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The Application of BS 7671: 2018 AMD 2 (2022) on the MOD Estate

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ESTATE MANAGEMENT

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Abbreviations

AFDD	Arc Fault Detection Device
AMD	Amendment
AE	Authorising Engineer
BS	British Standard
BS 7671	BS7671: 2018 Requirements for Electrical Installations (IET Wiring Regulations) as amended
CAFM	Computer aided facilities management
CO	Commanding Officer
CP	Competent Person
CoP	Code of Practice
DC	Direct Current
DIO	Defence Infrastructure Organisation
EAWR	Electricity at Work Regulations 1989
EFLI	Earth Fault Loop Impedance
EIC	Electrical Installation Certificate
EICR	Electrical Installation Condition Report
GN3	IET Guidance Note 3 Inspection and Testing
HoE	Head of Establishment
ICT	Information communication technology
IET	Institution of Engineering and Technology.
JSP	Joint Service Publication
LV	Low Voltage (not exceeding 1000V a.c. between conductors or 600V a.c. between conductors and Earth)
MMO	Maintenance Management Organisation
MOD	Ministry of Defence
NAPIT	National Association of Professional Inspectors and Testers
PME	Protective multiple earth
PV	Photovoltaic
RCBO	Residual Current Breaker with Over-Current
RCD	Residual Current Device
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
SFA	Service family accommodation
SKP (E)	Skilled person (electrically) [BS7671]
SPD	Surge protective device
TB	Technical bulletin
UPS	Uninterruptible Power Supply
USVF	United States Visiting Force

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1.0 AIM

The aim of the Technical Bulletin is to enable DIO Technical Services - Electrical Infrastructure to provide technical information and direction on BS7671 Requirements for Electrical Installations IET Wiring Regulations Eighteenth Edition Amendment 2 relating to the MOD estate. This Technical Bulletin provides direction on Amendment 2 from a MOD perspective but must always be read in conjunction with UK Regulations, Standards, and industry best practice.

2.0 DEROGATION

Any clause within this Technical Bulletin that is written as “shall” be followed is an absolute requirement. There may be occasions when it is not reasonably practicable to comply with a “shall” clause, or that the requirements placed upon it may result in an inefficient outcome either in the short or longer term. In these circumstances, a request to Technical Services Electrical Infrastructure for a derogation from the Technical Bulletin should be submitted.

A request for a derogation should be submitted in writing to the contact in “document information” and should include detailed information to enable the author to decide, including a comprehensive and (where possible) quantitative assessment of the impact of complying with the Technical Bulletin. References shall be made to the associated clause(s) within this Technical Bulletin and BS7671.

3.0 STATUTORY REQUIREMENTS

The legal requirement most relevant to this Technical Bulletin are the Electricity at Work Regulations 1989. It should be recognised that a British Standard such as BS 7671, carries no regulatory status. However, it is referenced as a method of deeming to comply with relevant UK legislation, as detailed within HSR25 Guidance on the Electricity at Work Regulations 1989, “*BS 7671 is a code of practice which is widely recognised and accepted in the UK and compliance with it is likely to achieve compliance with relevant aspects of the Electricity at Work Regulations 1989.*”

4.0 STATUS OF BS7671 AMD 2 FOR NEW INSTALLATIONS AND MODIFICATIONS

The introduction to Amendment 2 of BS 7671:2018, states: ‘*BS 7671:2018+A2:2022 Requirements for Electrical Installations was issued on 28th March 2022 and may be implemented immediately. BS 7671:2018+A1:2020 remains current and will be withdrawn on 27th September 2022.*’

It is of paramount importance, that all parties working with BS 7671 communicate with each other as early as possible where there are projects or contracts which straddle two editions or more of the standard.

Any electrical installation that has not reached the stage 4, detailed design (or equivalent) shall be designed in accordance with BS7671: 2018 + A2: 2022. Any tender pack as part of a design and build contract must take this into account.

For any project that is at stage 4, detailed design, or beyond, it is recommended that this should be brought in line with BS7671: 2018+A2: 2022. If this is not feasible the variances should be determined, understood, risk assessed and documented. Additional factors to consider if not utilising the latest standard include:

- upon initial verification, that the contractor can inspect, test, and certify to the older edition of BS7671. Most systems, software etc is now based on the latest edition.

- upon the 1st periodic inspection and testing period (frequency to be determined by the designer) the installation will be Inspected and tested to the latest edition and so the likelihood there will be several C3s (recommendation for improvement) against an almost new electrical installation.

Refer to IET article for further information and background <https://electrical.theiet.org/wiring-matters/years/2022/92-september-2022/back-to-the-forum-withdrawn-standards/>.

5.0 STATUS OF BS7671 AMD 2 FOR EXISTING INSTALLATIONS

BS 7671:2018+A2:2022 apply to the design, erection, and verification of electrical installations, also additions and alterations to existing installations. Existing installations that have been installed in accordance with earlier editions of BS7671 may not comply with BS 7671:2018+A2:2022 in every respect. This does not necessarily mean that they are unsafe for continued use or require upgrading.

All electrical installations shall have subsequent maintenance regimes inspected and tested in accordance with BS7671:2018+A2:2022. As stated above the standard isn't retrospective and the installation may not meet all the of the current standards. However, the observation codes (usually C3s) shall document these, where applicable.

6.0 GUIDANCE ON BS7671 AMD 2

The following link provides a list from the IET on an overview of the main changes within Amendment 2:2022 to BS 7176:2018 18th Edition IET Wiring Regulations (publishing 28 March 2022).

<https://electrical.theiet.org/bs-7671/18th-edition-resources/18th-edition-changes/>

Section 6 below provides further advise specific to MOD. If any areas are not covered within Section 6, but further clarification is deemed necessary please contact the author and given point of contact.

7.0 DIRECTION ON SPECIFIC CHANGES.

7.1 RCD Application

7.1.1 Background

Previous editions allowed building owners to omit RCDs in certain cases where a risk assessment had been complete. This is still an option where certain conditions are met. However, AMD 2 now insists that an RCD must be provided where ordinary persons, children or disabled persons are present.

7.1.2 AMD 2 Requirement

Chapter 41 Protection against electric shock, Clause 411.3.3

“In AC systems, additional protection by means of an RCD with a rated residual operating current not exceeding 30 mA shall be provided for:

- (i) socket-outlets with a rated current not exceeding 32 A in locations where they are liable to be used by persons of capability BA1, BA3 or children (BA2, BA3),*
- (ii) socket-outlets with a rated current not exceeding 32 A in other locations, and*
- (iii) mobile equipment with a rated current not exceeding 32 A for use outdoors.*

An exception to (ii) but not (i) or (iii) is permitted where a suitably documented risk assessment undertaken with the involvement of a skilled person (electrically) determines that RCD protection is not necessary.”

“Instructed person (electrically). Person adequately advised or supervised by a skilled person (as defined) to enable that person to perceive risks and to avoid hazards which electricity can create.”

“Skilled person (electrically). Person who possesses, as appropriate to the nature of the electrical work to be undertaken, adequate education, training, and practical skills, and who is able to perceive risks and avoid hazards which electricity can create.”

7.1.3 DIO TS direction

RCDs shall be installed for socket-outlets with a rated current not exceeding 32 A for all new installations. The only exceptions being locations where socket-outlets are to be used by instructed and/or skilled persons and the completion of a risk assessment. The designer and the AE for the site shall complete and sign the risk assessment. The HoE shall be informed.

For existing installations, it is recommended to install RCDs where reasonably practicable. Where RCDs are not installed a risk assessment will be required. A SkP(E) is to complete the risk assessment, which shall be reviewed by the AE. The HoE shall be informed.

7.2 RCD Selection

7.2.1 RCD types

The following RCDs are available with the respective symbols. It is important to select the correct Type of RCD for the equipment to be used. The Type of RCD will depend on the characteristics of the equipment being supplied.



Type AC

RCD tripping on alternating sinusoidal residual current, suddenly applied or smoothly increasing



Type A

RCD tripping on alternating sinusoidal residual current and on residual pulsating direct current, suddenly applied, or smoothly increasing



Type F

Suitable for equipment with frequency-controlled speed drives. Can detect and respond as per type A and high frequency residual currents.



Type B

Can detect and respond as per type F and additional smooth DC residual currents. Suitable for electric vehicle chargers and PV supplies.

7.2.2 Background

Before AMD 2, clause 531.3.3 stated that you may use type AC RCDs for general purposes.

As described above type AC RCDs will be ineffective for equipment with DC residual current created by most non-linear electrical equipment, such as those circuits containing electronic devices. Type AC RCDs are suitable for equipment, which is purely resistive, e.g., a resistive heater with a mechanical switch. Any equipment with electronics, such as LED drivers, variable speed drives etc. will have an element of DC residual current. This can lead to reduced protection from a Type AC RCD or at worst the Type AC RCD not operating at all.

7.2.3 AMD 2 Requirement

The requirement is within clause 531.3.3 but the point of note is “*RCD Type AC shall only be used to serve fixed equipment, where it is known that the load current contains no DC components.*”

7.2.4 DIO TS direction

Type AC RCD shall not be installed for any new installation, except for fixed equipment with no dc residual current. Where the equipment is known the designer should contact the equipment’s manufacturers to determine the RCD Type required. It is a legal requirement of UK Product Safety Regulations for manufacturers to provide clear installation instructions to enable safe installation.

For existing installations, it is to be determined, by the inspector [person conducting EICR], whether the RCDs are acceptable. This will be particularly relevant for type AC RCDs installed as part of a socket outlet circuit, where the equipment has changed over time. This should form part of the routine checks and periodic inspection and testing of the fixed wiring. The risks need to be understood, managed, and controlled with replacement of RCDs/RCBOs where necessary.

7.3 RCD protection for external lighting

7.3.1 Background

AMD 2 has added that this requirement is only applicable where “*accessible to the public*” and added a list of equipment that is excluded.

7.3.2 AMD 2 Requirement

Additional protection, Clause 714.411.3.4

“Lighting that is accessible to the public shall have additional protection by an RCD having the characteristics specified in Regulation 415.1.1. Examples include:

- (i) gardens, spaces open to the public*
 - (ii) telephone kiosks*
 - (iii) bus shelters*
 - (iv) advertising panels and town plans.*
- This list is not exhaustive.*
The following are excluded:
- (v) Street lighting & traffic signage*
 - (vi) Illumination of monuments*
 - (vii) Platform lighting at rail / bus stations.”*

7.3.3 DIO TS direction

This would include any external lighting that is not on the excluded list and is accessible to the public. The location of the RCD should be considered from a maintenance perspective and conducting the 6 monthly functional testing.

For existing installations, it is recommended to install RCDs where reasonably practicable. Where RCDs are not installed the Skilled Person conducting the inspection and testing and the AE for the site shall complete and sign the risk assessment. The HoE shall be informed.

7.4 Protected escape routes

7.4.1 Background

AMD 2 introduces a new phrase: protected escape route, which aligns with Building Regulations Part B. Previous editions of BS 7671 referred to escape routes, which was not defined and led to misinterpretation. AMD 2, clause 442.1 defines a protected escape route as “a route enclosed with specified fire-resisting construction designated for escape to a place of safety in the event of an emergency”

7.4.2 AMD 2 Requirement

Clause 422.2 states “*Cables or other electrical equipment shall not be installed in a protected escape route unless part of: -*

- i. an essential fire safety or related safety system*
- ii. general needs lighting*
- iii. socket-outlets provided for cleaning or maintenance.*

7.4.3 DIO TS direction

For new builds or major refurbishment, the design team shall establish whether a building needs to have protected escape routes as defined within the Building Regulations Part B. The likelihood protected escape routes will be applicable for larger or more complex buildings. This shall be discussed and agreed between the project team, appointed Building Control Advisor and appointed fire specialist early within the design process.

Generally, this means cables and electrical equipment in a protected escape routes should be limited to lighting and associated accessories, emergency lighting and fire detection and alarm systems, although cables for other safety systems may be necessary.

Cables installed in a protected escape route shall:

- Meet the fire performance requirements laid out in clause 422.2
- shall be as short as practicable,

Cables encroaching on escape routes shall not be installed within arm’s reach unless they are provided with protection against mechanical damage likely to occur during an evacuation.

The use of cables for equipment outside of the protected escape route can be installed within the protected escape route but shall be in a fire resisting enclosure. An access and maintenance strategy shall be produced as part of this approach. The distribution routes may be determined by the location of protected escape routes, in all instances the distribution routes must consider future access and maintenance requirements.

Not all lobbies, corridors and stairways are protected escape routes as defined within the Building Regulations. It is essential that available fire safety information on the building, (fire strategy’s fire risk assessments, as built drawings, operation, and maintenance manual information etc.) be consulted to identify the protected escape routes. Where inadequate information exists, refer to the project designer, appointed Building Control Advisor and appointed fire specialist.

For minor modifications to existing buildings clause 422.2 shall be applied so far as is reasonably practicable. This could be achieved for cables or other circuits passing through the protected escape route to be installed in a non-combustible conduit e.g., steel. There shall be no cable joints, connector blocks or ancillaries for equipment not associated with the protected escape route to be installed within the protected escape route.

For any works carried out on fire compartmentation refer to Technical Standard – 2022/02.

7.5 Arc fault detection devices (AFDD)

7.5.1 Background

AFDD's requirements has changed from "recommended in AC final circuits", to, "shall be provided for single phase AC final circuits" in buildings where risk to life is greater, either due to the building construction or by its occupants.

7.5.2 AMD 2 Requirement

Chapter 42 Protection against thermal effects, clause 421.1.7 has been redrafted.

"Arc fault detection devices (AFDD) conforming to BS EN 62606 shall be provided for single-phase AC final circuits supplying socket-outlets with a rated current not exceeding 32 A in:

- *Higher Risk Residential Buildings, (HRRB) defined within the Building Safety Act 2022*
- *Houses in Multiple Occupation, (HMO)*
- *Purpose-built student accommodation*
- *Care homes."*

"For all other premises, the use of AFDDs conforming to BS EN 62606 is recommended for single-phase AC final circuits supplying socket-outlets not exceeding 32 A."

7.5.3 DIO TS direction

On the MOD estate AFDDs conforming to BS EN 62606 shall be provided for single-phase AC final circuits supplying socket-outlets with a rated current not exceeding 32 A as detailed within the above clause and additional in:

- Sleeping accommodation where multiple occupants are combined within a single building e.g., single living accommodation, training accommodation and Mess accommodation.
- Other buildings where there is the designated for personnel to sleep e.g., medical facilities, hospitals, fire stations.

This excludes SFA that isn't part of HRRB.

For all other premises, the regulation recommends AFDDs for single-phase AC final circuits supplying socket-outlets not exceeding 32 A. As part of the project design process, a design risk assessment shall be conducted to determine where AFDDs are to be installed.

For any existing installation that falls within the requirements of clauses 7.5.1 or 7.5.2 it is recommended that AFDDs should be installed.

7.6 Surge Protection Devices

7.6.1 Background

The Risk Assessment method previously detailed in clause 443.5 has now been deleted. SPDs shall now be installed as described within clause 443.4.1.

7.6.2 AMD 2 Requirement

Transient overvoltages due to the effects of indirect lightning strokes, clause 443.4.1

"Protection against transient overvoltages shall be provided where the consequence caused by the overvoltage could result in:

- (i) serious injury to, or loss of, human life
- (ii) failure of a safety service, as defined in Part 2
- (iii) significant financial or data loss.

For all other cases, protection against transient overvoltages shall be provided unless the owner of the installation declares it is not required due to any loss or damage being tolerable and they accept the risk of damage to equipment and any consequential loss."

7.6.3 DIO TS direction

For new builds or major refurbishments SPDs shall follow the clause in its entirety.

Existing installation shall be assessed against AMD 2 and where not compliant should be recommended for improvement (C3).

7.7 ICT Installations

7.7.1 Background

AMD 2 has deleted clause 543.7.1.201. which stated, "*Equipment having a protective conductor current exceeding 3.5 mA but not exceeding 10 mA, shall be either permanently connected to the fixed wiring of the installation without the use of a plug and socket-outlet or connected by means of a plug and socket-outlet complying with BS EN 60309-2.*" The additional requirements associated with the installation of equipment having high protective conductor currents is only applicable for an excess of 10 mA.

7.7.2 AMD 2 Requirement

Chapter 54, Earthing arrangements and protective conductors' clause 543.7, has been modified for the installation of equipment having high protective conductor currents. ICT cabinets are a typical example of this type of equipment.

Clause 543.7.1.202 ii (b) relates to BSEN 60309-2 plugs, "*the protective conductor of the associated flexible cable is of a cross-sectional area not less than that of the line conductor*" has been deleted and is longer allowed.

7.7.3 DIO TS direction

Follow clause 543.7, which requires, that individual items of electrical equipment having a protective conductor current exceeding 10 mA should be either permanently connected to the fixed wiring of the installation or connected by means of a plug and socket-outlet complying with BS EN 60309-2 or have an earth monitoring system. Refer to the clause for further details.

7.8 Protective bonding conductors

7.8.1 Background

An update has been made relating to bonding of outbuildings. Any outbuilding supplied via a TN-S or TT earthing system can size the bonding conductor in accordance with the incoming cable protective conductor related to that building. Previous editions of BS7671 required the designer to size the bonding conductor based on the main building. This is still the case for TN-C-S systems. AMD 2 allows the designer to reduce the bonding conductor size, preserving material.

7.8.2 AMD 2 Requirement

544.1 Main protective bonding conductor's clause 544.1.1

"Except where PME conditions apply, a main protective bonding conductor shall have a cross sectional area not less than half the cross-sectional area required for the earthing conductor of the installation. Where an installation serves more than one building, a main protective bonding conductor shall be selected in accordance with the characteristics of the distribution circuit protective conductor

for that particular building. The cross-sectional area shall be not less than 6 mm², and need not exceed 25 mm² if the bonding conductor is of copper or a cross-sectional area affording equivalent conductance in other metals.”

7.8.3 DIO TS direction

The supply arrangement must be confirmed. This information should be available on the EIC or the EICR. If confirmed not PME, often described as s TNC-S, you are to follow the requirement.

7.9 Protective equipotential bonding

7.9.1 Background

AMD 2 has added the words *“liable to introduce a dangerous potential difference”* from previous editions.

7.9.2 AMD 2 Requirement

411.3.1.2 Protective equipotential bonding

“In each consumer’s installation within a building, extraneous-conductive-parts liable to introduce a dangerous potential difference shall be connected to the main earthing terminal by protective bonding conductors complying with Chapter 54. Examples of extraneous-conductive-parts may include:

- (i) metallic water installation pipes*
- (ii) metallic gas installation pipes*
- (iii) other metallic installation pipework and ducting*
- (iv) central heating and air conditioning systems*
- (v) exposed metallic structural parts of the building.*

NOTE: Where non-metallic pipes (e.g., plastic) enter a building and are then connected to metallic pipes within the building, the metallic pipes within the building do not normally require protective bonding as they are unlikely to be extraneous-conductive-parts.”

“Extraneous-conductive-part. A conductive part liable to introduce a potential, generally Earth potential, and not forming part of the electrical installation.”

7.9.3 DIO TS direction

Where metallic services enter the building, they should be connected to the main earthing terminal.

Where non-metallic pipes enter the building and are connected to metallic pipes the designer, shall assess, and record, as to likelihood of the metallic pipes introducing a dangerous potential difference, to determine the need to connect to the main earthing terminal.

For existing installation this assessment should be carried out by a skilled person usually via a visual inspection as part of periodic inspection and testing. Particular attention should be paid to if the pipe work enters the ground downstream

7.10 Inspection and testing of RCDs

7.10.1 Background

Previously editions of BS7671 required RCDs to disconnects within 40ms when tested at a current equal to or higher than five times its rated residual operating current. AMD 2 now only requires this to be a one times current test.

7.10.1 AMD 2 Requirement

Regardless of RCD Type, effectiveness is deemed to have been verified where an RCD disconnects

within the time stated below with an alternating current test at rated residual operating current ($I_{\Delta n}$):

- For general non-delay type, 300 ms maximum
- For delay 'S' type RCD, between 130 ms minimum and 500 ms maximum.

7.10.2 DIO TS direction

All existing and new installation shall follow the requirements within AMD 2.

7.11 Consumer unit Inspection and testing labels

7.11.1 Background

Previously BS7671 required Electrical Installation to have labels at the origin of supply upon completion of periodic inspection and testing inclusive of domestic.

7.11.2 AMD 2 Requirement

"The requirements of this regulation need not be applied for domestic (household) premises or similar installations where certification for initial verification, complete with Guidance for Recipients as detailed in Appendix 6, has been issued to the person ordering the work."

7.11.3 DIO TS direction

Labels should be omitted from domestic consumer unit. Inspection and testing shall be controlled via the CAFM and record documentation. Occupants shall be informed of the change.

ANNEX A – FURTHER REFERENCES / BIBLIOGRAPHY

- BS 7671:2018+A2:2022 Requirements for Electrical Installations
- HSR 25 (3rd Edition): Memorandum of Guidance on the Electricity at Work Regulations 1989
- IET Code of Practices
- IET Guidance Notes
- IET Onsite guide
- NAPIT EICR Codebreakers

ANNEX B – RISK ASSESSMENT FOR OMMISION OF A RCDS

This Risk Assessment is to be uploaded on the CAFM or equivalent with the associated EICR and electrical certification.

Site Name:	Building Name/No:	Room(s) supplied:	Equipment supplied:

1. This Risk Assessment covers the requirement for a Risk Assessment where it is deemed appropriate to omit RCD protection for socket outlets not exceeding 32A within the MOD Estate.
2. A Risk assessment is required under the exception detailed under clause 411.3.3.

“411.3.3 Additional requirements for socket-outlets and for the supply of mobile equipment for use outdoors

In AC systems, additional protection by means of an RCD with a rated residual operating current not exceeding 30 mA shall be provided for:

- (i) socket-outlets with a rated current not exceeding 32 A in locations where they are liable to be used by persons of capability BA1, BA3 or children (BA2, BA3),*
- (ii) socket-outlets with a rated current not exceeding 32 A in other locations, and*
- (iii) mobile equipment with a rated current not exceeding 32 A for use outdoors.*

An exception to (ii) but not (i) or (iii) is permitted where a suitably documented risk assessment undertaken with the involvement of a skilled person (electrically) determines that RCD protection is not necessary.”

Guidance on assessing risk level

Likelihood (1-5) should consider the following to determine the likelihood of an incident: -

- Speak with local H&S advisor and/or review IMS for reported accidents and incidents.
- Check if any reported RIDDOR incidents based on same set up.
- location of sockets and associated connected equipment
- the environment,
- Class of equipment connected. If unknown should assume class I.
- Maintenance regimes.
- Installation is under the control of a skilled person (electrically).

The Severity (1-5) should consider the following: -

- Previous incidents resulted in electric shock or uncontrolled electrical discharge.
- The impact of omitting RCDs.
- Any existing remedials noted on the EICR that could impact electrical safety.
- Check the EICR relating to the bonding for the associated circuit.

The risk is dependent on the conditions and control measures detailed below being in place.

Description of Hazard Being Assessed	Potential for harm Likelihood x Severity = Risk Level (1-5)		
	Likelihood (1-5)	Severity (1-5)	Risk Level (1-25)
Omission of RCDs for socket outlets risk outcome			
Control measures in place to reduce likelihood or severity	Potential for harm Likelihood x Severity = Risk Level (1-5)		
	Likelihood (1-5)	Severity (1-5)	Risk Level (1-25)
Omission of RCDs risk outcome			

Outcome Possibilities and Level of Risk			
Low Risk 1-5			
Moderate Risk 6-10			
Substantial Risk 11-15			
Extreme Risk 16-25			
Risk Assessment Outcome			
Risk Assessment Outcome(s)			
Risk/Task assessed without control measures or safe systems of work in place and is deemed to be an acceptable/unacceptable outcome (delete as appropriate)			
Designer/SkP(E) (Designer for new installations, inspector for existing)			
Risk Assessor Name	Company	Signature	Date
Authorising Engineer			
Risk Assessor Name	Company	Signature	Date
HoE/HoE representative			
HoE/HoE representative Name	Position/Post	Date informed	

Any control measures applied should be maintained and monitored.

Refer to NAPIT EICR Codebreakers Part 2 Risk Assessment for Omission of an RCD for further guidance.