurrent protective devices is permitted only for transformers up to 50 VA.

## **715.5 Selection and erection of equipment**

### **715.52 Wiring systems**

#### **715.521 Types of wiring system**

**715.521.1** The following wiring systems shall be used:

- (i) Insulated conductors in conduit systems according to KS IEC 61386 series or cable trunking/ducting systems according to IEC 61084-2 series
- (ii) Rigid cables
- (iii) Flexible cables
- (iv) Systems for ELV lighting according to KS IEC 60598-2-23
- (v) Track systems according to IEC 60570
- (vi) Bare conductors (see Section 715.521.106).

Where parts of the ELV lighting installation are accessible, the requirements of Section 423 also apply.

Metallic structural parts of buildings, for example pipe systems, or parts of furniture, shall not be used as live conductors.

#### **715.521.106 Bare conductors**

If the nominal voltage does not exceed 25 V AC or 60 V DC, bare conductors may be used provided that the extra-low voltage lighting installation complies with all the following requirements:

- (i) The lighting installation shall be designed, and installed or enclosed in such a way that the risk of a short-circuit is reduced to a minimum
- (ii) The conductors used shall have a cross-sectional area according to Section 715.524
- (iii) The conductors shall not be placed directly on combustible material.

For suspended bare conductors, at least one conductor and its terminals shall be insulated for that part of the circuit between the transformer and the short-circuit protective device to prevent a short-circuit.

#### **715.521.107 Suspended systems**

Suspension devices for extra-low voltage luminaires, including supporting conductors, shall be capable of carrying five times the mass of the luminaires (including their lamps) intended to be supported, but not less than 5 kg.

Terminations and connections of conductors shall be made by screw terminals or screwless clamping devices complying with KS IEC 60998-2-1 or IEC 60998-2-2.

Safety of the installation due to expected stresses in the conductors shall be in accordance with Section 559.5.2.

Insulation piercing connectors and termination wires which rely on counterweights hung over suspended conductors to maintain the electrical connection shall not be used.

The suspended system shall be fixed to walls or ceilings by insulated distance cleats and shall be continuously accessible throughout the route.

#### **715.524 Cross-sectional area of conductors**

**715.524.201** The minimum cross-sectional area of the ELV conductors for connection to the output terminals or terminations of transformers/convertors shall be chosen according to the load current.

In the case of systems with luminaires suspended from the conductors, the minimum cross-sectional area of the ELV conductors for connection to the output terminals or terminations of transformers/convertors shall be 4 mm<sup>2</sup>, for mechanical reasons.

## **715.525 Voltage drop in consumers' installations**

In ELV lighting installations, if the voltage drop between the transformer and the furthest luminaire does not exceed 5 % of the nominal voltage of the ELV installation it shall be deemed to comply with Section 525.

## **715.53 Protection, isolation, switching, control and monitoring**

### **715.530.3 General and common requirements**

#### **715.530.3.104 Protective devices and SELV sources**

Protective devices may be located above false ceilings, which are removable or easily accessible, provided that information is given about the presence and location of such devices.

SELV sources, protective devices or similar equipment mounted above false ceilings or in a similar place shall be permanently connected.

SELV sources and their protective devices shall be installed so as to:

- (i) avoid mechanical stress on their electrical connections, and
- (ii) be adequately supported, and
- (iii) avoid overheating of the equipment due to thermal insulation.

#### **715.537 Isolation and switching**

**715.537.1.1** Where transformers are operated in parallel, the primary circuits shall be permanently connected to a common isolating device.

PUBLIC REVIEW DRAFT MARCH 2026

## SECTION 717: MOBILE OR TRANSPORTABLE UNITS

### 717.1 Scope

The particular requirements of this section apply to AC and DC installations for mobile or transportable units.

For the purposes of this section, the term 'unit' is intended to mean a vehicle and/or mobile or transportable structure in which all or part of an electrical installation is contained.

Units are either:

- (i) of the mobile type, e.g. vehicles (self-propelled or towed), or
- (ii) of the transportable type, e.g. containers or cabins.

Examples of the units include technical and facilities vehicles for the entertainment industry, medical or health screening services, welfare units, promotion & demonstration, firefighting, workshops, offices, transportable catering units etc.

The requirements are not applicable to:

- (iii) generating sets
- (iv) marinas and pleasure craft
- (v) mobile machinery in accordance with KS IEC 60204-1
- (vi) caravans to Section 721
- (vii) traction equipment of electric vehicles
- (viii) electrical equipment required by a vehicle to allow it to be driven safely or used on the highway.

Additional requirements shall be applied where necessary for units including showers, or for medical locations, etc.

### 717.132 Design

The design of the installation within a mobile or transportable unit shall take into account the characteristics of the variety of supplies to which the unit might be connected and any limitation shall be clearly stated in the user documentation. See also Section 717.514.

### 717.313 Supplies

One or more of the following methods shall be used to supply a unit:

- (i) Connection to a low voltage generating set, located inside the unit, in accordance with Section 551 (see Figure 717.1)
- (ii) Connection to a low voltage electrical supply external to the unit, in which the protective measures are effective (see Figure 717.3), the supply derived from either a fixed electrical installation or a generating set in accordance with Section 551
- (iii) Connection to a low voltage electrical supply external to the unit, and where internal protective measures are provided by the use of simple separation, in accordance with Section 413 (see Figures 717.4, 717.5, 717.6 and 717.7 showing alternative forms of fault protection within the unit).

**NOTE 1:** In cases (i), (ii) and (iii), an earth electrode may be provided where supplies are used external to the vehicle (see Section 717.411.4).

**NOTE 2:** In the case of Figure 717.4, an earth electrode may be necessary for protective purposes (see Section 717.411.6.2(ii)).

**NOTE 3:** Simple separation or electrical separation is appropriate, for example, where information technology equipment is used in the unit or where a reduction of electromagnetic disturbances is necessary, or if high protective conductor currents are to be expected (use of frequency convertors), and/or if the supply to the unit comes from alternative supply systems (as is the case in disaster management).

The sources, means of connection or separation may be within the unit.

**NOTE 4:** Where there is a potential hazard due to moving the unit whilst connected to an external installation, it is recommended that the unit is equipped with an electrical interlock, warning, alarm or other appropriate means to reduce the risk.

**NOTE 5:** For the purpose of this section, power inverters or frequency convertors supplied from the unit's electrical system or an auxiliary system driven by the unit's prime mover are also considered as generating sets.

Power inverters or frequency convertors shall include electrical separation where both the DC supply and the AC neutral point are earthed.

## **717.4 Protection for safety**

### **717.41 Protection against electric shock**

#### **717.410.3 General requirements**

**717.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**717.410.3.6** The protective measure of non-conducting location (Section 418.1) shall not be used. The protective measure of earth-free local equipotential bonding (Section 418.2) is not recommended.

#### **717.411 Protective measure: Automatic disconnection of supply**

##### **717.411.1 General**

For a supply in accordance with 717.313(ii), automatic disconnection of supply shall be provided by means of a residual current protective device, with a rated residual operating current not exceeding 30 mA.

##### **717.411.3.1.2 Protective equipotential bonding**

Accessible conductive parts of the unit, such as the conductive structure of the unit, shall be connected through the main protective bonding conductors to the main earthing terminal within the unit. The main protective bonding conductors shall be finely stranded.

**NOTE:** Cable types H05V-K and H07V-K to IEC 60502-2-31 are considered appropriate.

##### **717.411.4 TN system**

A PME earthing facility shall not be used as the means of earthing for an installation falling within the scope of this section except where:

- (i) the installation is continuously under the supervision of a skilled or instructed person(s), competent in such work, and
- (ii) the suitability and effectiveness of the means of earthing has been confirmed before the connection is made.

##### **717.411.6 IT system**

**717.411.6.2** An IT system can be provided by:

- (i) an isolating transformer or a low voltage generating set, with an insulation monitoring device or an insulation fault location system, both without automatic disconnection of the supply in case of the first fault and without a need of connection to an earthing installation (see Figure 717.7); the second fault shall be automatically disconnected by overcurrent protective devices according to Section 411.6.5, or
- (ii) a transformer providing simple separation, e.g. in accordance with KS IEC 61558-1, with an RCD and an earth electrode installed to provide automatic disconnection in the case of failure in the transformer providing the simple separation (see Figure 717.4)

#### **717.413 Protective measure: Electrical separation**

Electrical separation can be provided by the use of a transformer providing simple separation, e.g. meeting the requirements of KS IEC 61558-1, in accordance with Section 413.1.3. It shall be used only where:

- (i) an insulation monitoring device is installed to provide automatic disconnection of supply in the case of a first fault between live parts and the conductive structure of the unit (see Figure 717.5), or
- (ii) an RCD and an earth electrode are installed to provide automatic disconnection in the case of failure in the transformer providing the electrical separation (see Figure 717.4). Each socket-outlet intended to supply current-using equipment outside the unit shall be protected individually by an RCD having the characteristics specified in Section 415.1.1.

#### **717.415 Additional protection**

**717.415.1** Additional protection by an RCD having the characteristics specified in Section 415.1.1, shall be provided for every socket-outlet intended to supply current-using equipment outside the unit, with the exception of socket-outlets which are supplied from circuits with protection by:

- (i) SELV, or
- (ii) PELV, or
- (iii) electrical separation, with an insulation monitoring device; see Section 717.413(i).

## **717.5 Selection and erection of equipment**

### **717.51 Common requirements**

#### **717.514 Identification and notices**

A permanent notice of such durable material as to be likely to remain easily legible throughout the life of the installation, shall be fixed to the unit in a prominent position, preferably adjacent to each supply inlet connector. The notice should state in clear and unambiguous terms the following:

- (i) The types of supply which may be connected to the unit and any limitations on use imposed by the designer
- (ii) The voltage rating of the unit
- (iii) The number of supplies, phases and their configuration
- (iv) The on-board earthing arrangement
- (v) The maximum power requirement of the unit.

#### **717.52 Wiring systems**

**717.52.1** Where the supply to the mobile or transportable unit is provided by means of a plug and socket-outlet, flexible cables in accordance with H07RN-F (IEC 60502-2-21), or cables of equivalent design, having a minimum cross-sectional area of 2.5 mm<sup>2</sup> copper, shall be used for connecting the unit to the supply. The flexible cable shall enter the unit by an insulating inlet in such a way as to minimize the possibility of any insulation damage or fault which might energize the exposed-conductive-parts of the unit.

**717.52.2** The wiring system shall be installed using one or more of the following:

- (i) Unsheathed flexible cable with thermoplastic or thermosetting insulation to IEC 60502-2-31, -3-31 or IEC 60502-3-41 installed in conduit in accordance with the appropriate part of KS IEC 61386series or in trunking or ducting in accordance with the appropriate part of IEC 61084-2 series
- (ii) Sheathed flexible cable with thermoplastic or thermosetting insulation to IEC 60502-2-11, -2-21, -3-11 or -3-21, if precautionary measures are taken such that no mechanical damage is likely to occur due to any sharp-edged parts or abrasion.

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

Conduits shall comply with KS IEC 61386-21, KS IEC 61386-22 or KS IEC 61386-

23.

#### **717.528.3 Proximity to non-electrical services**

**717.528.3.4** No electrical equipment, including wiring systems, except ELV equipment for gas supply control, shall be installed in any gas cylinder storage compartment.

ELV cables and electrical equipment may only be installed within the LPG cylinder compartment if the installation serves the operation of the gas cylinder (e.g. indication of empty gas cylinder) or is for use within the 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, they shall be protected against mechanical damage by installation within a conduit system complying with the appropriate part of the KS IEC 61386series or within a ducting system complying with the appropriate part of the IEC 61084-2 series.

Where installed, this conduit or ducting system shall be able to withstand an impact equivalent to AG3 without visible physical damage.

### **717.55 Other equipment**

**717.55.1** Where the means of connection is a plug and socket-outlet, mounted, accessed or used outside the unit and used to connect the unit to the supply, or supply other equipment, it shall comply with the appropriate parts of KS IEC 60309-2 series and shall meet with the following requirements:

- (i) Plugs shall have an enclosure of insulating material
- (ii) Connecting devices, plugs and socket-outlets, with an enclosure as necessary, shall afford a degree of

protection of at least IP44 when in use or connected and protection of at least IP55 when not connected, e.g. when the unit is in transit

(iii) The inlet (with 'male' contacts) shall be situated on the unit.

**717.55.2** *Not used*

**717.55.3** Generating sets able to produce voltages other than SELV or PELV, mounted in a mobile unit, shall automatically be switched off in case of an accident to the unit (e.g. event causing the release of airbags). If this requirement is difficult to implement an emergency switch, easily accessible, shall be installed.

**717.551.6 Additional requirements for installations where the generating set provides a supply as a switched alternative to the normal supply to the installation**

Live conductors from different power supplies shall not be interconnected.

Protective conductors, including functional earthing conductors, from different earthing systems shall only be interconnected where suitable precautions have been taken into account; see also Section 542.1.3.3.

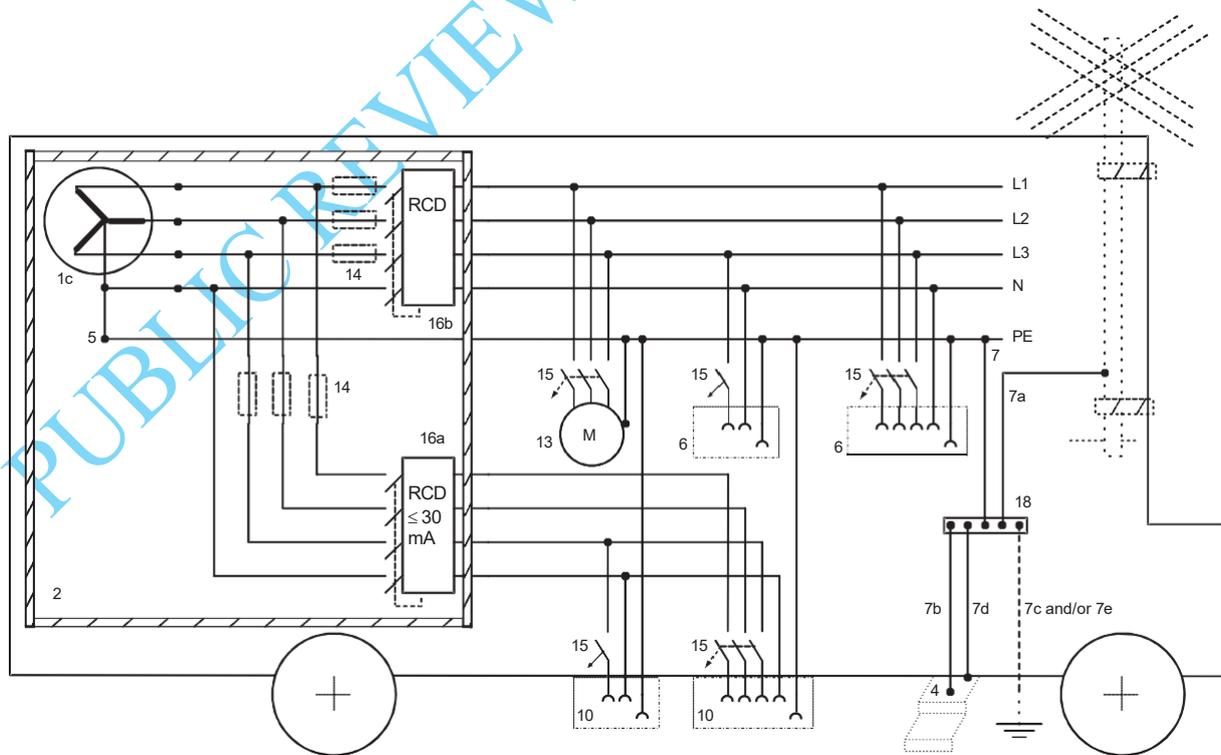
Plugs and socket-outlets shall comply with the appropriate parts of KS IEC 60309 series, except those intended for special equipment, such as broadcasting equipment where combined connectors for information signals and power supply are used.

**717.551.7.2 Additional requirements for installations where the generating set may operate in parallel with other sources including systems for distribution of electricity to the public**

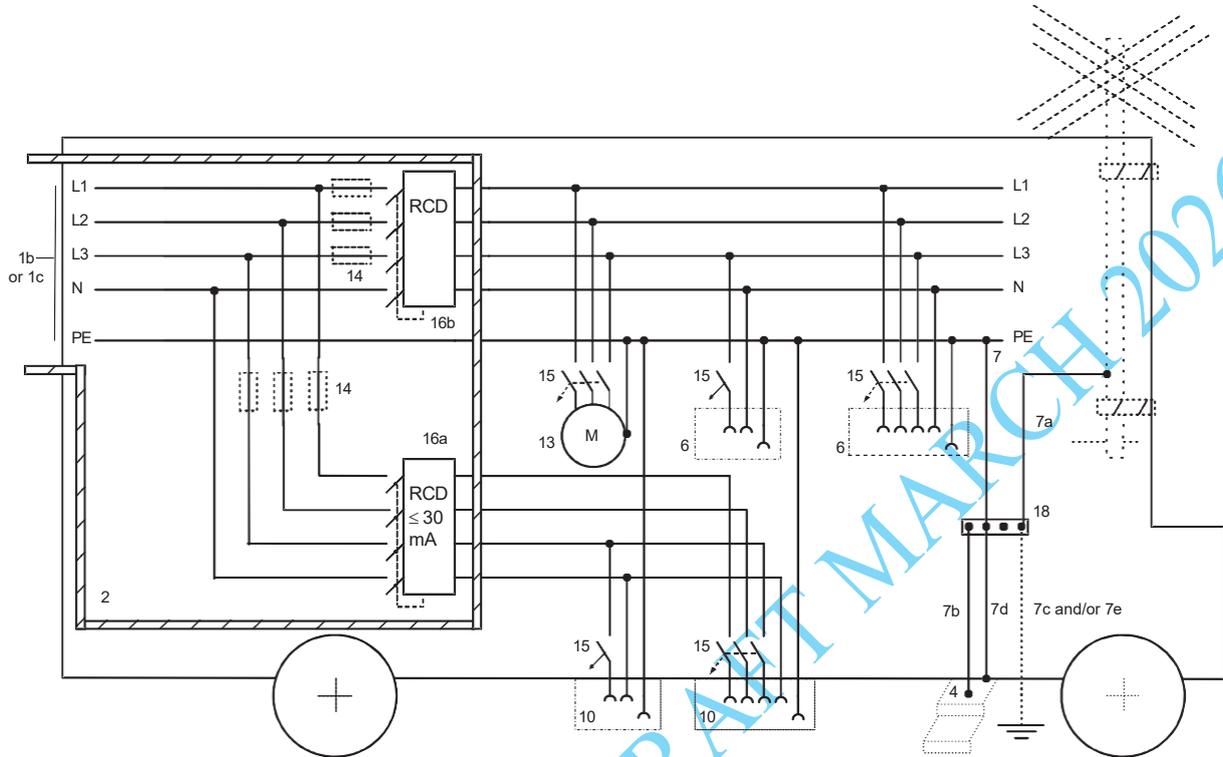
A generating set used as an additional source of supply in parallel with another source shall only be connected on the supply side of all the protective devices for the final circuits of the installation.

Protective conductors, including functional earthing conductors, from different earthing systems shall only be interconnected where suitable precautions have been taken into account; see also Section 542.1.3.3.

**Fig 717.1 – An example of a connection to a low voltage generating set located inside the unit, with or without an earth electrode**

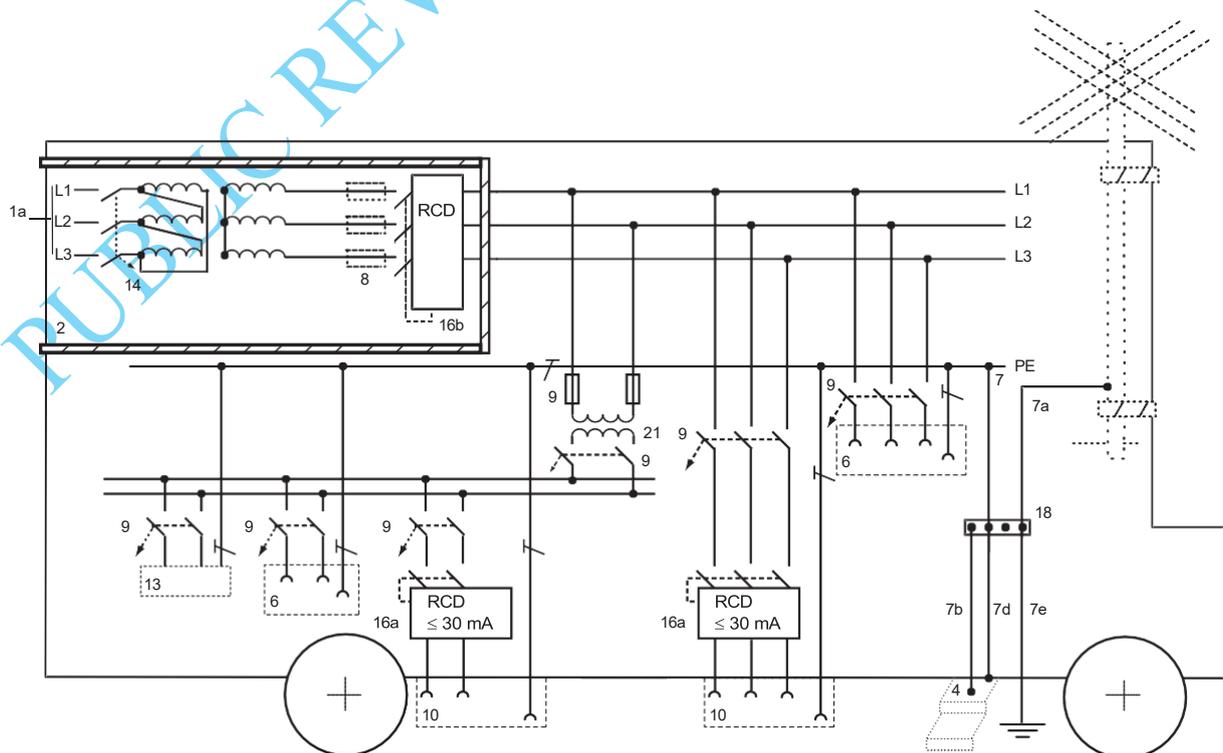


**Fig 717.3 – An example of a connection to a low voltage electrical supply external to the unit in which the protective measures are effective, the supply derived from either a fixed electrical installation or a generating set, with or without an earth electrode at the unit**

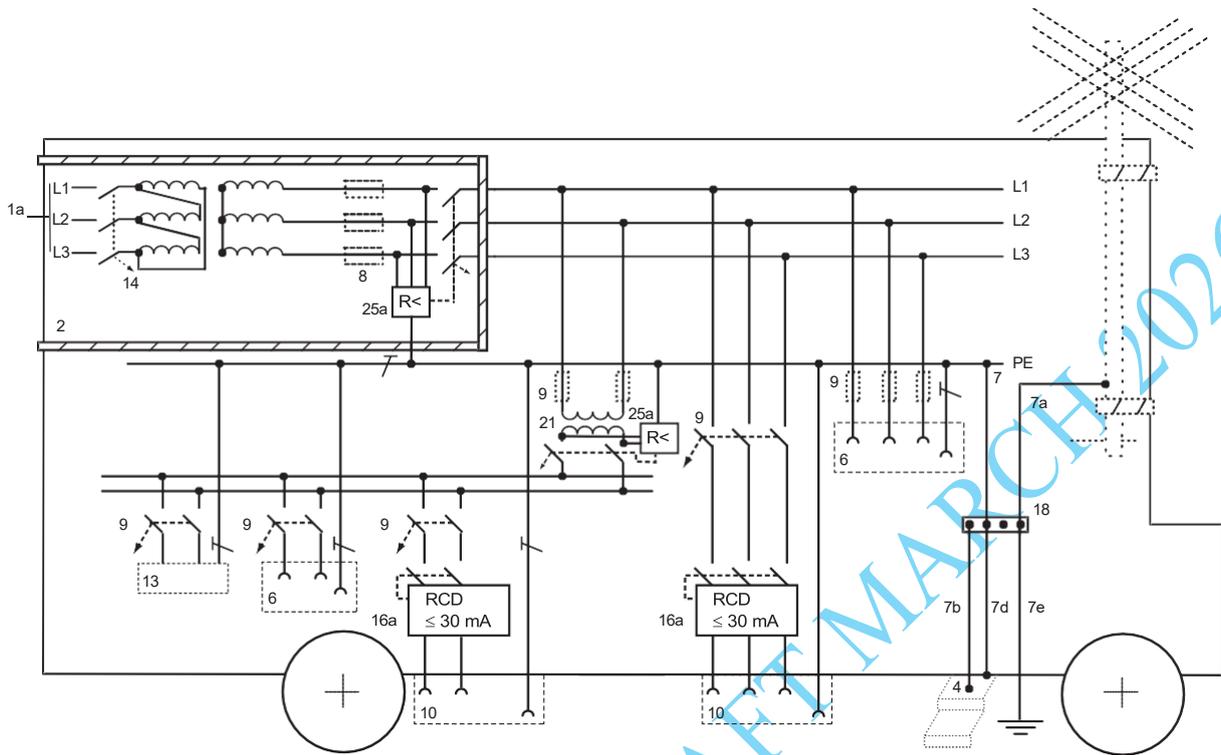


**NOTE:** Where a PME earthing facility is used, see Section 717.411.4.

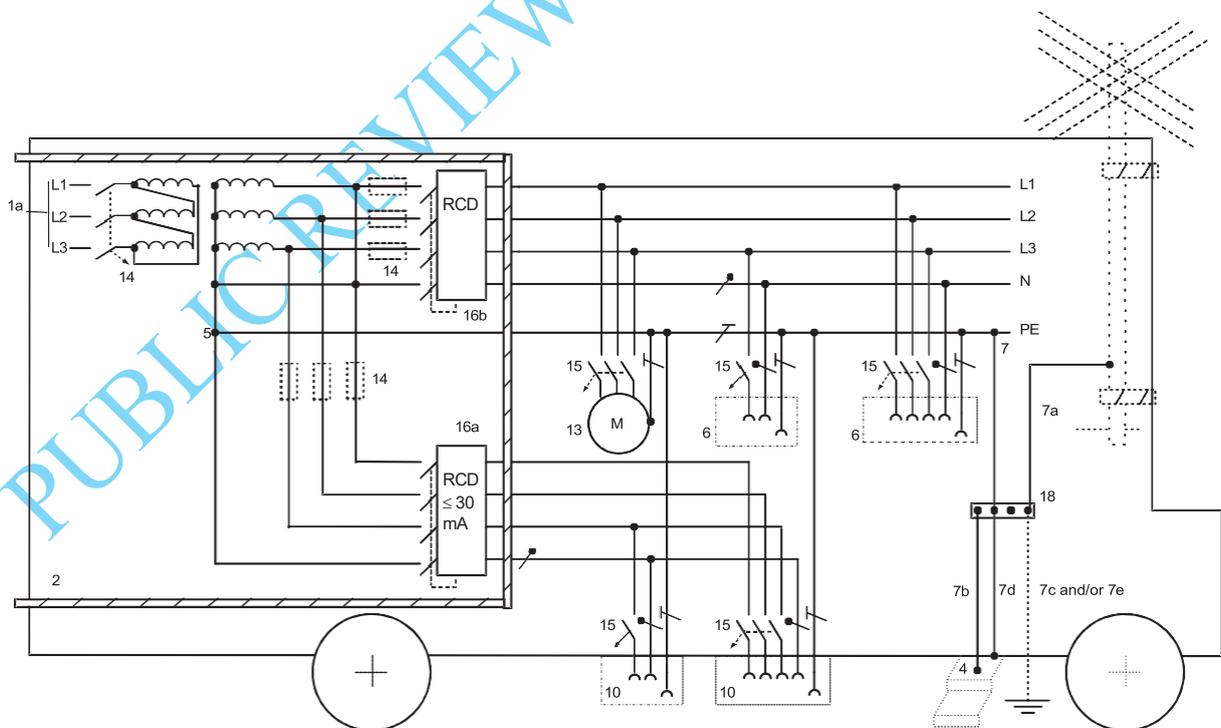
**Fig 717.4 – An example of a connection to a low voltage electrical supply external to the unit, derived from either a fixed electrical installation or a generating set with any type of earthing arrangement using simple separation and an internal IT system, with an earth electrode**



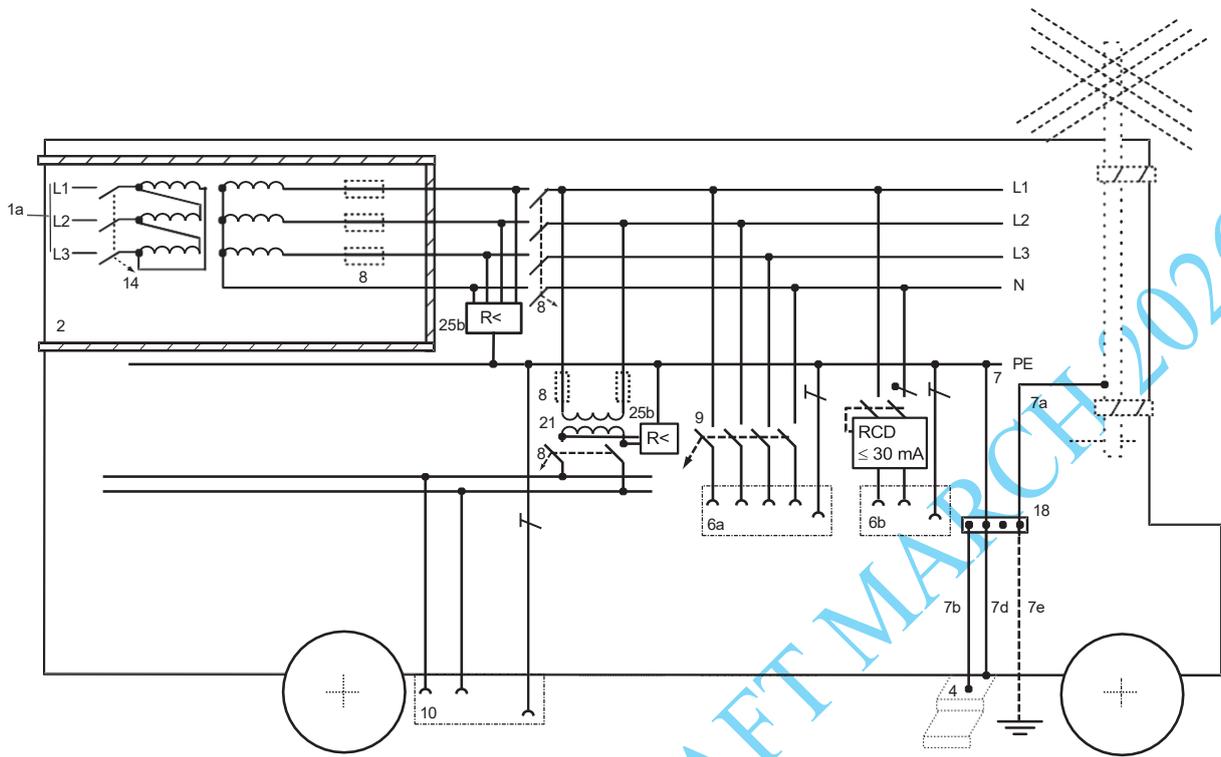
**Fig 717.5 – An example of a connection to a low voltage electrical supply external to the unit, using simple separation and an internal IT system with an insulation monitoring device and automatic disconnection of supply on the occurrence of a first fault, with earth electrode**



**Fig 717.6 – An example of a connection to a low voltage electrical supply external to the unit, with any type of earthing arrangement using an internal TN system with simple separation**



**Fig 717.7 – An example of a connection to a low voltage electrical supply external to the unit, with any type of earthing arrangement using simple separation with an internal IT system with automatic disconnection on the occurrence of a second fault**



## Key to Figures 717.1 to 7

- 1a** Connection of the unit to an external supply through an on board transformer with simple separation
- 1b** Connection of the unit to a supply in which the protective measures are effective
- 1c** Connection to an LV generator set in accordance with Section 551
- 2** Class II or equivalent enclosure up to the first protective device providing automatic disconnection of supply
- 4** Conductive external staircase, if any
- 5** Connection of the neutral point (or, if not available, a line conductor) to the conductive structure of the unit
- 6** Socket-outlets for use exclusively within the unit
- 6a** Socket-outlets for use exclusively within the unit for reasons of continuity of supply in the event of first fault
- 6b** Socket-outlets for general use if explicitly required (operation of the RCD in the event of first fault cannot be excluded)
- 7** Protective equipotential bonding in accordance with Section 717.411.3.1.2
- 7a** to an antenna pole, if any
- 7b** to the conductive external stairs, if any, in contact with the ground
- 7c** to a functional earth electrode, if required
- 7d** to the conductive structure of the unit
- 7e** to an earth electrode for protective purposes, if required
- 8** Protective devices, if required, for overcurrent and/or for protection by disconnection of supply in case of a second fault
- 9** Protective devices for overcurrent and for automatic disconnection of supply in case of a second fault
- 10** Socket-outlets for current-using equipment for use outside the unit
- 13** Current-using equipment for use exclusively within the unit
- 14** Overcurrent protective device, if required
- 15** Overcurrent protective device
- 16a** RCD having the characteristics specified in Section 415.1.1 for protection by automatic disconnection of supply for circuits of equipment for use outside the unit
- 16b** RCD for protection by automatic disconnection of supply for circuits of equipment for use inside the unit: see Sections 411.4.4 and 411.5.3. Where an internal IT system is installed, see also Section 411.6.4
- 18** Main earthing terminal or bar
- 21** Transformer with at least simple separation, e.g. 230 V current-using equipment
- 25a** Insulation monitoring device providing disconnection on the first fault, see Figure 717.5
- 25b** Insulation monitoring device or insulation fault location system including monitoring of the N conductor if distributed (disconnection only in the event of second fault), see Figure 717.7

## SECTION 721: ELECTRICAL INSTALLATIONS IN CARAVANS AND MOTOR CARAVANS

**NOTE:** In order not to mix requirements on different subjects, such as those for electrical installations of caravan parks with those for electrical installations inside caravans, refer to:

- Section 708, which concerns electrical installations in caravan parks, camping parks and similar locations and
- Section 721, which concerns electrical installations in caravans and motor caravans.

### 721.1 Scope

The particular requirements of this section apply to the electrical installations of caravans and motor caravans at nominal voltages not exceeding 230/400 V AC or 48 V DC.

They do 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, nor to installations covered by IEC 60364-7-721 and IEC 60364-7-721.

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

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

**NOTE 2:** For transportable units see Section 717.

For the purposes of this section, caravans and motor caravans are referred to as 'caravans'.

The particular requirements of some other sections of Part 7 may also apply to such installations in caravans, e.g. Section 701.

### 721.31 Purposes, supplies and structure

#### 721.313 Supplies

**721.313.1.2** The nominal supply system voltage shall be chosen from KS 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 General requirements

**721.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**721.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

#### 721.411 Protective measure: Automatic disconnection of supply

##### 721.411.3.1 Protective earthing and protective equipotential bonding

###### 721.411.3.1.2 Protective equipotential bonding

Structural metallic parts which are accessible from within the caravan 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 of 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 Section 414.

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

**NOTE:** The requirements of Section 721 are also applicable to extra low-voltage DC installations. See Annex A721 for recommendations that may be applied in addition.

### **721.415.1 Additional protection: RCDs**

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 KS IEC 60947-2 (Annex B), IEC 61008-1, IEC 61009-1 or IEC 62423 breaking all live conductors, shall be provided having the characteristics specified in 415.1.1.

Each supply inlet shall be directly connected to its associated RCD.

**NOTE:** This implies that there may not be any taps or junctions in this connection.

## **721.43 Protection against overcurrent**

### **721.43.1 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 the relevant requirements of the Sections.

### **721.514 Identification and notices**

#### **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:

- (i) a description of the installation
- (ii) a description of the function of the RCD(s) and the use of the test button(s)
- (iii) a description of the function of the main isolating switch
- (iv) the text of the instructions of Figure 721.

If it is necessary to take precautions during user maintenance, appropriate details shall be given.

**Fig 721 – Instructions for electricity supply**

**INSTRUCTIONS FOR ELECTRICITY SUPPLY**

**TO CONNECT**

1. Before connecting the caravan installation to the mains supply, check that:
  - (a) the supply available at the caravan pitch supply point is suitable for the caravan electrical installation and appliances, and
  - (b) the voltage, frequency and current ratings are suitable, and
  - (c) the caravan main switch is in the OFF position.Also, prior to use, examine the supply flexible cable to ensure there is no visible damage or deterioration.
2. Open the cover to the appliance inlet provided at the caravan supply point, if any, and insert the connector of the supply flexible cable.
3. Raise the cover of the electricity outlet provided on the pitch supply point and insert the plug of the supply cable.

**THE CARAVAN SUPPLY FLEXIBLE CABLE MUST BE FULLY UNCOILED TO AVOID DAMAGE BY OVERHEATING**
4. Switch on at the caravan main isolating switch.
5. Check the operation of residual current devices (RCDs) fitted in the caravan by pressing the test button(s) 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 OR THE OPERATOR'S AGENT OR A QUALIFIED ELECTRICIAN.**

**TO DISCONNECT**

6. Switch off at the caravan main isolating switch, unplug the cable first from the caravan pitch supply point and then from the caravan inlet connector.

**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 and a report on their condition obtained as prescribed in KS 662

## **721.521 Types of wiring system**

**721.521.2** The wiring systems shall be installed using one or more of the following:

- (i) Insulated single-core cables, with flexible class 5 conductors, in non-metallic conduit
- (ii) Insulated single-core cables, with stranded class 2 conductors (minimum of 7 strands), in non-metallic conduit
- (iii) Sheathed flexible cables.

All cables shall, as a minimum, meet the requirements of KS IEC 60332-1-

2. Non-metallic conduits shall comply with KS IEC 61386-21.

Cable management systems shall comply with KS IEC 61386.

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

### **Vibration (AH)**

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.

### **Other mechanical stresses (AJ)**

**721.522.8.1.3** All cables, unless enclosed in rigid conduit, and all 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<sup>2</sup>.

## **721.528 Proximity of wiring systems to other services**

### **721.528.1 Proximity to electrical services**

Cables of low voltage systems shall be run separately from the cables of extra-low voltage systems, in such a way, so far as is reasonably practicable, that there is no risk of physical contact between the two wiring systems.

### **721.528.2 Proximity to non-electrical services**

**721.528.2.1** No electrical equipment, including wiring systems, except ELV equipment for gas supply control, shall be installed in any gas cylinder storage compartment.

ELV cables and electrical equipment may only be installed within the LPG cylinder compartment if the installation serves the operation of the gas cylinder (e.g. indication of empty gas cylinder) or is for use within the 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, they shall pass through the compartment at a height of not less than 500 mm above the base of the cylinders and shall be protected against mechanical damage by installation within a conduit system complying with the appropriate part of the KS IEC 61386 series or within a ducting system complying with the appropriate part of the IEC 61084-2 series.

Where installed, this conduit or ducting system shall be able to withstand an impact equivalent to AG3 without visible physical damage.

## **721.53 Protection, isolation, switching, control and monitoring**

### **721.537 Isolation and switching**

#### **721.537.2 Devices for Isolation**

**721.537.2.1.1** Each installation shall be provided with a main disconnecter which shall disconnect all live conductors and which shall be suitably placed for ready operation within the caravan. In an installation consisting of only one final circuit, the isolating switch may be the overcurrent protective device fulfilling the requirements for isolation.

**721.537.2.1.1.1** A notice of such durable material as to be likely to remain easily legible throughout the life of the installation, shall be permanently fixed near the main isolating switch inside the caravan, bearing the text shown in Figure 721 in the appropriate language(s) in indelible and easily legible characters.

### **721.543 Protective conductors**

#### **721.543.2 Types of protective conductor**

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

#### **721.544.1 Protective bonding conductors**

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

## **721.55 Other equipment**

### **721.55.1 Inlets**

**721.55.1.1** Any AC electrical inlet on the caravan shall be an appliance inlet complying with KS IEC 60309-1. If interchangeability is required the inlet shall comply with KS IEC 60309-2.

**721.55.1.2** The inlet shall be installed:

- (i) not more than 1.8 m above ground level, and
- (ii) in a readily accessible position, and
- (iii) such that it shall have a minimum degree of protection of IP44 with or without a connector engaged, and
- (iv) such that it shall not protrude significantly beyond the body of the caravan.

**721.55.2 Accessories**

**721.55.2.1** *Not used*

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

**721.55.2.3** 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 IP44.

**721.55.2.4** 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 in motion.

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

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

**721.55.2.6** The means of connection to the caravan pitch socket-outlet shall be supplied with the caravan and shall comprise the following (see Figure 708):

- (i) A plug complying with KS IEC 60309-2, and
- (ii) a flexible cable of continuous length 25 m ( $\pm 2$  m), having a harmonized code designation of H05RN-F or H07RN-F (IEC 60502-2-21) or equivalent, incorporating a protective conductor, with conductors to be identified according to Table 51 and of a cross-sectional area in accordance with Table 721, and
- (iii) a connector, if any, compatible with the appliance inlet installed under Section 721.55.1.

**TABLE 721 – Minimum cross-sectional areas of flexible cables for caravan connection**

Rated current A	Minimum cross-sectional area mm <sup>2</sup>
16	2.5
25	4
32	6
63	16
100	35

## **ANNEX A721 (Informative)**

# **GUIDANCE FOR EXTRA-LOW VOLTAGE DC INSTALLATIONS**

**NOTE:** In general, the requirements of Section 721 are also applicable to an extra-low voltage DC installation. The following requirements should be applied in addition.

### **A721.31 Purposes, supplies and structure**

#### **A721.313 Supplies**

##### **A721.313.4 Sources of supply**

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

- (i) The electrical installation of the towing vehicle
- (ii) An auxiliary battery mounted in the caravan
- (iii) A low voltage DC supply via a transformer/rectifier unit complying with KS IEC 60335-1 and KS IEC 61558-2-6
- (iv) A DC generator that is driven by any form of energy
- (v) Solar photovoltaic (PV) power supply systems.

### **A721.514 Identification and notices**

#### **A721.514.1 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:

- (i) A warning worded as follows: 'Any replacement of an auxiliary battery should be of the same type and specification as that originally fitted'
- (ii) 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
- (iii) Instructions on selecting and installing an auxiliary battery, in a compartment, if the caravan installation is designed for the installation of an auxiliary battery
- (iv) Details of the warning notice specified in A721.55.3.7 and its importance for safety
- (v) In order to provide for 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
- (vi) Type of appliances that can be used and from what source of supply
- (vii) Instructions for the correct operation and maintenance of fitted appliances, as supplied by the appliance manufacturer
- (viii) 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.'

### **A721.515 Prevention of mutual detrimental influence**

**A721.515.2** The ELV installation should be so installed that the protective measures of the LV installation for basic protection or for fault protection are not impaired.

It should be verified that the protective conductors of the LV installation are not loaded by the operating currents of the ELV installation.

### **A721.521 Types of wiring system**

**A721.521.2** Cables should be of stranded construction and should comply with IEC 60227-3, IEC 60502-1 or an appropriate part of IEC 60502.

### **A721.523 Current-carrying capacities of cables**

**A721.523.1** The cross-sectional areas of the fixed wiring should be such that the permissible voltage drop is not exceeded.

## **A721.525 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 British or Harmonized Standard relevant to the equipment. Where the equipment is not the subject of a British or Harmonized 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 voltage drop between the plug of the connector to the towing vehicle or LV battery charger and the auxiliary battery should not exceed 0.3 V.

The charging current  $I_c$  (A) to determine the voltage drop is established by the following formula:

$$I_c = \frac{c \times 0.1}{t}$$

where:

$I_c$  is the charging current in A

$c$  is the battery capacity in Ah

$t$  is the charging period in h.

**NOTE:** Some battery manufacturers now rate batteries in Watt/hours (Wh).

## **A721.528 Proximity of wiring systems to other services**

### **A721.528.2 Proximity to non-electrical services**

#### **A721.528.2.5 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.

## **A721.53 Protection, isolation, switching, control and monitoring**

### **A721.533 Devices for protection against overcurrent**

#### **A721.533.1 General requirements**

**A721.533.1.5** The overcurrent protective device for the power supply from the towing vehicle should be fitted 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 installed as near as possible to the unit or generator and, in all cases, upstream of the distribution circuits.

**A721.533.1.6** Overcurrent protective devices should be either fuse links according to ISO8820 or suitable circuit-breakers complying with IEC 60898-2.

**A721.533.1.7** Fuses should be protected to prevent accidental damage.

**A721.533.1.8** Overcurrent protective devices should not be fitted in a fuel storage compartment or fuel storage housing intended for the storage of liquefied petroleum gas (LPG) cylinders or in the compartment for housing an auxiliary battery.

## A721.55 Other equipment

### A721.55.1 Inlets

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

### A721.55.2 Accessories

**A721.55.2.6** The means of connection to the towing vehicle should be supplied with the caravan and comprise the following:

- (i) A plug complying with ISO 11446, and
- (ii) a flexible cable with the number of cores with the minimum cross-sectional area and the allocation according to Table A721 and a length not exceeding 5 m, and
- (iii) a connector complying with ISO 11446.

**TABLE A721 – Functional allocation and cross-sectional areas of cores for caravan connectors**

Core No.	Function	Contact numbers-ISO 11446	Minimum-cross-sectional area mm <sup>2</sup>
1	Left-hand direction – indicator light	1	1.5
2	Rear fog light	2	1.5
3	Common return for core Nos. 1,2 and 4 to 8	3*	2.5
4	Right-hand direction – indicator light	4	1.5
5	Right-hand rear position and marker lights, and rear registration-plate illumination device	5	1.5
6	Stop lights	6	1.5
7	Left-hand rear position and marker lights, and rear registration-plate illumination device	7	1.5
8	Reversing light	8	1.5
9	Continuous power supply	9	2.5
10	Power supply controlled by ignition switch	10	2.5
11	Return for core No. 10	11*	2.5
12	Coding for coupled trailer	12	-
13	Return for core No. 9	13*	2.5
14	No allocation	-	1.5

### A721.55.3 Auxiliary batteries

#### A721.55.3.1 Type of battery

An auxiliary battery should be of the rechargeable type.

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

#### A721.55.3.2 Capacity

An auxiliary battery should have a minimum capacity of 40 Ah at 20 h discharge rate.

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

#### A721.55.3.3 Terminals

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

#### **A721.55.3.4 Location**

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

#### **A721.55.3.5 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 effect of acid-laden gases, either by:

- (i) installing a sealed auxiliary battery that incorporates an external ventilating kit that is taken to the exterior of the caravan, or
- (ii) 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
- (iii) 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 anticorrosive finish. If the compartment opens into the interior of the caravan, the lid should provide an air seal. The minimum free area of ventilation should be not less than 80 mm<sup>2</sup> at low level and not less than 80 mm<sup>2</sup> 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 (i), (ii) or (iii), 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'.

The requirements concerning the protection against corrosion and ventilation are not applicable if batteries with bound electrolytes are used.

Where 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.'

#### **A721.55.3.6 Auxiliary battery cables**

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

#### **A721.55.3.7 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'.

### **A721.55.4 Other sources of supply**

#### **A721.55.4.1 Generators and transformer/rectifier unit**

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 14 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 peak-to-peak.

#### **A721.55.4.2 Regenerative sources**

Regenerative energy sources, such as wind energy, solar energy etc., should be installed only for charging batteries.

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

## **A721.55.5 Charging of auxiliary battery and operation of refrigerator**

**A721.55.5.1** The circuit to charge an auxiliary battery should be separate from a circuit to operate a refrigerator.

**A721.55.5.2** The charging circuit for an auxiliary battery should be completed only when the ignition of the towing vehicle is switched on.

**A721.55.5.3** The 12 V heating facility of a refrigerator should be completed only when the ignition of the towing vehicle is switched on. This may be performed by a device built into the refrigerator.

## **A721.55.6 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 with a degree of protection of at least IP34 according to IEC 60529.

## **A721.55.7 Appliances**

### **A721.55.7.1 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 systems are allowed provided that AC and DC systems are segregated and interconnection is prevented.

### **A721.55.7.2 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 should be used that have terminals clearly marked '–' and '+', or that have two conductors, indicating polarity by colour or by identification tags or sleeves marked '–' or '+'. |

### **A721.55.8 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.

### **A721.55.9 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 amperes should be limited to 10 % of the capacity of the auxiliary battery in Ah at 20 h discharge rate. |

### **A721.55.10 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 at least IP34 according to IEC 60529.

## SECTION 722: ELECTRIC VEHICLE CHARGING INSTALLATIONS

**NOTE:** Definitions relating to Section 722 can be found in KS 662-2 under electric vehicle (EV), {722}.

### 722.1 Scope

The particular requirements of this section apply to circuits intended to supply electric vehicles for charging purposes.

The requirements of this section do not apply to electric vehicle charging points that:

- (i) employ inductive charging
- (ii) charge mobility scooters and similar vehicles of 10 A and less.

**NOTE:** Requirements for protection for safety when feeding back electricity from an electric vehicle into a private or public supply network are under consideration.

### 722.3 Assessment of general characteristics

#### 722.31 Purposes, supplies and structure

#### 722.311 Maximum demand and diversity

A dedicated final circuit shall be provided for the connection to electric vehicles. It shall be considered that in normal use each single charging point is used at its rated current. Where the final circuit supplies more than one charging point no diversity shall be allowed.

Diversity may be allowed for a dedicated distribution circuit supplying multiple electric vehicle charging points if load control is available.

#### 722.312 Conductor arrangement and system earthing

##### 722.312.2.1 TN systems

For a TN system, the final circuit supplying a charging point for electric vehicles shall not include a PEN conductor.

#### 722.4 Protection for safety

#### 722.41 Protection against electric shock

##### 722.410.3 General requirements

**722.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**722.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

##### 722.411.4 TN system

**722.411.4.1** A PME earthing facility shall not be used as the means of earthing for the protective conductor contact of a charging point located outdoors or that might reasonably be expected to be used to charge a vehicle located outdoors unless one of the following methods is used:

- (i) The charging point forms part of a three-phase installation that also supplies loads other than for electric vehicle charging and, because of the characteristics of the load of the installation, the maximum voltage between the main earthing terminal of the installation and Earth in the event of an open-circuit fault in the PEN conductor of the low voltage network supplying the installation does not exceed 70 V rms.

**NOTE 1:** Annex 722, item A722.2 gives some information relating to (i).

**NOTE 2:** See also Section 641.5 when undertaking alterations and additions.

- (ii) The main earthing terminal of the installation is connected to an installation earth electrode by a protective conductor complying with Section 544.1.1. The resistance of the earth electrode to Earth shall be such that the maximum voltage between the main earthing terminal of the installation and Earth in the event of an open-circuit fault in the PEN conductor of the low voltage network supplying the installation does not exceed 70 V rms.

**NOTE:** Annex 722, item A722.3 gives guidance on determining the maximum resistance required for the earth electrode in (ii).

- (iii) Protection against electric shock is provided by a device which disconnects the charging point from the live conductors of the supply and from protective earth in accordance with Section 543.3.3.101(ii) within 5 s in the event of the voltage between the circuit protective conductor and Earth exceeding 70 V rms. The device shall not operate if the voltage exceeds 70 V rms for less than 4 s. The device shall provide isolation. Closing or resetting of the device shall be by manual means only. Equivalent functionality could be included within the charging equipment.

Where buried in the ground, a protective conductor connecting to an earth electrode for the purposes of (ii) or (iii) shall have a cross-sectional area not less than that stated in Table 54.1.

## **722.413 Protective measure: Electrical separation**

**722.413.1.2** This protective measure shall be limited to the supply of one electric vehicle supplied from one unearthed source. The circuit shall be supplied through a fixed isolating transformer complying with IEC 61558-2-4.

## **722.5 Selection and erection of equipment**

### **722.51 Common rules**

#### **722.511 Compliance with standards**

**722.511.1** Where an EV charging point is built into a low voltage switchgear or controlgear assembly the requirements of the relevant part of IEC 61439 series shall apply.

**722.511.101 EV charging equipment shall comply with the appropriate parts of the KS IEC 61851 series.**

#### **722.512 Operational conditions and external influences**

##### **722.512.2 External influences**

###### **722.512.2.201 Presence of water (AD)**

Where installed outdoors, the equipment shall be selected with a degree of protection of at least IPX4 in accordance with IEC 60529 in order to protect against water splashes (AD4).

###### **722.512.2.202 Presence of solid foreign bodies (AE)**

Where installed outdoors, the equipment shall be selected with a degree of protection of at least IP4X in accordance with IEC 60529 to protect against the ingress of very small objects (AE3).

###### **722.512.2.203 Impact (AG)**

Equipment installed in public areas and car park sites shall be protected against mechanical damage (impact of medium severity AG2). Protection of the equipment shall be afforded by one or more of the following:

- the position or location shall be selected to avoid damage by any reasonably foreseeable impact
- local or general mechanical protection shall be provided
- equipment shall be installed that complies with a minimum degree of protection against external mechanical impact of IK07 in accordance with the requirements of IEC 62262.

## **722.531 Devices for fault protection by automatic disconnection of supply**

### **722.531.2 RCDs**

**722.531.2.101** Except for circuits using the protective measure of electrical separation, each charging point shall be protected by its own RCD of at least Type A, having a rated residual operating current not exceeding 30 mA.

Each charging point incorporating a socket-outlet or vehicle connector complying with the KS IEC 62196 series, protective measures against DC fault current shall be taken, except where provided by the EV charging equipment. The appropriate measures, for each connection point, shall be as follows:

- RCD Type B; or
- RCD Type A and appropriate equipment that provides disconnection of the supply in case of DC fault current above 6 mA.

RCDs shall comply with one of the following standards: IEC 61008-1, IEC 61009-1, KS IEC 60947-2 or IEC 62423.

**NOTE:** Requirements for the selection and erection of RCDs in the case of supplies using DC vehicle connectors according to the KS IEC 62196 series are under consideration.

**722.531.2.1.1** RCDs shall disconnect all live conductors.

### **722.533 Devices for protection against overcurrent**

**722.533.101** Each charging point shall be supplied individually by a final circuit protected by an overcurrent protective device complying with KS IEC 60947-2, KS IEC 60947-6-2 or IEC 61009-1 or with the relevant parts of the IEC 60898 series or the IEC 60269 series.

**NOTE:** The electric vehicle charging equipment may have multiple charging points.

### **722.537 Isolation and switching**

#### **722.537.4 Emergency switching off**

**722.537.4.101** Where emergency switching off is required, such devices shall be capable of breaking the full load current of the relevant parts of the installation and disconnect all live conductors, including the neutral conductor.

### **722.55 Other equipment**

#### **722.55.101 Socket-outlets and connectors**

**722.55.101.0.201.1** The use of socket-outlet complying with KS EAS 495 is prohibited. Each AC charging point shall incorporate:

- (i) one socket-outlet or connector complying with KS IEC 60309-2 which is interlocked and classified to clause 6.1.5 of KS IEC 60309-1 to prevent the socket contacts being live when accessible, or
- (ii) one socket-outlet or connector complying with KS IEC 60309-2 which is part of an interlocked self-contained product complying with KS IEC 60309-4 and classified to clauses 6.1.101 and 6.1.102 to prevent the socket contacts being live when accessible, or
- (iii) one Type 1 vehicle connector complying with KS IEC 62196-2 for use with mode 3 charging only, or
- (iv) one Type 2 socket-outlet or vehicle connector complying with KS IEC 62196-2 for use with mode 3 charging only, or
- (v) one Type 3 socket-outlet or vehicle connector complying with KS IEC 62196-2 for use with mode 3 charging only.

**NOTE:** Vehicle manufacturers' instructions should be followed when determining the type of socket-outlet to be installed.

**722.55.101.0.201.2** Each socket-outlet shall be installed in a distribution board in accordance with Section 722.51 or in its appropriate enclosure (e.g. flush or surface mounted socket-outlet box) and mounted in a fixed position.

Portable socket-outlets shall not be used but tethered vehicle connectors are allowed.

**722.55.101.3** One socket-outlet or vehicle connector shall supply only one electric vehicle.

**722.55.101.4** In EV charging modes 3 and 4, an electrical or mechanical system shall be provided to prevent the plugging/unplugging of the plug unless the socket-outlet or the vehicle connector has been switched off from the supply.

**722.55.101.5** The lowest part of any socket-outlet shall be placed at a height of 0.5 to 1.5 m from the ground.

**NOTE:** The requirements of the relevant National Building Sections should be adhered to in respect of socket-outlet heights.

#### **722.55.101.6 Precautions on supply of the fixed installation by the EV**

**NOTE:** Requirements for precautions on supply of the fixed installation by the EV are under consideration.

## ANNEX A722 (Informative) GUIDANCE FOR TN SYSTEMS WHERE PME CONDITIONS APPLY

**NOTE:** A list of the symbols used in this Annex is given in item A722.4.

### A722.1 Neutral current of a three-phase installation

Where the power factors of the currents in all three phases are similar and triple harmonics can be neglected, it may be assumed that the neutral current of a three-phase installation is given by:

$$I_m = \sqrt{[I_{L1} - 0.5(I_{L2} + I_{L3})]^2 + [0.866(I_{L2} - I_{L3})]^2}$$

**NOTE:** The maximum neutral current ( $I_m$ ) occurs under conditions of maximum imbalance, not necessarily maximum overall demand.

### A722.2 Load balance

Where triple harmonics can be neglected, condition (i) of Section 722.411.4.1 may be assumed to apply where the following condition is met.

$$\frac{I_m \times U_0}{I_{L1} + I_{L2} + I_{L3}} \leq 70$$

### A722.3 Earth electrode resistance

For the purposes of condition (ii) of Section 722.411.4.1, the sum of the resistances of the earth electrode and the protective conductor connecting it to the main earthing terminal must meet the following condition, as applicable.

For a single-phase installation:

$$R_{A\text{ ev}} \leq \frac{70 U_0}{I_{\text{inst}} (U_0 - 70)}$$

For a three-phase installation:

$$R_{A\text{ ev}} \leq \frac{70}{I_m - \frac{70}{U_0} \times (I_{L1} + I_{L2} + I_{L3})}$$

**NOTE:** The above three-phase formula for  $R_{A\text{ ev}}$  is valid only where  $I_m > \frac{70}{U_0} \times (I_{L1} + I_{L2} + I_{L3})$ . Where this is not the case, this indicates that condition (i) of Section 722.411.4.1 applies and that an earth electrode is not required for the purposes of condition (ii) of that section.

### A722.4 Symbols used in this Annex

$I_{\text{inst}}$	is the rms maximum demand current of a single-phase installation (in amperes), including that of the electric vehicle charging load and any other loads, determined in accordance with Section 311.1.
$I_m$	is the rms maximum neutral current of a three-phase installation (in amperes), including that of the electric vehicle charging load and any other loads, determined in accordance with Section 311.1.
$I_{L1}$ , $I_{L2}$ and $I_{L3}$	are the rms values of current (in amperes) in lines 1, 2 and 3, respectively, that were used when determining the value of $I_m$ .
$R_{A\text{ ev}}$	is the sum of the resistances of the earth electrode and the protective conductor connecting it to the main earthing terminal of the installation (in ohms), in item A722.3.
$U_0$	is the nominal AC rms line voltage to Earth.

**NOTE 1:** The above currents and voltage are magnitudes only; they are not phasors.

**NOTE 2:** In determining  $I_m$ ,  $I_{L1}$ ,  $I_{L2}$  and  $I_{L3}$ , allowance must be made for single-phase vehicles being charged from three-phase charging points.

## **SECTION 729: OPERATING AND MAINTENANCE GANGWAYS**

### **729.1 Scope**

The particular requirements of this section apply to basic protection and other aspects relating to the operation or maintenance of switchgear and controlgear within areas including gangways, where access is restricted to skilled or instructed person(s).

### **729.3 Assessment of general characteristics**

For restricted access areas the following apply:

- (i) They shall be clearly and visibly marked by appropriate signs
- (ii) They shall not provide access to unauthorised persons
- (iii) Doors provided for closed restricted access areas shall allow easy evacuation by opening without the use of a key, tool or any other device not being part of the opening mechanism.

### **729.513 Accessibility**

#### **729.513.2 Requirements for operating and maintenance gangways**

The width of gangways and access areas shall be adequate for work, operational access, emergency access, emergency evacuation and for transport of equipment.

Gangways shall permit at least a 90 degree opening of equipment doors or hinged panels (see also Annex A729).

PUBLIC REVIEW DRAFT MARCH 2026

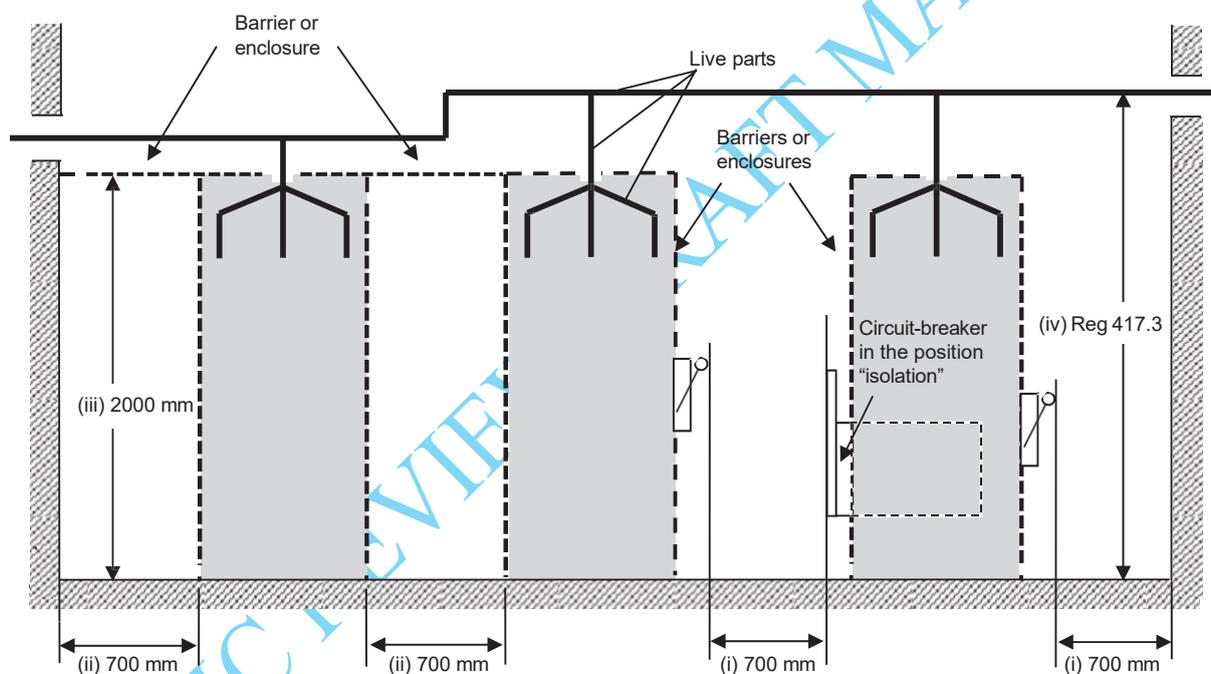
### 729.513.2.1 Restricted access areas where basic protection is provided by barriers or enclosures

Where basic protection is provided by barriers or enclosures in accordance with Chapter 41, the following minimum dimensions apply (see Figure 729.1):

(i)	Gangway width including between: barriers or enclosures and switch handles or circuit-breakers in the most onerous position, and barriers or enclosures or switch handles or circuit-breakers in the most onerous position and the wall	700 mm
(ii)	Gangway width between barriers or enclosures or other barriers or enclosures and the wall	700 mm
(iii)	Height of gangway to barrier or enclosure above floor	2000 mm
(iv)	Live parts placed out of reach, see Section 417.3	2500 mm

**NOTE:** Where additional workspace is needed e.g. for special switchgear and controlgear assemblies, larger dimensions may be required.

**Fig 729.1 – Gangways in installations with protection by barriers or enclosures**



**NOTE:** The above dimensions apply after barriers and enclosures have been fixed and with circuit-breakers and switch handles in the most onerous position, including "isolation".

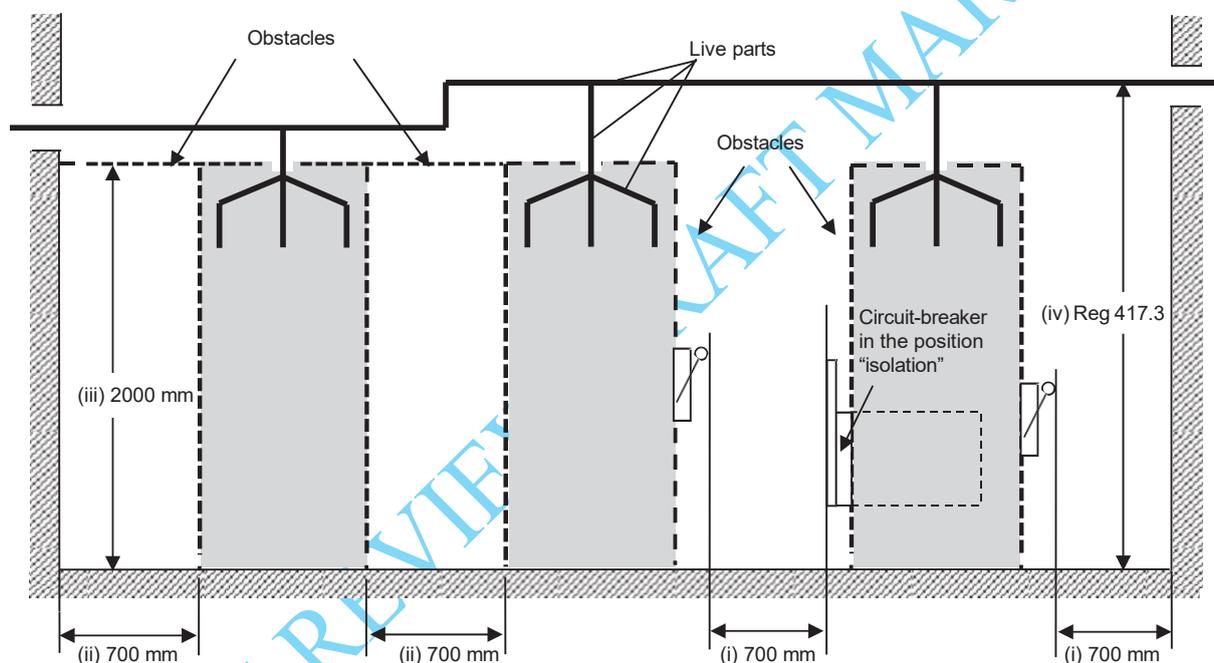
### 729.513.2.2 Restricted access areas where the protective measure of obstacles is applied

Where the protective measure of obstacles is used, the requirements of Section 417, Obstacles and placing out of reach, apply. The measure is for application in those parts of installations controlled or supervised by skilled persons.

The following minimum dimensions apply (see Figure 729.2):

(i)	Gangway width including between: obstacles and switch handles or circuit-breakers in the most onerous position, and obstacles or switch handles or circuit-breakers in the most onerous position and the wall.	700 mm
(ii)	Gangway width between obstacles or other obstacles and the wall	700 mm
(iii)	Height of gangway to obstacles above floor	2000 mm
(iv)	Live parts placed out of reach, see Section 417.3	2500 mm

Fig 729.2 – Gangways in installations with protection by obstacles



**NOTE:** The above dimensions apply after all obstacles have been fixed and with circuit-breakers and switch handles in the most onerous position, including “isolation”.

### 729.513.2.3 Access to gangways

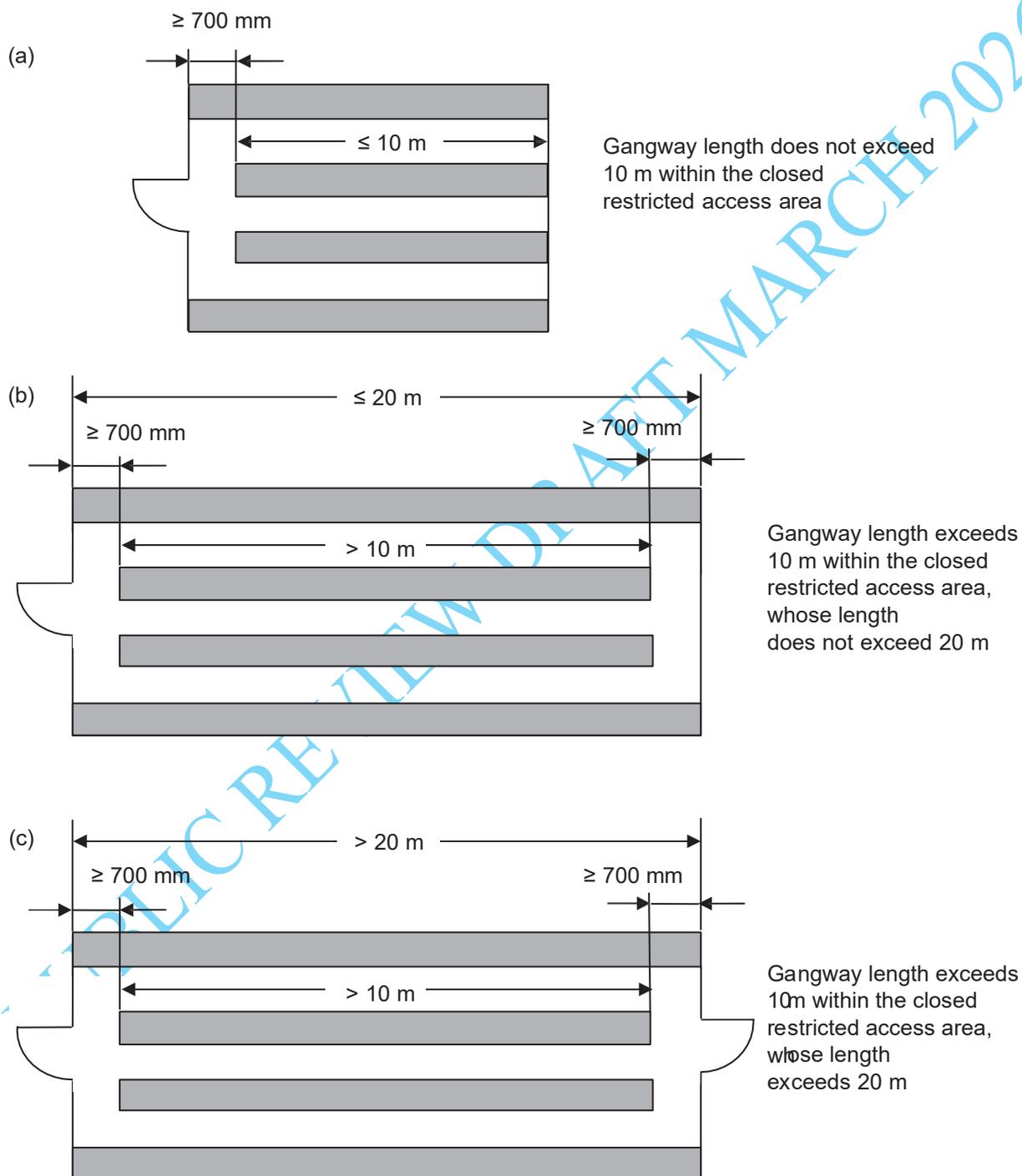
Gangways longer than 10 m shall be accessible from both ends.

**NOTE 1:** This may be accomplished by placement of the equipment a minimum of 700 mm from all walls (see Figure 729.3) or by providing an access door, if needed, on the wall against which the equipment is positioned.

Closed restricted access areas with a length exceeding 20 m shall be accessible by doors from both ends.

**NOTE 2:** For closed restricted access areas with a length exceeding 6 m, accessibility from both ends is recommended.

**Fig 729.3 – Examples of positioning of doors in closed restricted access areas**



Doors giving access to gangways shall open outwards (see Figure 729.3) and they shall have the following minimum dimensions:

- (i) width 700 mm
- (ii) height 2000 mm.

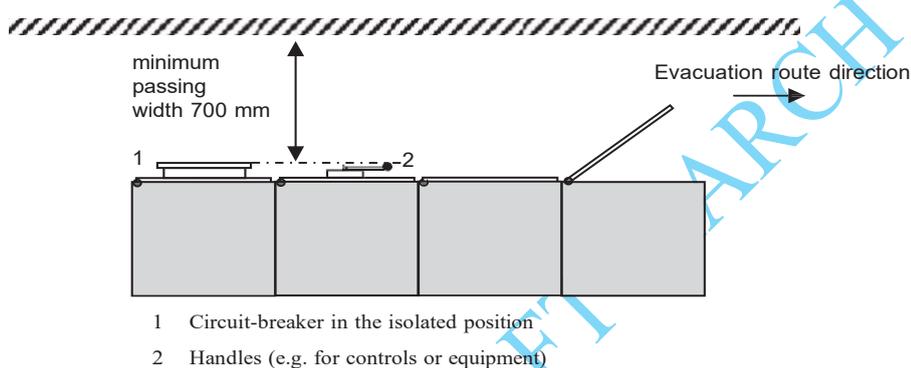
## ANNEX A729

### (Normative) ADDITIONAL REQUIREMENTS FOR CLOSED RESTRICTED ACCESS AREAS

#### A729.1 Evacuation

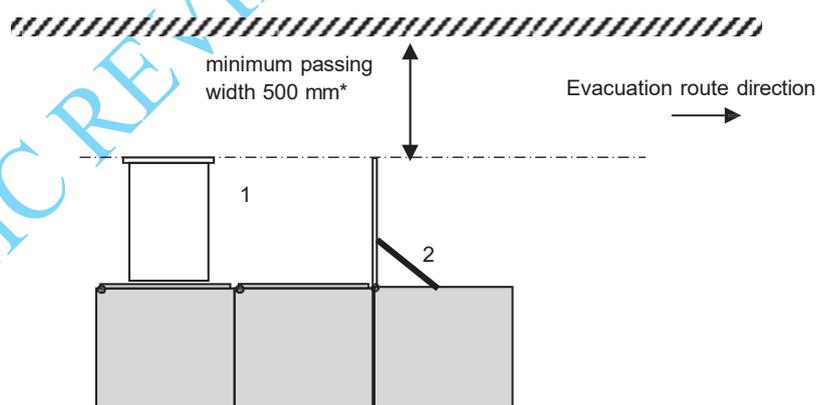
For reason of easy evacuation the doors of any equipment inside the location shall close in the direction of the evacuation route (see Figure A729.1). Gangways shall permit at least a 90 degree opening of equipment doors or hinged panels (see Figure A729.2).

Fig A729.1 – Minimum passing width in case of evacuation – Case 1



In the case of doors which can be fixed in the open position and circuit-breakers which are withdrawn fully for maintenance (completely extracted) a minimum distance of 500 mm shall be complied with between the door edge or circuit-breaker/ equipment edge and the opposite limitation of the gangway (see Figure A729.2).

Fig A729.2 – Minimum passing width in case of evacuation – Case 2



1 Circuit-breaker in the position “completely extracted”

2 Fixing device of a door

\* The minimum width gangway of 500 mm shall be taken into consideration between the wall and the circuit-breaker in the position “completely extracted” and equipment door in the 90 degree position.

## SECTION 730: ONSHORE UNITS OF ELECTRICAL SHORE CONNECTIONS FOR INLAND NAVIGATION VESSELS

### 730.1 Scope

The particular requirements of this section apply to onshore installations dedicated to the supply of inland navigation vessels for commercial and administrative purposes, berthed in ports and berths.

**NOTE 1:** For supplies to pleasure craft or houseboats in marinas and similar locations, see Section 709.

This section applies to installations with nominal supply voltages not exceeding 230 V AC single-phase and 400 V AC three-phase.

**NOTE 2:** Additional requirements that do not relate to electrical installation are given in IEC 60092-304 and IEC 60364-7-709.

The particular requirements do not apply to the onboard installations of inland navigation vessels including their connection cables. Additional requirements on the onboard installation are given in IEC 60721-3-3.

### 730.31 Purposes, supplies and structure

### 730.312 Conductor arrangement and system earthing

### 730.313 Supplies

**730.313.1.101** The nominal supply voltage shall be 400 V three-phase AC, 50 Hz.

**NOTE:** An arrangement diagram of an electrical shore connection is shown in IEC 60092-304, and an overview diagram of an electrical power-supply station with two connector units is shown in IEC 60364-7-709.

### 730.313.1.102 Galvanic separation

Where a fixed onshore isolating transformer is used to prevent galvanic currents circulating between the hull of the vessel and metallic parts on the shore side, equipment complying with IEC 61558-2-4 shall be used.

The protective conductor (PE) of the supply to the isolating transformer shall not be connected to the earth terminal in the socket-outlet supplying the inland navigation vessel.

### 730.4 Protection for safety

### 730.41 Protection against electric shock

**730.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**730.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

### 730.411.4 TN system

Connection of a PME earthing facility to any metalwork in a boat is prohibited.

This does not preclude the use of a PME earthing facility as the means of earthing for other purposes, such as to the installations of permanent buildings.

**NOTE:** The requirements of other sections of Part 7 may also apply.

### 730.5 Selection and erection of equipment

### 730.512 Operational conditions and external influences

### 730.512.2 External influences

### 730.512.2.101 Degree of protection

Equipment shall be selected with a minimum degree of protection of IP44.

## **730.521 Types of wiring system**

### **730.521.101 Wiring systems of berths, ports and floating landing stages**

#### **730.521.101.1 Berths and ports**

The following wiring systems and cables are suitable for distribution circuits in berths and ports:

- (i) underground cables
- (ii) overhead cables
- (iii) cables with copper conductors and thermoplastic or elastomeric insulation and installed within an appropriate cable management system taking into account external influences such as movement, impact, corrosion and ambient temperature
- (iv) mineral-insulated cables with thermoplastic protective covering
- (v) armoured cables with a thermoplastic or elastomeric covering.

Other cables and materials that are at least as suitable as those listed above may be used.

#### **730.521.101.2 Floating landing stages**

Wiring systems and cables shall be suitable for the movement of floating landing stages. The following wiring systems and cables are suitable for distribution circuits on floating landing stages:

- (i) cables with copper conductors and thermoplastic or elastomeric insulation and installed within an appropriate cable management system taking into account external influences such as movement, impact, corrosion and ambient temperature
- (ii) armoured cables with a thermoplastic or elastomeric covering.

Other cables and materials that are at least as suitable as those listed in (i) or (ii) may be used.

#### **730.521.101.3 Cables and cable management systems**

##### **730.521.101.3.1 General**

Cables and cable management systems shall be selected and installed so that mechanical damage due to tidal and other movement of floating structures is prevented.

Cable management systems shall be installed to allow the drainage of water/condensate, e.g. by sloping away and/or drainage holes.

##### **730.521.101.3.2 Underground cables**

Underground distribution circuits shall, unless provided with additional mechanical protection, be buried at a sufficient depth to avoid being damaged, e.g. by movement of vehicles.

**NOTE 1:** A depth of 0.6 m is generally considered as a minimum depth to fulfil this requirement.

**NOTE 2:** For conduit systems buried underground, see KS IEC 61386-24.

##### **730.521.101.3.3 Overhead cables**

Overhead cables shall not be used over waterways.

Poles and other supports for overhead wiring shall be located or protected so that they are unlikely to be damaged by any foreseeable movement of vehicles.

Overhead cables shall be at a height above ground of not less than 6 m in all areas subjected to movement of vehicles and 3.5 m in all other areas.

Any overhead conductors shall be insulated.

## **730.53 Protection, isolation, switching, control and monitoring**

### **730.531 Devices for protection against electric shock by automatic disconnection of supply**

#### **730.531.3 Residual current protective devices (RCDs)**

Socket-outlets with a rated current not exceeding 63 A shall be individually protected by an RCD providing additional protection in accordance with Section 415.1 having a rated residual operating current not exceeding 30 mA.

The RCD selected shall disconnect all live conductors, i.e. line and neutral.

Socket-outlets with a rated current exceeding 63 A shall be individually protected by an RCD having a rated residual operating current not exceeding 300 mA. The RCD selected shall disconnect all live conductors, i.e. line and neutral.

**NOTE:** The purpose of these RCDs is to protect the shore supply and the flexible cable. It is not intended to provide protection for onboard circuits, which are outside the scope of this section.

### **730.533 Devices for protection against overcurrent**

Socket-outlets shall be individually protected by an overcurrent protective device.

### **730.537 Isolation and switching**

#### **Devices for isolation**

At least one means of isolation shall be installed for each distribution board. This device shall disconnect all live conductors.

### **730.55 Other equipment**

#### **730.55.1 Socket-outlets**

**730.55.1.1** Socket-outlets shall comply with KS IEC 60309-1 and KS IEC 60309-4 and socket-outlets with a current rating not exceeding 125 A shall comply with KS IEC 60309-2.

Where interchangeability is not required, socket-outlets shall comply with KS IEC 60309-1 and KS IEC 60309-4 and need not comply with KS IEC 60309-2.

**730.55.1.2** Socket-outlets shall be located as close as practicable to the berth to be supplied.

**730.55.1.3** No more than four socket-outlets shall be grouped together in any one enclosure.

**730.55.1.4** Each socket-outlet shall supply only one vessel.

**730.55.1.6** Socket-outlets shall be placed in an enclosure in accordance with IEC 60364-7-709.

**730.55.1.13** Socket-outlets shall be placed at a height of not less than 1 m above the highest water level. In the case of floating pontoons or walkways only, this height may be reduced to 0.3 m above the highest water level provided that appropriate additional measures are taken to protect against the effects of splashing.

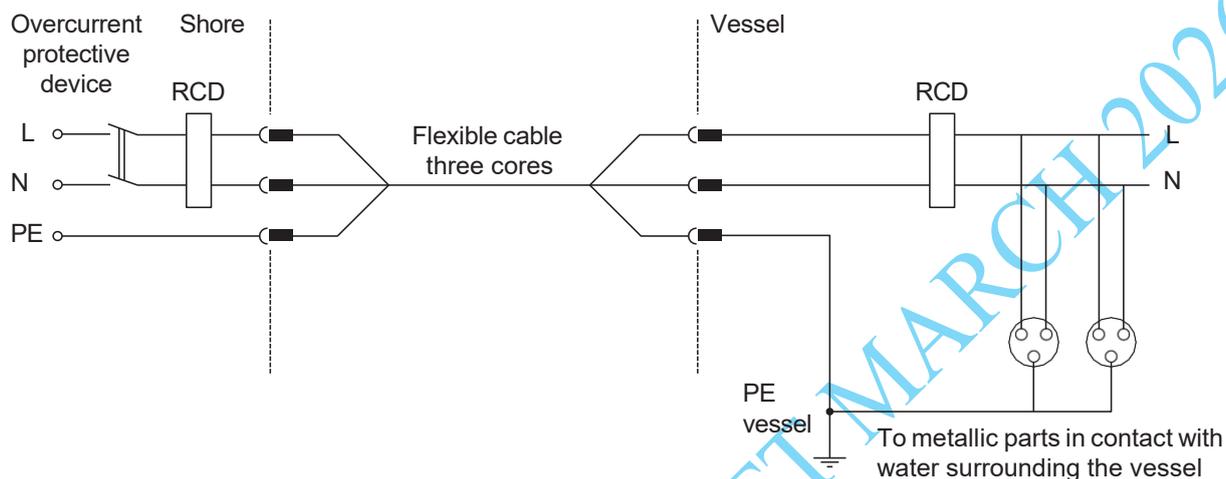
PUBLIC REVIEW DRAFT MARCH 2026

# ANNEX A730

## (Informative) Examples of methods of obtaining supply

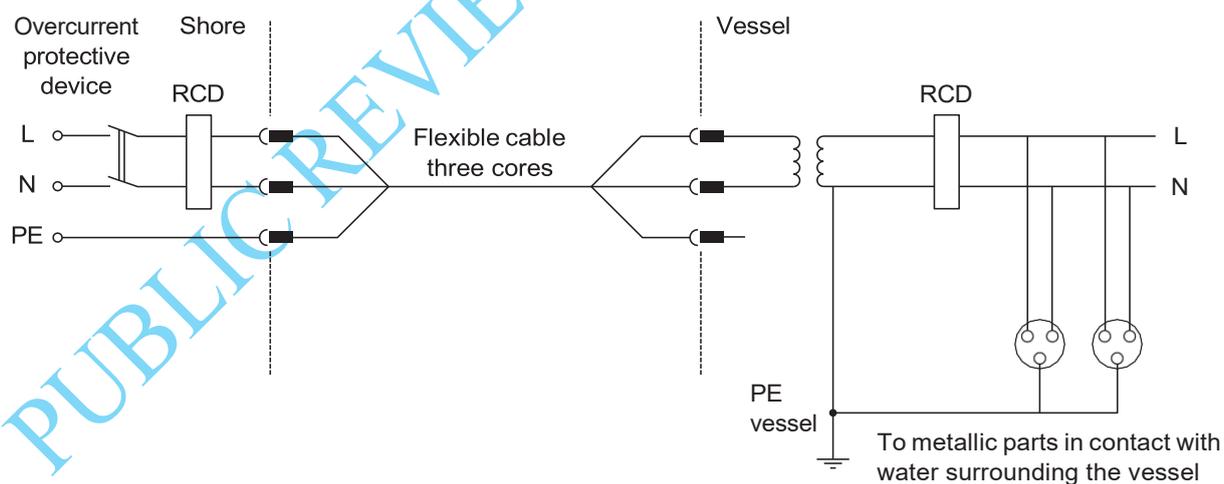
**NOTE:** In Figures A730.1 to A730.4, functional switches are not shown.

**Fig A730.1 – Direct connection to a single-phase mains supply**



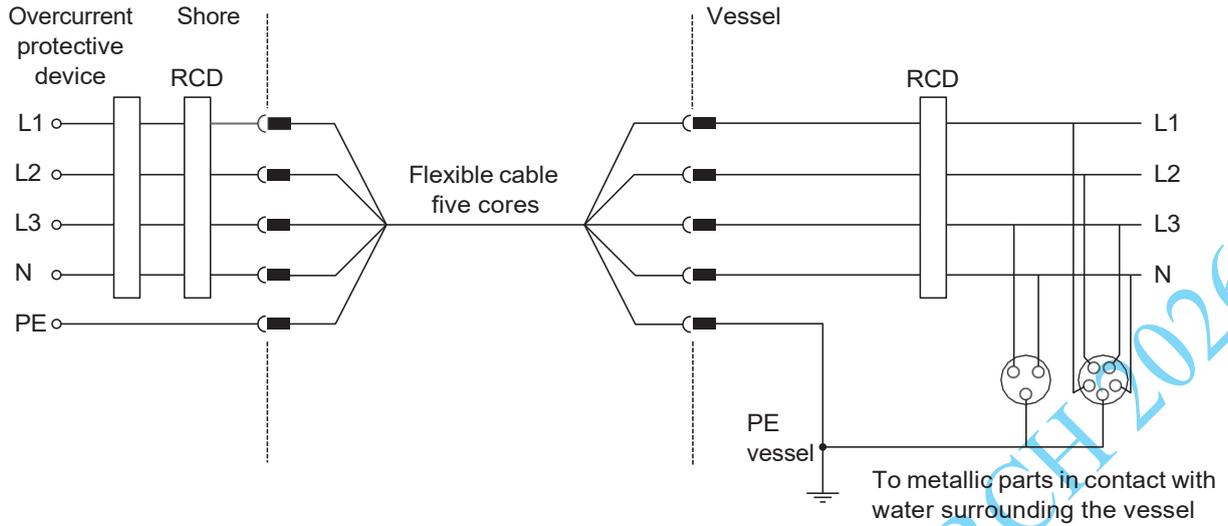
There is a risk of electrolytic corrosion resulting from circulating galvanic currents in the protective conductor to shore.

**Fig A730.2 – Direct connection to a single-phase mains supply with an isolating transformer on the vessel**



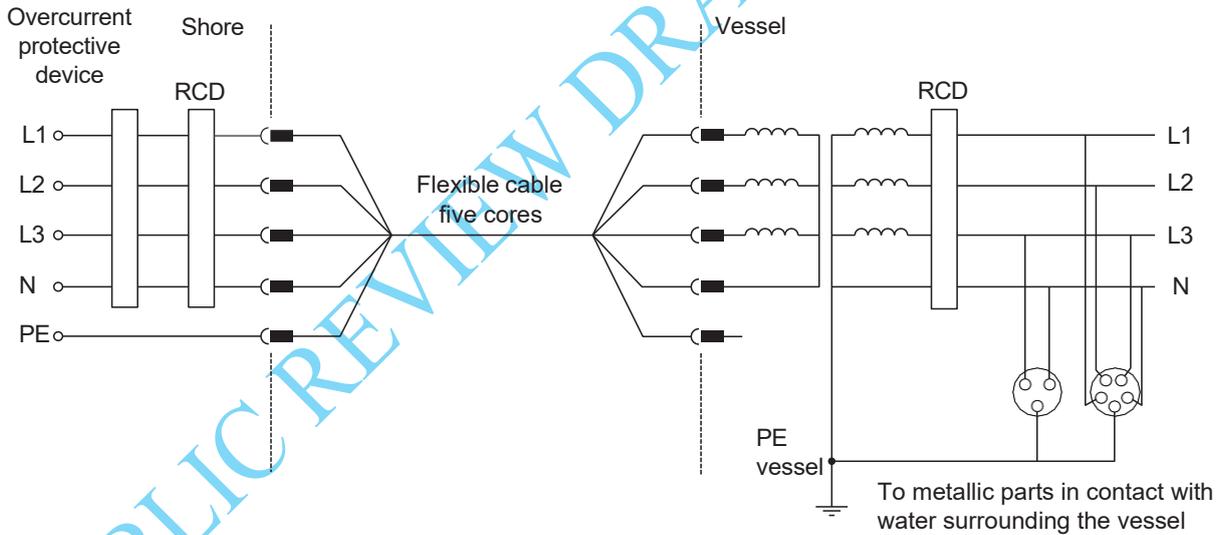
No connection shall be made between the PE conductor of the vessel and the PE conductor of the shore supply (see Section 730.313.1.102). This is to prevent galvanic currents circulating between the hull of the vessel and metallic parts on the shore side.

**Fig A730.3 – Direct connection to a three-phase mains supply**



There is a risk of electrolytic corrosion resulting from circulating galvanic currents in the protective conductor to shore.

**Fig A730.4 – Direct connection to a three-phase mains supply with an isolating transformer on the vessel**



No connection shall be made between the PE conductor of the vessel and the PE conductor of the shore supply (see Section 730.313.1.102). This is to prevent galvanic currents circulating between the hull of the vessel and metallic parts on the shore side.

## **SECTION 740: TEMPORARY ELECTRICAL INSTALLATIONS FOR STRUCTURES, AMUSEMENT DEVICES AND BOOTHS AT FAIRGROUNDS, AMUSEMENT PARKS AND CIRCUSES**

### **740.1 Scope, object and fundamental principles**

#### **740.1.1 Scope**

This section specifies the minimum electrical installation requirements to facilitate the safe design, installation and operation of temporarily erected mobile or transportable electrical machines and structures which incorporate electrical equipment. The machines and structures are intended to be installed repeatedly, without loss of safety, temporarily, at fairgrounds, amusement parks, circuses or similar places.

The object of this section is to define the electrical installation requirements for such structures and machines, being either integral parts or constituting the total amusement device.

This section does not apply to the internal electrical wiring of machines (see KS IEC 60204-1).

**NOTE 1:** The permanent electrical installation is excluded from the scope.

### **740.3 Assessment of general characteristics**

#### **740.31 Purposes, supplies and structure**

##### **740.313 Supplies**

###### **740.313.1.1 Voltage**

The nominal supply voltage of temporary electrical installations in booths, stands and amusement devices shall not exceed 230/400 V AC or 440 V DC.

###### **740.313.3 Supply from the public network**

Irrespective of the number of sources of supply, the line and neutral conductors from different sources shall not be interconnected downstream of the origin of the temporary electrical installation. The instructions of the operator for the supply of the system to the public shall be followed.

### **740.4 Protection for safety**

#### **740.41 Protection against electric shock**

##### **740.410.3 General requirements**

Automatic disconnection of supply to the temporary electrical installation shall be provided at the origin of the installation by one or more RCDs with a rated residual operating current not exceeding 300 mA. The RCD shall incorporate a time delay in accordance with KS IEC 60947-2 or be of the type S in accordance with IEC 61008-1 or IEC 61009-1 where necessary to provide selectivity with RCDs protecting final circuits.

**740.410.3.5** The protective measure of obstacles (Section 417.2) shall not be used.

Placing out of arm's reach is acceptable for electric dodgems (see Section 740.55.9).

**740.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

##### **740.411 Protective measure: Automatic disconnection of supply**

**NOTE:** For supplies to AC motors, RCDs, where used, should be of the time-delayed type in accordance with KS IEC 60947-2 or be of the type S in accordance with IEC 61008-1 or IEC 61009-1 where necessary to prevent unwanted tripping.

#### **740.411.4 TN system**

**740.411.4.1** A PME earthing facility shall not be used as the means of earthing for an installation falling within the scope of this section.

**740.411.4.3** Where the type of system earthing is TN, a PEN conductor shall not be used downstream of the origin of the temporary electrical installation.

#### **740.411.6 IT system**

Where an alternative system is available, an IT system shall not be used. IT systems, however, may be used for DC applications where continuity of service is needed.

#### **740.415 Additional protection**

##### **740.415.1 Additional protection: RCDs**

All final circuits for:

- (i) lighting,
- (ii) socket-outlets rated up to 32 A, and
- (iii) mobile equipment connected by means of a flexible cable with a current-carrying capacity up to 32 A

shall be protected by RCDs having the characteristics specified in Section 415.1.1.

**NOTE:** The requirement for additional protection relates to the increased risk of damage to cables.

The supply to a battery-operated emergency lighting circuit shall be connected to the same RCD protecting the lighting circuit.

This requirement does not apply to:

- (iv) circuits protected by SELV or PELV, or
- (v) circuits protected by electrical separation, or
- (vi) lighting circuits placed out of arm's reach, provided they are not supplied by socket-outlets for household or similar purposes or socket-outlets according to KS IEC 60309-1.

##### **740.415.2 Additional protection: Supplementary protective equipotential bonding**

**740.415.2.1** In locations intended for livestock, supplementary bonding shall connect all exposed-conductive-parts and extraneous-conductive-parts that can be touched by livestock. Where a metal grid is laid in the floor, it shall be included within the supplementary bonding of the location (see Figure 705).

Extraneous-conductive-parts in, or on, the floor, e.g. concrete reinforcement in general or reinforcement of cellars for liquid manure, shall be connected to the supplementary protective equipotential bonding.

It is recommended that spaced floors made of prefabricated concrete elements be part of the equipotential bonding (see Figure 705). The supplementary protective equipotential bonding and the metal grid, if any, shall be erected so that it is durably protected against mechanical stresses and corrosion.

#### **740.42 Protection against thermal effects**

##### **740.422.3 Nature of processed or stored materials**

**740.422.3.7** A motor which is automatically or remotely controlled and which is not continuously supervised shall be fitted with a manually reset protective device against excess temperature.

#### **740.5 Selection and erection of equipment**

##### **740.51 Common rules**

Switchgear and controlgear shall be placed in cabinets which can be opened only by the use of a key or a tool, except for those parts designed and intended to be operated by ordinary persons (BA1) as defined in Part 2 (see also Appendix 5).

## **740.512 Operational conditions and external influences**

### **740.512.2 External influences**

Electrical equipment shall have a degree of protection of at least IP 44.

## **740.52 Wiring systems**

### **740.521 Types of wiring system**

#### **740.521.1 Cables and cable management systems**

Conduit systems shall comply with the relevant part of the KS IEC 61386 series, cable trunking systems and cable ducting systems shall comply with the relevant part 2 of IEC 61084-2, and tray and ladder systems shall comply with IEC 61537.

All cables shall meet the requirements of KS IEC 60332-1-2.

Cables shall have a minimum rated voltage of 450/750 V, except that, within amusement devices, cables having a minimum rated voltage of 300/500 V may be used.

The routes of cables buried in the ground shall be marked at suitable intervals. Buried cables shall be protected against mechanical damage.

**NOTE 1:** Conduit classified as 450 N regarding protection against compression and classified as normal regarding protection against impact, according to KS IEC 61386-24, is considered to fulfil the above requirement.

Armoured cables or cables protected against mechanical damage shall be used wherever there is a risk of mechanical damage due to external influence, e.g. > AG2. Mechanical protection shall be used in public areas and in areas where wiring systems are crossing roads or walkways.

The following methods are considered to meet the above requirements:

- (i) conduit systems complying with KS IEC 61386-21 with a classification of heavy regarding protection against compression, a classification of heavy regarding protection against impact, and, for metallic and composite conduit systems, class 3 protection against corrosion (i.e. medium protection inside and high protection outside)
- (ii) cable trunking systems and cable ducting systems complying with IEC 61084-2 series with a classification 5 J regarding protection against impact.

Where subjected to movement, wiring systems shall be of flexible construction. Where flexible conduit systems are provided they shall comply with KS IEC 61386-23.

**NOTE 2:** Cables of type H07RN-F or H07BN4-F (IEC 60502-2-21) together with conduit complying with KS IEC 61386-23 are deemed to satisfy this requirement.

### **740.526 Electrical connections**

Joints shall not be made in cables except where necessary as a connection into a circuit. Where joints are made, these shall either use connectors in accordance with the relevant British or Harmonized Standard or the connection shall be made in an enclosure with a degree of protection of at least IPXXD or IP4X.

Where strain can be transmitted to terminals the connection shall incorporate cable anchorage(s).

## **740.53 Switchgear and controlgear**

### **740.537 Isolation and switching**

#### **740.537.1 General**

Every electrical installation of a booth, stand or amusement device shall have its own means of isolation, switching and overcurrent protection, which shall be readily accessible.

**740.537.2.1.1** Every separate temporary electrical installation for amusement devices and each distribution circuit supplying outdoor installations shall be provided with its own readily accessible and properly identified means of isolation.

### **740.537.2.2 Devices for isolation**

A device for isolation shall disconnect all live conductors (line and neutral conductors).

### **740.55 Other equipment**

#### **740.55.1 Lighting installation**

##### **740.55.1.1 Luminaires**

Every luminaire and decorative lighting chain shall be installed so as not to impair its ingress protection, and be securely attached to the structure or support intended to carry it. Its weight shall not be carried by the supply cable, unless it has been selected and erected for this purpose.

Luminaires and decorative lighting chains mounted less than 2.5 m (arm's reach) above floor level or otherwise accessible to accidental contact, shall be firmly fixed and so sited or guarded as to prevent risk of injury to persons or ignition of materials. Access to the fixed light source shall only be possible after removing a barrier or an enclosure which shall require the use of a tool.

Lighting chains shall use H05RN-F or HO7RN-F (IEC 60502-2-21) cable or equivalent.

**NOTE:** Lighting chains may be used in any length provided the overcurrent protective device in the circuit is properly rated.

##### **740.55.1.2 Lampholders**

Insulation-piercing lampholders shall not be used unless the cables and lampholders are compatible and the lampholders are non-removable once fitted to the cable.

##### **740.55.1.3 Lamps in shooting galleries**

All lamps in shooting galleries and other sideshows where projectiles are used shall be suitably protected against accidental damage.

##### **740.55.1.4 Floodlights**

Where transportable floodlights are used, they shall be mounted so that the luminaire is inaccessible. Supply cables shall be flexible and have adequate protection against mechanical damage.

##### **740.55.1.5 Fire risks from luminaires and floodlights**

Luminaires and floodlights shall be so fixed and protected that a focusing or concentration of heat is not likely to cause ignition of any material.

#### **740.55.3 Electric discharge lamp installations**

Installations of any luminous tube, sign or lamp on a booth, stand or amusement device with an operating voltage higher than 230/400 V AC shall comply with Sections 740.55.3.1 and 740.55.3.2.

##### **740.55.3.1 Location**

The luminous tube, sign or lamp shall be installed out of arm's reach or be adequately protected to reduce the risk of injury to persons.

##### **740.55.3.2 Emergency switching device**

A separate circuit shall be used to supply luminous tubes, signs or lamps, which shall be controlled by an emergency switch. The switch shall be easily visible, accessible and marked in accordance with the requirements of the local authority.

#### **740.55.5 Safety isolating transformers and electronic converters**

Safety isolating transformers shall comply with KS IEC 61558-2-6 or provide an equivalent degree of safety.

A manually reset protective device shall protect the secondary circuit of each transformer or electronic convertor.

Safety isolating transformers and electronic convertors shall be mounted out of arm's reach or be mounted in a location that provides equal protection, e.g. in a panel or room with adequate ventilation that can only be accessed by skilled or instructed persons. Such access shall be provided only to facilitate inspection, testing and maintenance.

Electronic convertors shall conform to IEC 61347-2-2.

Enclosures containing rectifiers and transformers shall be adequately ventilated and the vents shall not be obstructed when in use.

#### **740.55.7 Plugs and socket-outlets**

An adequate number of socket-outlets shall be installed to allow the user requirements to be met safely.

**NOTE 1:** In booths, stands and for fixed installations, one socket-outlet for each square metre or linear metre of wall is generally considered adequate.

Socket-outlets dedicated to lighting circuits placed out of arm's reach (in accordance with Section 740.415.1) shall be encoded or marked according to their purpose.

When used outdoors, plugs, socket-outlets and couplers shall comply with:

- (i) KS IEC 60309-2, or
- (ii) where interchangeability is not required, KS IEC 60309-1.

However, socket-outlets according to the relevant National Standard may also be installed if they have suitable mechanical protection (equivalent to the requirements of KS IEC 60309-1) and a rated current not exceeding 16 A.

**NOTE 2:** Suitable mechanical protection may be provided by the socket-outlet or by an enclosure.

#### **740.55.8 Electrical supply**

At each amusement device, there shall be a connection point readily accessible and permanently marked to indicate the following essential characteristics:

- (i) Rated voltage
- (ii) Rated current
- (iii) Rated frequency.

#### **740.55.9 Electric dodgems**

Electric dodgems shall only be operated at voltages not exceeding 50 V AC or 120 V DC. The circuit shall be electrically separated from the supply mains by means of a transformer in accordance with IEC 61558-2-4 or a motor-generator set.

#### **740.551 Low voltage generating sets**

##### **740.551.8 Generators**

All generators shall be so located or protected as to prevent danger and injury to people through inadvertent contact with hot surfaces and dangerous parts.

Electrical equipment associated with the generator shall be mounted securely and, if necessary, on anti-vibration mountings.

Where a generator supplies a temporary installation, forming part of a TN, TT or IT system, care shall be taken to verify that the earthing arrangements are in accordance with Section 542.1 and, where earth electrodes are used, with Section 542.2.

The neutral conductor of the star-point of the generator shall, except for an IT system, be connected to the exposed-conductive-parts of the generator.

#### **740.6 Inspection and testing**

The electrical installation between its origin and any electrical equipment shall be inspected and tested in accordance with the requirements of Part 6 after each assembly on site.

**NOTE 1:** Internal electrical wiring of roller coasters, electric dodgems and similar equipment are not considered as part of the verification.

**NOTE 2:** In special cases the number of the tests may be modified according to the type of temporary electrical installation.

## SECTION 753: HEATING CABLES AND EMBEDDED HEATING SYSTEMS

### 753.1 Scope

This section applies to embedded electric heating systems for surface heating. It also applies to electric heating systems for de-icing, frost prevention and similar applications. Both indoor and outdoor systems are covered.

Heating systems for industrial and commercial applications complying with relevant parts of IEC 60519, IEC/IEEE 62395 and KS IEC 60079 are not covered.

**NOTE:** Examples of heating systems covered by this Standard are heating systems for walls, ceilings, floors, roofs, drainpipes, gutters, pipes, stairs, roadways, and non-hardened compacted areas (e.g. football fields, lawns).

### 753.4 Protection for safety

#### 753.41 Protection against electric shock

##### 753.410.3 General requirements

**753.410.3.5** The protective measures of obstacles and placing out of reach (Section 417) shall not be used.

**753.410.3.6** The protective measures of non-conducting location (Section 418.1) and earth-free local equipotential bonding (Section 418.2) shall not be used.

##### 753.411 Protective measure: Automatic disconnection of supply

**753.411.3.2** RCDs having the characteristics specified in Section 415.1.1 shall be used as disconnecting devices. In the case of heating units which are delivered from the manufacturer without exposed-conductive-parts, a suitable conductive covering, for example, a metal grid with a spacing of not more than 30 mm, shall be provided on site as an exposed-conductive-part above the floor heating elements or under the ceiling heating elements, and connected to the protective conductor of the electrical installation.

**NOTE 1:** Where Class II floor or ceiling heating units complying with the requirements of Sections 412.1.1 and 412.2.1.1 are used, the mesh metal grid detailed in Section 753.411.3.2 is not required.

**NOTE 2:** Limitation of the rated heating power to 7.5 kW/230 V or 13 kW/400 V downstream of a 30 mA RCD may avoid unwanted tripping due to leakage current.

##### 753.412 Protective measure: Double or reinforced insulation

**753.412.1.201** Where this protective measure is used as the sole protective measure for floor or ceiling heating units, complying with the requirements of Section 412.2.1.1, the heating-free areas shall be readily identifiable.

The mesh metal grid detailed in Section 753.411.3.2 is not required.

The use of this protective measure as the sole protective measure for a wall heating system is not permitted.

##### 753.413 Protective measure: Electrical separation

Electrical separation shall not be used for wall heating systems (Section 413).

##### 753.415 Additional protection: RCDs

**753.415.1** Circuits supplying heating units shall have additional protection by the use of RCDs having the characteristics specified in Section 415.1.1. Time delayed type RCDs shall not be used.

##### 753.42 Protection against thermal effects

##### 753.423 Protection against burns

In floor areas where contact with skin or footwear is possible, the surface temperature of the floor shall be limited.

**NOTE:** For example, to no more than 35 °C for floor heating systems. For additional information reference can be made to CENELEC Guide 29.

## **753.424 Protection against overheating**

To meet the requirements of Chapter 42, special care shall be taken to prevent the heating elements creating high temperatures to adjacent material. This may be achieved by using heating units with temperature self-limiting functions or by separation with heat-resistant materials. The latter may be accomplished by placing on a metal sheet, in metal conduit or at a distance of at least 10 mm in air from the ignitable structure.

**NOTE:** Dependent on adjacent material it may be prudent to consider a larger separation distance.

**753.424.201** For floor or ceiling heating systems in buildings, one or more of the following measures shall be applied within the zone where heating units are installed to limit the temperature to a maximum of 80 °C:

- (i) appropriate design of the heating system
- (ii) appropriate installation of the heating system
- (iii) use of protective devices.

Heating units shall be connected to the electrical installation via cold tails or suitable terminals.

Heating units shall be inseparably connected to cold tails, for example, by a crimped connection.

For wall heating systems, the heating units shall be provided with a metal sheath or metal enclosure or fine mesh metallic grid. The metal sheath or metal enclosure or fine mesh metallic grid shall be connected to the protective conductor of the supply circuit.

**NOTE:** This requirement is intended to protect against the effects of overheating caused by a short-circuit between live conductors due to penetration of an embedded heating unit.

## **753.5 Selection and erection of electrical equipment**

### **753.51 Common rules**

#### **753.511 Compliance with standards**

Flexible sheet heating elements shall comply with the requirements of IEC 60335-2-96. Heating cables shall comply with IEC 60800.

#### **753.514 Identification**

##### **753.514.1 General**

The designer of the installation/heating system or installer shall provide documentation for each heating system, containing the following details:

- (i) Manufacturer and type of heating units
- (ii) Number of heating units installed
- (iii) Length/area of heating units
- (iv) Rated power
- (v) Surface power density
- (vi) Layout of the heating units in the form of a sketch, drawing or picture
- (vii) Position/depth of heating units
- (viii) Position of junction boxes
- (ix) Cables, earthed conductive shields and the like
- (x) Rated voltage
- (xi) Rated resistance (cold) of heating units
- (xii) Rated current of overcurrent protective device
- (xiii) Rated residual operating current of RCD
- (xiv) The insulation resistance of the heating installation and the test voltage used
- (xv) Product information containing provisions about approved materials in contact with the heating units, with necessary instructions for installation.

This documentation shall be fixed to, or adjacent to, the distribution board of the heating system.

Furthermore, the requirements of Figure 753 apply.

## **753.515 Prevention of mutual detrimental influence**

**753.515.1** Electric heating systems shall be selected and erected so as to avoid any harmful influence between the heating system and any electrical or non-electrical installations envisaged.

If materials other than those recommended are used in the surroundings of the heating units the manufacturer shall be consulted.

**NOTE:** For example, an electric heating system can affect other parts of the electrical installation such as reducing the current-carrying capacity of cables of other circuits due to high local ambient temperature caused by the heating system.

**753.515.101** Heating units shall not cross expansion joints of the building or structure.

## **753.52 Wiring systems**

### **753.520 Introduction**

#### **753.520.4 Heating-free areas**

For the necessary attachment of room fittings, heating-free areas shall be provided in such a way that the heat emission is not prevented by such fittings.

## **753.522 Selection and erection of wiring systems in relation to external influence**

### **753.522.1 Ambient temperature (AA)**

**753.522.1.3** For cold leads (circuit wiring) and control leads installed in the zone of heated surfaces, the increase of ambient temperature shall be taken into account.

### **753.522.4 Presence of solid foreign bodies (AE)**

**753.522.4.3** Where heating units are installed there shall be heating-free areas where drilling and fixing by screws and the like may be carried out without risk of damage to the units.

PUBLIC REVIEW DRAFT MARCH 2026

## Fig 753 – Information for the user of the installation

A description of the heating system shall be provided to the person ordering the work. The description shall contain at least the following information:

- a) Description of the construction of the heating system, especially the installation depth of the heating units;
- b) Location diagram with information concerning
  - the distribution of the heating circuits and their rated power;
  - the position of the heating units in each room;
  - particularities which have been taken into account when installing the heating units, for example, heating-free areas, complementary heating zones, heating-free areas for fixing means penetrating into the covering material;
- c) Data on the control equipment used, with relevant circuit diagrams and the dimensioned position of floor temperature and weather conditions sensors, if any;
- d) Data on the type of heating units and their maximum operating temperature.

The installer shall inform the owner that the description of the heating system includes all necessary information, for example for repair work.

Instructions for use shall be provided to the person ordering the work upon completion. One copy of the instructions for use shall be permanently fixed in or near each relevant distribution board.

The instructions for use shall include at least the following data:

- a) Description of the heating system and its function;
- b) Operation of the heating installation in the first heating period in the case of a new building, for example, regarding drying out;
- c) Operation of the control equipment for the heating system in the dwelling area and the complementary heating zones, if any;
- d) Information on restrictions on placing of furniture or similar.

additional floor coverings for example, carpets with a thickness of >10 mm may lead to higher floor temperatures which can adversely affect the performance of the heating system pieces of furniture solidly covering the floor and/or built-in cupboards shall only be placed on heating-free areas furniture, such as carpets, seating and rest furniture with pelmets, which in part do not solidly cover the floor, may not be placed in complementary heating zones, if any;

- e) In the case of ceiling heating systems, restrictions regarding the height of furniture. Cupboards of room height may be placed only below the area of ceiling where no heating elements are installed;
- f) Dimensioned position of complementary heating zones and placing areas;
- g) Statement that, in the case of thermal floor, wall and ceiling heating systems, no fixing shall be made into the floor, wall or ceiling respectively. Excluded from this requirement are heating-free areas.

26

PUBLIC REL

## APPENDIX 5 (Informative) CLASSIFICATION OF EXTERNAL INFLUENCES

This appendix gives the classification and codification of external influences.

**NOTE 1:** The appendix is an extract from IECIEC 60364-5-51.

Each condition of external influence is designated by a code comprising a group of two capital letters and a number, as follows:

The first letter relates to the general category of external influence:

- A** Environment
- B** Utilization
- C** Construction of buildings

The second letter relates to the nature of the external influence:

- ... **A**
- ... **B**
- ... **C**

The number relates to the class within each external influence:

- ... .. **1**
- ... .. **2**
- ... .. **3**

For example, the code **AA4** signifies:

- A** = Environment
- AA** = Environment - Ambient temperature
- AA4** = Environment - Ambient temperature in the range of  $-5\text{ }^{\circ}\text{C}$  to  $+40\text{ }^{\circ}\text{C}$ .

**NOTE 2:** The codification given in this appendix is not intended to be used for marking equipment.

The following key is for use when referencing the list of external influences:

- <sup>a</sup> May necessitate certain supplementary precautions (e.g. special lubrication).
- <sup>b</sup> This means that ordinary equipment will operate safely under the described external influences.
- <sup>c</sup> This means that special arrangements should be made, for example, between the designer of the installation and the equipment manufacturer, e.g. for specially designed equipment.

## CONCISE LIST OF EXTERNAL INFLUENCES

<b>Environment</b>	<b>A</b>	<b>AA</b>	<i>Ambient (°C)</i>	<b>AF</b>	<i>Corrosion</i>	<b>AM8</b>	<b>Radiated magnetic fields</b>
		AA1	-60 °C +5 °C	AF1	Negligible	AM9	Electric fields
		AA2	-40 °C +5 °C	AF2	Atmospheric	AM21	High-frequency etc. . .
		AA3	-25 °C +5 °C	AF3	Intermittent	AM22	Conducted. . .nano. . .
		AA4	-5 °C +40 °C	AF4	Continuous	AM23	Conducted. . .micro. . .
		AA5	+5 °C +40 °C			AM24	Conducted oscillatory
		AA6	+5 °C +60 °C	<b>AG</b>	<i>Impact</i>	AM25	Radiated HF
		AA7	-25 °C +55 °C	AG1	Low	AM31	Electrostatic discharges
		AA8	-50 °C +40 °C	AG2	Medium	AM41	Ionization
				AG3	High		
		<b>AB</b>	<i>Temperature and Humidity</i>			<b>AN</b>	<i>Solar</i>
				<b>AH</b>	<i>Vibration</i>	AN1	Low
		<b>AC</b>	<i>Altitude (metres)</i>	AH1	Low	AN2	Medium
		AC1	≤ 2000 metres	AH2	Medium	AN3	High
		AC2	> 2000 metres	AH3	High		
						<b>AP</b>	<i>Seismic</i>
		<b>AD</b>	<i>Water</i>	<b>AJ</b>	<i>Other mechanical stresses</i>	AP1	Negligible
		AD1	Negligible			AP2	Low
		AD2	Drops	<b>AK</b>	<i>Flora</i>	AP3	Medium
		AD3	Sprays	AK1	No hazard	AP4	High
		AD4	Splashes	AK2	Hazard		
		AD5	Jets			<b>AQ</b>	<i>Lightning</i>
		AD6	Waves	<b>AL</b>	<i>Fauna</i>	AQ1	Negligible
		AD7	Immersion	AL1	No hazard	AQ2	Indirect
		AD8	Submersion	AL2	Hazard	AQ3	Direct
		<b>AE</b>	<i>Foreign Bodies</i>	<b>AM</b>	<i>Electromagnetic. . .</i>	<b>AR</b>	<i>Movement of air</i>
	AE1	Negligible	AM1	Level	AR1	Low	
	AE2	Small	AM2	Signalling voltages	AR2	Medium	
	AE3	Very small	AM3	Voltage amplitude variations	AR3	High	
	AE4	Light dust	AM4	Voltage unbalance			
	AE5	Moderate dust	AM5	Power frequency variations	<b>AS</b>	<i>Wind</i>	
	AE6	Heavy dust	AM6	Induced low-frequency voltage	AS1	Low	
			AM7	DC current in AC voltage	AS2	Medium	
					AS3	High	
<b>Utilization</b>	<b>B</b>	<b>BA</b>	<i>Capability</i>	<b>BC</b>	<i>Contact with Earth</i>	<b>BE</b>	<i>Materials</i>
		BA1	Ordinary	BC1	None	BE1	No risk
		BA2	Children	BC2	Low	BE2	Fire risk
		BA3	Handicapped	BC3	Frequent	BE3	Explosion risk
		BA4	Instructed	BC4	Continuous	BE4	Contamination risk
		BA5	Skilled				
				<b>BD</b>	<i>Evacuation</i>		
		<b>BB</b>	<i>Resistance</i>	BD1	Normal		
				BD2	Difficult		
				BD3	Crowded		
			BD4	Difficult and crowded			
<b>Buildings</b>	<b>C</b>	<b>CA</b>	<i>Materials</i>	<b>CB</b>	<i>Structure</i>		
		CA1	Non-combustible	CB1	Negligible		
		CA2	Combustible	CB2	Fire propagation		
				CB3	Structural movement		
				CB4	Flexible		

**A ENVIRONMENT:**

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only	
A	<i>Environmental conditions</i>			
AA	<i>Ambient temperature</i>			
	<p>The ambient temperature is that of the ambient air where the equipment is to be installed</p> <p>It is assumed that the ambient temperature includes the effects of other equipment installed in the same location</p> <p>The ambient temperature to be considered for the equipment is the temperature at the place where the equipment is to be installed resulting from the influence of all other equipment in the same location, when operating, not taking into account the thermal contribution of the equipment to be installed.</p>			
AA1	-60 °C +5 °C	Specially designed equipment or appropriate arrangements <sup>a</sup>	Includes temperature range of IEC 60721-3-3, class 3K8, with high air temperature restricted to +5 °C. Part of temperature range of IEC 60721-3-4, class 4K4, with low air temperature restricted to -60 °C and high air temperature restricted to +5 °C	
AA2	-40 °C +5 °C		Part of temperature range of IEC 60721-3-3, class 3K7, with high air temperature restricted to +5 °C. Includes part of temperature range of IEC 60721-3-4, class 4K3, with high air temperature restricted to +5 °C	
AA3	-25 °C +5 °C		Part of temperature range of IEC 60721-3-3, class 3K6, with high air temperature restricted to +5 °C. Includes temperature range of IEC 60721-3-4, class 4K1, with high air temperature restricted to +5 °C	
AA4	-5 °C +40 °C		Normal (in certain cases special precautions may be necessary)	Part of temperature range of IEC 60721-3-3, class 3K5, with high air temperature restricted to +40 °C
AA5	+5 °C +40 °C		Normal <sup>b</sup>	Identical to temperature range of IEC 60721-3-3, class 3K3

**A ENVIRONMENT (cont.)**

Code	External influences						Characteristics required for selection and erection of equipment	Reference for information only
AA6	+5 °C +60 °C						Specially designed equipment or appropriate arrangements <sup>a</sup>	Part of temperature range of IEC 60721-3-3, class 3K7, with low air temperature restricted to +5 °C and high air temperature restricted to +60 °C. Includes temperature range of IEC 60721-3-4, class 4K4 with low air temperature restricted to +5 °C
AA7	-25 °C +55 °C						Specially designed equipment or appropriate arrangements <sup>a</sup>	– Identical to temperature range of IEC 60721-3-3, class 3K6 – Identical to temperature range of IEC 60721-3-4, class 4K3
AA8	-50°C+40°C							
Ambient temperature classes are applicable only where humidity has no influence  The average temperature over a 24 h period must not exceed 5 °C below the upper limits  Combination of two ranges to define some environments may be necessary. Installations subject to temperatures outside the ranges require special consideration								
AB	<i>Atmospheric humidity</i>							
	<b>Air temperature °C</b> a) low b) high		<b>Relative humidity %</b> c) low d) high		<b>Absolute humidity g/m<sup>3</sup></b> e) low f) high			
AB1	-60	+5	3	100	0.003	7	Indoor and outdoor locations with extremely low ambient temperatures  Appropriate arrangements should be made <sup>e</sup>	Includes temperature range of IEC 60721-3-3, class 3K8, with high air temperature restricted to +5°C. Part of temperature range of IEC 60721-3-4, class 4K4, with low air temperature restricted to – 60°C and high air temperature restricted to +5°C
AB2	-40	+5	10	100	0.1	7	Indoor and outdoor locations with low ambient temperatures  Appropriate arrangements should be made <sup>e</sup>	Part of temperature range of IEC 60721-3-3, class 3K7, with high temperature restricted to +5°C. Part of temperature range of IEC 60721-3-4, class 4K4, with low air temperature restricted to –40°C and high air temperature restricted to +5°C

**A ENVIRONMENT (cont.)**

Code	External influences						Characteristics required for selection and erection of equipment	Reference for information only
	Air temperature °C a) low b) high		Relative humidity % c) low d) high		Absolute humidity g/m <sup>3</sup> e) low f) high			
AB3	-25	+5	10	100	0.5	7	Indoor and outdoor locations with low ambient temperatures  Appropriate arrangements should be made <sup>c</sup>	Part of temperature range of IEC 60721-3-3, class 3K6, with high air temperature restricted to +5°C. Includes temperature range of IEC 60721-3-4, class 4K1, with high air temperature range restricted to +5°C
AB4	-5	+40	5	95	1	29	Weather protected locations having neither temperature nor humidity control. Heating may be used to raise low ambient temperatures  Normal <sup>b</sup>	Identical with temperature range of IEC 60721-3-3, class 3K5. The high air temperature restricted to +40°C
AB5	+5	+40	5	85	1	25	Weather protected locations with temperature control  Normal <sup>b</sup>	Identical with temperature range of IEC 60721-3-3, class 3K3
AB6	+5	+60	10	100	1	35	Indoor and outdoor locations with extremely high ambient temperatures, influence of cold ambient temperatures is prevented. Occurrence of solar and heat radiation  Appropriate arrangements should be made <sup>c</sup>	Part of temperature range of IEC 60721-3-3, class 3K7, with low air temperature restricted to +5°C and high air temperature restricted to +60°C. Includes temperature range of IEC 60721-3-4, class 4K4, with low air temperature restricted to +5°C
AB7	-25	+55	10	100	0.5	29	Indoor weather protected locations having neither temperature nor humidity control, the locations may have openings directly to the open air and be subjected to solar radiation  Appropriate arrangements must be made <sup>c</sup>	Identical to temperature range of IEC 60721-3-3, class 3K6
AB8	-50	+40	15	100	0.04	36	Outdoor and non-weather protected locations, with low and high temperatures  Appropriate arrangements should be made <sup>c</sup>	Identical to temperature range of IEC 60721-3-4, class 4K3

**A ENVIRONMENT (cont.)**

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only
AC AC1 AC2	<i>Altitude</i> ≤2 000 m >2 000 m	Normal <sup>b</sup> May necessitate special precautions such as the application of derating factors <b>NOTE:</b> For some equipment special arrangements may be necessary at altitudes of 1 000 m and above	
AD AD1	<i>Presence of water</i> Negligible	IPX0 Probability of presence of water is negligible. Location in which the walls do not generally show traces of water but may do so for short periods, for example in the form of vapour which good ventilation dries rapidly	IEC 60529 IEC 60721-3-4, class 4Z6
AD2	Free-falling drops	IPX1 or IPX2 Possibility of vertically falling drops Location in which water vapour occasionally condenses as drops or where steam may occasionally be present	IEC 60529 IEC 60721-3-3, class 3Z7
AD3	Sprays	IPX3 Possibility of water falling as a spray at an angle up to 60° from the vertical Locations in which sprayed water forms a continuous film on floors and/or walls	IEC 60529 IEC 60721-3-3, class 3Z8
AD4	Splashes	IPX4 Possibility of splashes from any direction Locations where equipment may be subjected to splashed water; this applies, for example, to certain external luminaires, construction site equipment	IEC 60721-3-4, class 4Z7 IEC 60529 IEC 60721-3-3, class 3Z9 IEC 60721-3-4, class 4Z7
AD5	Jets	IPX5 Possibility of jets of water from any direction Locations where hose water is used regularly (yards, car-washing bays)	IEC 60529 IEC 60721-3-3, class 3Z10
AD6	Waves	IPX6 Possibility of water waves Seashore locations such as piers, beaches, quays, etc	IEC 60721-3-4, class 4Z8 IEC 60529 IEC 60721-3-4, class 4Z9
AD7	Immersion	IPX7 Locations which may be flooded and/or where the equipment is immersed as follows: <ul style="list-style-type: none"> <li>• Equipment with a height of less than 850 mm is located in such a way that its lowest point is not more than 1 000 mm below the surface of the water</li> <li>• Equipment with a height equal to or greater than 850 mm is located in such a way that its highest point is not more than 150 mm below the surface of the water</li> </ul>	
AD8	Submersion	IPX8 Possibility of permanent and total covering by water Locations such as swimming pools where electrical equipment is permanently and totally covered with water	

**A ENVIRONMENT (cont.)**

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only
AE	<i>Presence of foreign solid bodies</i>	IPXX see also Section 416	
AE1	Negligible	IP0X The quantity or size of dust or foreign solid bodies is not significant	IEC 60529 IEC 60721-3-3, class 3S1 IEC 60721-3-4, class 4S1
AE2	Small objects (2.5 mm)	IP3X Presence of foreign solid bodies where the smallest dimension is not less than 2.5 mm Tools and small objects are examples of foreign solid bodies of which the smallest dimension is at least 2.5 mm	IEC 60529 IEC 60721-3-3, class 3S2 IEC 60721-3-4, class 4S2
AE3	Very small objects (1 mm)	IP4X Presence of foreign solid bodies where the smallest dimension is not less than 1 mm Wires are examples of foreign solid bodies of which the smallest dimension is not less than 1 mm	IEC 60529 IEC 60721-3-3, class 3S3 IEC 60721-3-4, class 4S3
AE4	Light dust	IP5X Presence of dust if dust penetration is not harmful to the functioning of the equipment	IEC 60529 IEC 60721-3-3, class 3S2 IEC 60721-3-4, class 4S2 IEC 60529
AE5	Moderate dust	IP6X Presence of dust if dust penetration is harmful to the functioning of the equipment	IEC 60721-3-4, class 3S3 IEC 60721-3-3, class 4S3 IEC 60721-3-3, class 3S4
AE6	Heavy dust	IP6X Presence of dust Dust must not penetrate equipment	IEC 60721-3-4, class 4S4
AF	<i>Presence of corrosive or polluting substances</i>		
AF1	Negligible	Normal <sup>b</sup>	IEC 60721-3-3, class 3C1 IEC 60721-3-4, class 4C1
AF2	Atmospheric	The presence of corrosive or polluting substances of atmospheric origin is significant. Installations situated by the sea or near industrial zones producing serious atmospheric pollution, such as chemical works, cement works; this type of pollution arises especially in the production of abrasive, insulating or conductive dusts  According to the nature of substances (for example, satisfaction of salt mist test according to IEC 60068-2-11)	IEC 60721-3-3, class 3C2 IEC 60721-3-4, class 4C2
AF3	Intermittent or accidental	Intermittent or accidental subjection to corrosive or polluting chemical substances being used or produced Locations where some chemical products are handled in small quantities and where these products may come only accidentally into contact with electrical equipment; such conditions are found in factory laboratories, other laboratories or in locations where hydrocarbons are used (boiler-rooms, garages, etc.)  Protection against corrosion according to equipment specification	IEC 60721-3-3, class 3C3 IEC 60721-3-4, class 4C3

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only
AF4	Continuous	Continuously subject to corrosive or polluting chemical substances in substantial quantity, e.g. chemical works Equipment specially designed according to the nature of substances	IEC 60721-3-3, class 3C4 IEC 60721-3-4, class 4C4
AG	<i>Mechanical stress: Impact</i>		
AG1	Low severity	Normal, e.g. household and similar equipment	IEC 60721-3-3, classes 3M1/3M2/3M3 IEC 60721-3-4, classes 4M1/4M2/4M3
AG2	Medium severity	Standard industrial equipment, where applicable, or reinforced protection	IEC 60721-3-3, classes 3M4/3M5/3M6 IEC 60721-3-4, classes 4M4/4M5/4M6
AG3	High severity	Reinforced protection	IEC 60721-3-3, classes 3M7/3M8 IEC 60721-3-4, classes 4M7/4M8

PUBLIC REVIEW DRAFT MARCH 2026

**A ENVIRONMENT (cont.)**

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only
AH AH1	<i>Vibration</i> Low severity	Household and similar conditions where the effects of vibration are generally negligible  Normal	IEC 60721-3-3, classes 3M1/3M/3M3  IEC 60721-3-4, classes 4M1/4M2/4M3
AH2	Medium severity	Usual industrial conditions Specially designed equipment or special arrangements	IEC 60721-3-3, classes 3M4/3M5/3M6  IEC 60721-3-4, classes 4M4/4M5/4M6
AH3	High severity		
AJ	<i>Other mechanical stresses</i>	Under consideration	
AK AK1	<i>Presence of flora and/or mould growth</i> No hazard	No harmful hazard from flora and/or mould growth  Normal <sup>b</sup>	IEC 60721-3-3, class 3B1  IEC 60721-3-4, class 4B1
AK2	Hazard	Harmful hazard from flora and/or mould growth  The hazard depends on local conditions and the nature of flora. Distinction should be made between harmful growth of vegetation or conditions for promotion of mould growth  Special protection, such as: <ul style="list-style-type: none"> <li>- increased degree of protection (see AE)</li> <li>- special materials or protective coating of enclosures</li> <li>- arrangements to exclude flora from location</li> </ul>	IEC 60721-3-3, class 3B2 IEC 60721-3-4, class 4B2
AL AL1	<i>Presence of fauna</i> No hazard	No harmful hazard from fauna  Normal <sup>b</sup>	IEC 60721-3-3, class 3B1 IEC 60721-3-4, class 4B1

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only
AL2	Hazard	<p>Harmful hazard from fauna (insects, birds, small animals) The hazard depends on the nature of the fauna. Distinction should be made between:</p> <ul style="list-style-type: none"> <li>– presence of insects in harmful quantity or of an aggressive nature;</li> <li>– presence of small animals or birds in harmful quantity or of an aggressive nature</li> </ul> <p>Protection may include:</p> <ul style="list-style-type: none"> <li>– an appropriate degree of protection against penetration of foreign solid bodies (see AE)</li> <li>– sufficient mechanical resistance (see AG)</li> <li>– precautions to exclude fauna from the location (such as cleanliness, use of pesticides)</li> <li>– special equipment or protective coating of enclosures</li> </ul>	IEC 60721-3-3, class 3B2 IEC 60721-3-4, class 4B2

PUBLIC REVIEW DRAFT MARCH 2026

**A ENVIRONMENT (cont.)**

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only
AM	<i>Electromagnetic, electrostatic, or ionizing influences</i>  <i>Low-frequency electromagnetic phenomena (conducted or radiated)</i>  <i>Harmonics, interharmonics</i>		
AM-1-1	Controlled level	Care should be taken that the controlled situation is not impaired	Lower than table 1 of IEC 61000-2-2
AM-1-2	Normal level	Special measures in the design of the installation, e.g. filters	Complying with table 1 of IEC 61000-2-2
AM-1-3	High level	Special measures in the design of the installation, e.g. filters	Locally higher than table 1 of IEC 61000-2-2
AM-2-1	<i>Signalling voltages</i> Controlled level	Possibly: blocking circuits	Lower than specified below
AM-2-2	Medium level	No additional requirement	IEC/TR 61000-2-1 and IEC 61000-2-2
AM-2-3	High level	Appropriate measures	
AM-3-1	<i>Voltage amplitude variations</i> Controlled level	e.g. controlled by UPS	
AM-3-2	Normal level	Compliance with KS 662-4 Chapter 44	
AM-4	<i>Voltage unbalance</i>		Compliance with IEC 61000-2-2
AM-5	<i>Power frequency variations</i>		±1 Hz according to IEC 61000-2-2
AM-6	<i>Induced low-frequency voltages</i> No classification	Refer to KS 662-4 Chapter 44  High withstand of signal and control systems of switchgear and controlgear	ITU-T (International Telecommunication Union)
AM-7	<i>Direct current in AC networks (321.10.1.7)</i> No classification	Measures to limit their presence in level and time in the current-using equipment or their vicinity	
AM-8-1	<i>Radiated magnetic fields</i> Medium level	Normal <sup>b</sup>	Level 2 of IEC 61000-4-8
AM-8-2	High level	Protection by appropriate measures e.g. screening and/or separation	Level 4 of IEC 61000-4-8

**A ENVIRONMENT (cont.)**

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only
AM-9-1 AM-9-2 AM-9-3 AM-9-4	<i>Electric fields</i> Negligible level Medium level High level Very high level	Normal <sup>b</sup>	IEC TR 61000-2-5 IEC TR 61000-2-5 IEC TR 61000-2-5
<i>High-frequency electromagnetic phenomena conducted, induced or radiated (continuous or transient)</i>			
AM-21	<i>Induced oscillatory voltages or currents</i> No classification	Normal <sup>b</sup>	IEC 61000-4-6
AM-22-1 AM-22-2 AM-22-3 AM-22-4	<i>Conducted unidirectional transients of the nanosecond time scale</i> Negligible level Medium level High level Very high level	Protective measures are necessary Protective measures are necessary Normal equipment High immunity equipment	IEC 61000-4-4 Level 1 Level 2 Level 3 Level 4
AM-23-1 AM-23-2 AM-23-3	<i>Conducted unidirectional transients of microsecond to millisecond time scale</i> Controlled level Medium level High level	Impulse withstand of equipment and overvoltage protective means chosen taking into account the nominal supply voltage and the impulse withstand category according to KS 662-4 Chapter 44	KS 662-4 Chapter 44 KS 662-4 Chapter 44
AM-24-1 AM-24-2	<i>Conducted oscillatory transients</i> Medium level High level	Refer to IEC 61000-4-12 Refer to IEC 60255-26	IEC 61000-4-12 IEC 60255-26:2013
AM-25-1 AM-25-2 AM-25-3	<i>Radiated high-frequency phenomena</i> Negligible level Medium level High level	Normal <sup>b</sup> Reinforced level	IEC 61000-4-3 Level 1 Level 2 Level 3
AM-31-1 AM-31-2 AM-31-3 AM-31-4	<i>Electrostatic discharges</i> Small level Medium level High level Very high level	Normal <sup>b</sup> Normal <sup>b</sup> Normal <sup>b</sup> Reinforced	IEC 61000-4-2 Level 1 Level 2 Level 3 Level 4
AM-41-1	<i>Ionization</i> No classification	Special protection such as: – Spacings from source – Interposition of screens, enclosure by special materials	

**A ENVIRONMENT (cont.)**

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only
AN AN1 AN2 AN3	<i>Solar radiation</i> Low Medium High	Intensity $\leq 500 \text{ W/m}^2$ Normal <sup>b</sup> 500 $\text{W/m}^2 < \text{intensity} \leq 700 \text{ W/m}^2$ Appropriate arrangements must be made <sup>c</sup> 700 $\text{W/m}^2 < \text{intensity} \leq 1120 \text{ W/m}^2$ Appropriate arrangements must be made <sup>c</sup> Such arrangements could be: – material resistant to ultraviolet radiation – special colour coating – interposition of screens	IEC 60721-3-3 class 3K1 IEC 60721-3-3 Classes 3K2 to 3K5 IEC 60721-3-3 Higher than class 3K5 IEC 60721-3-4
AP AP1 AP2 AP3 AP4	<i>Seismic effects</i> Negligible Low severity Medium severity High severity	Acceleration $\leq 30 \text{ Gal}$ (1 Gal = $1 \text{ cm/s}^2$ ) Normal <sup>b</sup> 30 Gal < acceleration $\leq 300 \text{ Gal}$ Under consideration 300 Gal < acceleration $\leq 600 \text{ Gal}$ Under consideration 600 Gal < acceleration Under consideration Vibration which may cause the destruction of the building is outside the classification Frequency is not taken into account in the classification; however, if the seismic wave resonates with the building, seismic effects must be specially considered. In general, the frequency of seismic acceleration is between 0 Hz and 10 Hz	
AQ AQ1 AQ2 AQ3	<i>Lightning</i> Negligible Indirect exposure Direct exposure	Normal <sup>b</sup> In accordance with Section 443 IEC 62305-1	
AR AR1 AR2 AR3	<i>Movement of air</i> Low Medium High	Speed $\leq 1 \text{ m/s}$ Normal <sup>b</sup> 1 $\text{m/s} < \text{speed} \leq 5 \text{ m/s}$ Appropriate arrangements should be made <sup>c</sup> 5 $\text{m/s} < \text{speed} \leq 10 \text{ m/s}$ Appropriate arrangements should be made <sup>c</sup>	
AS AS1 AS2 AS3	<i>Wind</i> Low Medium High	Speed $\leq 20 \text{ m/s}$ Normal <sup>b</sup> 20 $\text{m/s} < \text{speed} \leq 30 \text{ m/s}$ Appropriate arrangements should be made <sup>c</sup> 30 $\text{m/s} < \text{speed} \leq 50 \text{ m/s}$ Appropriate arrangements should be made <sup>c</sup>	

## B UTILIZATION:

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only												
BA	<b>Capability of persons</b>														
BA1	Ordinary	Uninstructed persons Normal <sup>b</sup>	Inaccessibility of electrical equipment. Limitation of temperature of accessible surfaces												
BA2	Children	Locations intended for presence of children e.g. nurseries, infant schools, etc. Equipment of degrees of protection equal to or greater than IP2XC. Inaccessibility of equipment with external surface temperature exceeding 60 °C													
BA3	Handicapped	Persons not in command of all their physical and/or intellectual abilities (sick persons, old persons) According to the nature of the handicap													
BA4	Instructed														
BA5	Skilled	Persons adequately advised or supervised by skilled persons to enable them to avoid dangers which electricity may create (operating and maintenance staff) Electrical operating areas  Equipment not having basic protection against direct contact with live parts admitted solely in locations which are accessible only to duly authorized persons with technical knowledge or sufficient experience to enable them to avoid danger which electricity may create (engineers and technicians) Closed electrical operating areas													
BB	<b>Electrical resistance of the human body</b> Under consideration														
BC	<b>Contact of persons with Earth potential</b>														
BC1	None	<p><b>Class of equipment according to KS IEC 61140</b></p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <td>Persons in non-conducting situations</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>A</td> <td>A</td> <td>A</td> </tr> </table>		I	II	III	Persons in non-conducting situations					A	A	A	
	I	II	III												
Persons in non-conducting situations															
	A	A	A												
BC2	Occasional	<p>Persons who do not in usual conditions make contact with extraneous-conductive-parts or stand on conducting surfaces</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>A</td> <td>A</td> <td>A</td> </tr> </table>		A	A	A									
	A	A	A												
BC3	Frequent	<p>Persons who are frequently in touch with extraneous-conductive-parts or stands on conducting services Locations with extraneous-conductive-parts, either numerous or of a large area</p> <p>Class of equipment according to KS IEC61140</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>0-01</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <td>X</td> <td>A</td> <td>A</td> <td>A</td> </tr> </table> <p>A Equipment permitted X Equipment prohibited Y Permitted if used as class 0</p>	0-01	I	II	III	X	A	A	A					
0-01	I	II	III												
X	A	A	A												
BC4	Continuous	Persons who are immersed in water or in long term permanent contact with metallic surroundings and for whom the possibility of interrupting contact is limited Metallic surroundings such as boilers and tanks	Under consideration												
BD	<b>Conditions of evacuation in an emergency</b>														
BD1	Low density / easy exit	Normal <sup>b</sup>  Low density occupation, easy conditions of evacuation  Buildings of normal or low height used for habitation													
BD2	Low density / difficult exit	Low density occupation, difficult conditions of evacuation  High-rise buildings													
BD3	High density / easy exit	High density occupation, easy conditions of evacuation  Locations open to the public (theatres, cinemas, departments stores, etc.)													
BD4	High density / difficult exit	High density occupation, difficult conditions of evacuation  High-rise buildings open to the public (hotels, hospitals, etc.)													

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only
BE	<b>Nature of processed or stored materials</b>		
BE1	No significant risk	Normal <sup>b</sup>	
BE2	Fire risks	<p>Manufacture, processing or storage of flammable materials including presence of dust</p> <p>Barns, wood-working shops, paper factories</p> <p>Equipment made of material retarding the spread of flame</p> <p>Arrangements such that a significant temperature rise or a spark within electrical equipment cannot initiate an external fire</p>	<p>Chapter 42</p> <p>Chapter 52</p>
BE3	Explosion risks	<p>Processing or storage of explosive or low-flash-point materials including presence of explosive dusts</p> <p>Oil refineries, hydrocarbon stores</p> <p>Requirements for electrical apparatus for explosive atmospheres (see KS IEC 60079),</p>	Under consideration
BE4	Contamination risks	<p>Presence of unprotected foodstuffs, pharmaceuticals, and similar products without protection</p> <p>Foodstuff industries, kitchens:</p> <p>Certain precautions may be necessary, in the event of fault, to prevent processed materials being contaminated by electrical equipment, e.g. by broken lamps</p> <p>Appropriate arrangements, such as:</p> <ul style="list-style-type: none"> <li>protection against falling debris from broken lamps and other fragile objects</li> <li>screens against harmful radiation such as infrared or ultraviolet</li> </ul>	Under consideration

PUBLIC REVIEW DRAFT MARCH 2026

### C CONSTRUCTION OF BUILDINGS:

Code	External influences	Characteristics required for selection and erection of equipment	Reference for information only
CA	<b>Construction materials</b>		
CA1	Non-combustible	Normal	
CA2	Combustible	Buildings mainly constructed of combustible materials Wooden buildings  Under consideration	IEC 60364-4-42
CB	<b>Building design</b>		
CB1	Negligible risks	Normal	
CB2	Propagation of fire	Buildings of which the shape and dimensions facilitate the spread of fire (e.g. chimney effect) High-rise buildings. Forced ventilation systems  Equipment made of material retarding the propagation of fire including fires not originating from the electrical installation.  Fire barriers	IEC 60364-4-42 IEC 60364-5-52
CB3	Movement	Risk due to structural movement (e.g. displacement)  Buildings of considerable length or erected on unstable ground	Contraction or expansion joints (under consideration)  IEC 60364-5-52
CB4	Flexible or unstable	Contraction or expansion joints in electrical wiring Structures which are weak or subject to movement (e.g. oscillation)  Tents, air-support structures, false ceilings, removable partitions. Installations to be structurally self-supporting  Under consideration	Flexible wiring  IEC 60364-5-52

PUBLIC REVIEW DRAFT MARCH 2026

PUBLIC REVIEW DRAFT MARCH 2026