

An aerial photograph of a large, flat industrial roof. The roof is covered with a grid of metal racking for solar panels. Several large, white HVAC units are mounted on the roof. In the background, there are some electrical control boxes and a small structure. The overall scene is a typical industrial rooftop solar installation.

Ivegate

Building Services Engineers

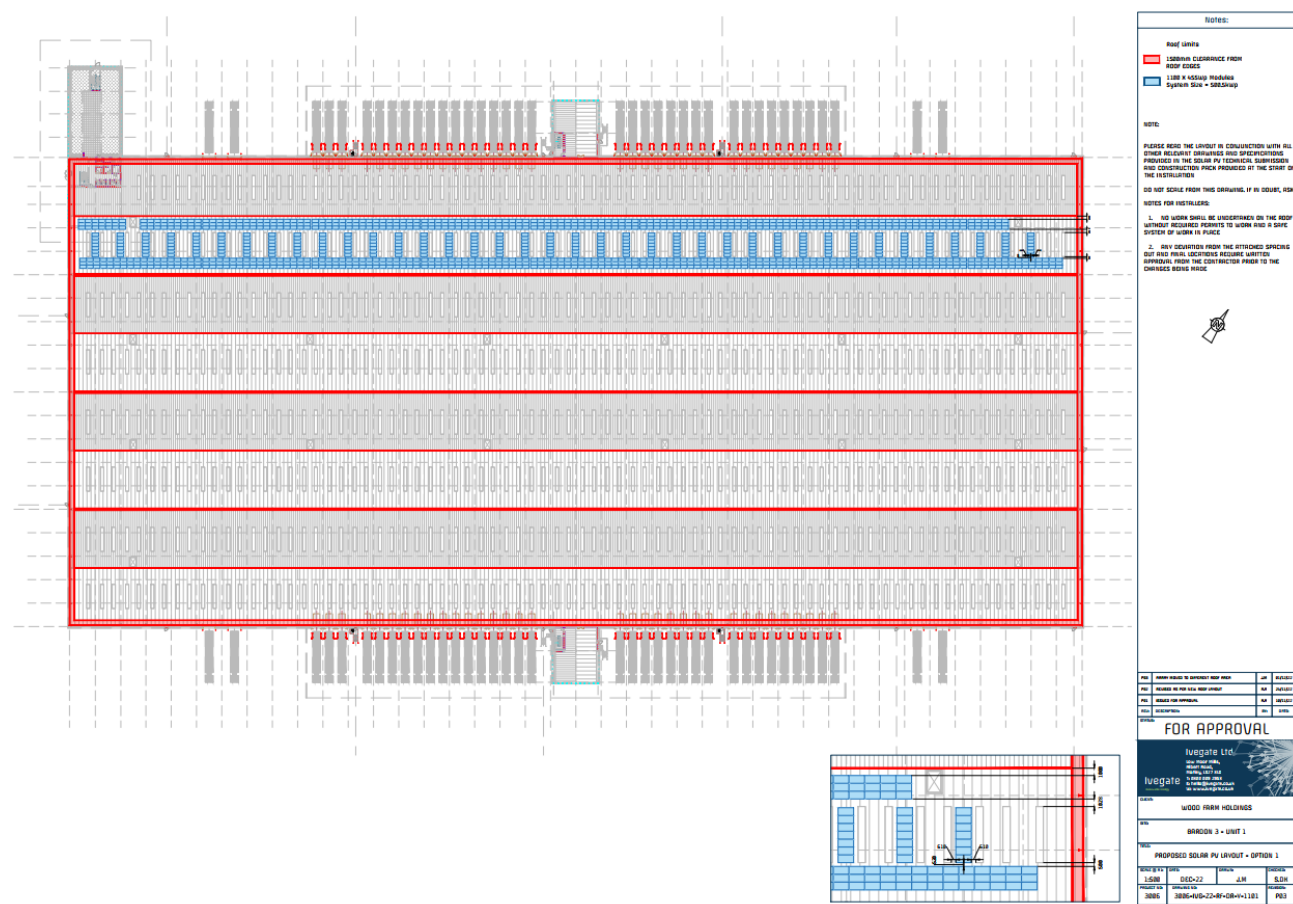
Proposed Solar PV Safe Access & Maintenance Statement

Project:
Bardon 3
For Marc Moran

Reference:
3006– Revision B

This document is intended to give the user an understanding of the proposed procedure for safe access to the solar PV system for the purposes of general maintenance and replacement of system parts (if required).

The solar PV system is located on the roof of each warehouse and is located below and between fragile rooflights as indicated in the plan below; (Plan below shows a typical install and is subject to final design)

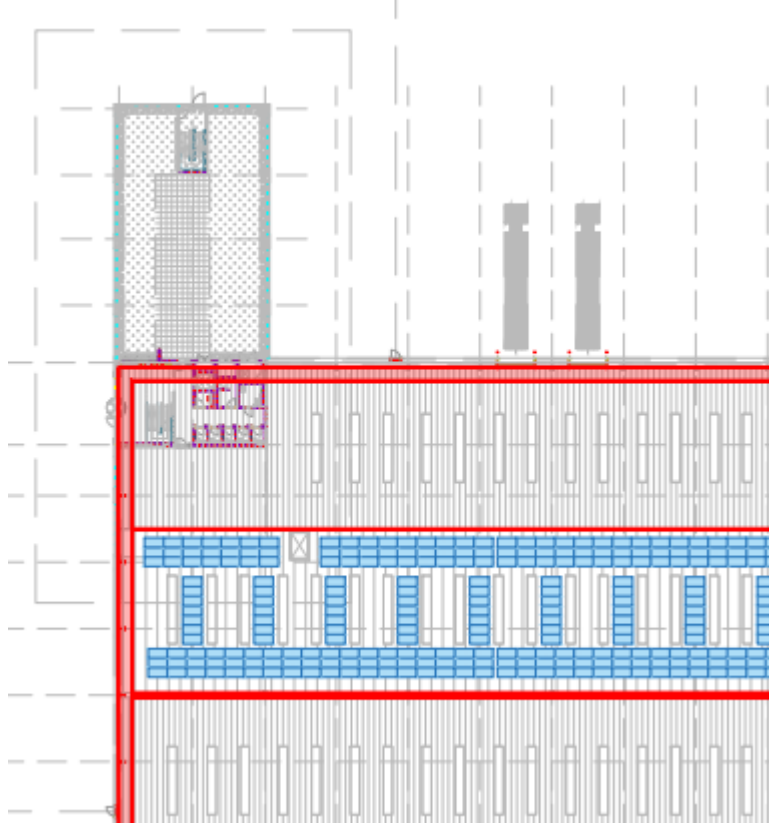


D. 001 – Roof level Solar PV system – Bardon 3

It is recommended the engineer carrying out servicing of the PV arrays or the personnel carrying out visual inspections on the system familiarises themselves with this document to understand the location of equipment and how to safely access all areas of the system.

ACCESSING THE LOCATION OF THE SOLAR PV ARRAYS

Access to the roof will be via the built in access hatch ways indicated in red below. Internal locations for the roof access hatches have not yet been confirmed, but it is assumed the main point of access as time will be from the internal plant deck via a CAT ladder installed by the main contractor.



D. 003 – Roof access hatch locations for high level roof – Bardon 3

ACCESS ONTO THE ROOF

At this stage we anticipate there would be a mansafe system installed 2 meters in from the perimeter of the building as noted by the red perimeter line in the above layout. Min. 600mm clearances have been left around all rooflights to allow for access up and down slopes where required for future maintenance.

Alternatively, the advancement of new technology has made the use of Drones an ideal inspection tool for visual inspections of PV arrays which should be considered as an alternative to accessing the roof, this can be carried out by a trained operator (correctly insured for commercial use of a drone) and operators can be safely at ground level whilst the visual inspections are carried out. This is also an ideal way to gather evidence for completion of a maintenance report evidencing an inspection of modules.

After an initial inspection of the site location, there are no immediate concerns for flying a drone in the area, so this could be an ideal option for this project.

GENERAL MAINEANCE OF THE SOLAR PV SYSTEM

It is worth noting that a solar PV system in general is considered “low maintenance” due to the fact there are no mechanical parts on the solar panels and when elevated further than 5 degrees (this system is elevated at 6 degrees avg.) are considered self-cleaning when it rains.

For the avoidance of doubt, this document should be read in conjunction with the operation & maintenance manual issued at project completion and the included user manuals provided within it.

Ivegate would recommend that an annual service is carried out, in addition to monthly or quarterly visual checks of the system. Whilst considered ‘low maintenance’, its important this is carried out to ensure the system remains in good working order and to prolong its service lifetime.

Failure to maintain the system according to the recommended maintenance schedule may invalidate Ivegate’s warranty. Currently, there is no maintenance package in place for the solar PV system on this project.

The maintenance of the system should only be carried out by suitably qualified or trained personnel. Ivegate can accept no liability for maintenance undertaken by others. the client is free to consider other O&M companies suitably qualified to carry out maintenance on solar PV systems should they wish.

The following provides an outline of the checks/works required on each visit. For further information and substantiation; please refer to the operation & maintenance manual included which will be provided on project completion.

- Quarterly or Monthly Visual Checks

To ensure the system is in good working order; the following visual checks should be carried out on a monthly, or at least quarterly period.

- Visual check of the inverter to ensure there are no error prompts and that the system is generating
- Check of the generation meter to check the generation yield is meeting the estimated projections
- Visual check of the panels to ensure there is no build up or dirt or soiling on the modules or any visible damage to panels.
- Visual check over the system cabling, to ensure there is no physical damage to cables or connections.
- Production of a visual checklist for the PV system to retain on file as proof of visual checks completed.

If there is any damage or errors present during these checks; please contact us. Repairs can be carried out during our defects/installation warranty period. After this period, we can advise on costs associated with the required repairs or the best way to proceed. Alternatively, if a maintenance package is sought for this project, they will also be able to assist where required.

- Annual Maintenance of the solar PV system

To maintain good working order of the PV system and ensure the lifespan of the arrays; the following tasks should be completed during an annual maintenance visit; This list is not exhaustive and some/all tasks may be required depending on the current state & age of the PV system;

- Annual cleaning to keep efficiencies maximised, especially where bird soiling or atmospheric pollution has degraded the surface of the panel
- Checking of module clamps Torque settings to ensure clamps are tightened as per manufacturers recommendations and have not become loose.
- Visual inspection of all panels
- Photovoltaic module string tests
- Inverter system checks
- Junction box, isolator, distribution board and cabling inspection

- Meter check
- Labelling/schematic check
- Energy production analysis
- Voltage and current check
- production of maintenance report

Following the annual maintenance of the system; the engineer should produce an on-site report detailing works carried out, and details of any faults (if any) that may be found during the maintenance works that weren't able to be resolved whilst on site.

For reference, we have included a blank form in appendix A which can be used by the service engineer to highlight his findings and indicates the relevant checks required on the system.

CLEANING OF MODULES, REPLACEMENT OR TEMPORARY REMOVAL OF PARTS AND ACCESS TO PANELS IN THE MIDDLE OF AN ARRAY.

The following has been provided as a guide on the proposed method of access to the solar PV system for the purposes of carrying out the above tasks. Roof works should always be carried out by a minimum of 2 people at all times.

Cleaning of modules

For the purposes of cleaning the panels, we re-commend that this project takes advantage of new, safer technology in using robots to clean the panels between rooflights, omitting the need to access modules down the side next to roof lights.

The robot is fixed with a soap dispenser and hose attachment and comes complete with a caterpillar type tyre that grips well to the modules, (see picture example below), the robot would be controlled from a remote panel by the qualified/trained engineer, who can safely operate the robot within a safe zone on the roof.

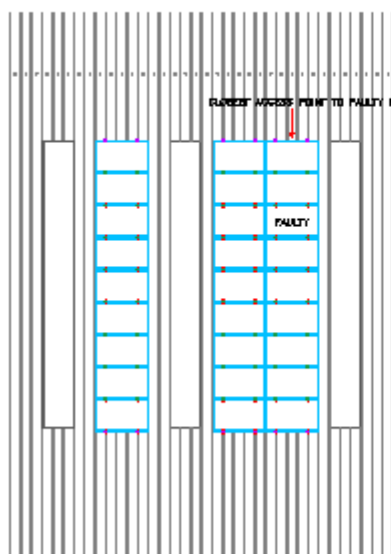


D. 003 – Cleaning of modules by Robot example

Access / Replacement of specific modules

In the event of having to replace a faulty module, panels can be removed, one by one from any position to reach the affected panel meaning there will be sufficient space to allow safe working.

ACCESSING A FAULTY/SOILED PANEL ONCE INSTALLED

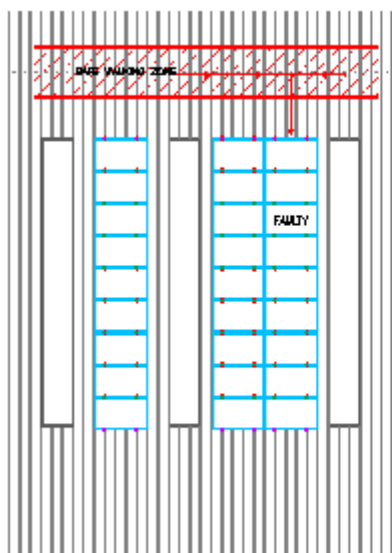


NOTE: BEFORE PROCEEDING WITH ANY WORKS ON PV PANELS. THE AFFECTED STRING SHOULD BE SAFELY ISOLATED AT THE NEAREST AVAILABLE POINT. (IN THIS CASE, BACK AT THE INVERTER).

THE PRINCIPLE OF ACCESSING A FAULTY OR SOILED MODULE IS THE SAME METHOD USED DURING THE INSTALLATION PROCESS. AT NO POINT ARE PANELS ACCESSED BETWEEN GAPS EITHER SIDE OF THE ROOF LIGHT.

IN CASE OF ACCESS DUE TO A FAULTY PANEL, OR IN NEED OF CLEANING PURPOSES. A QUALIFIED ENGINEER SHALL ACCESS THE PANEL FROM THE NEAREST POINT ON THE AFFECTED ROW.

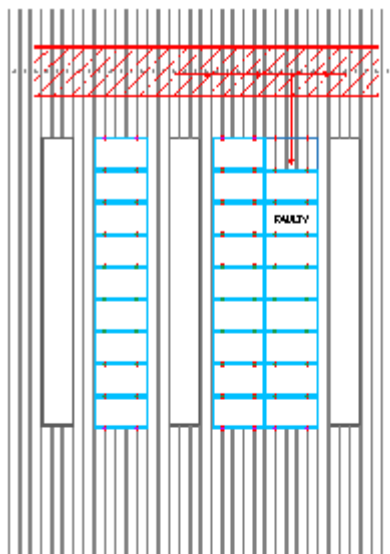
IN THE EXAMPLE PROVIDED TO THE LEFT, THE NEAREST ACCESS POINT IS HIGHLIGHTED BY THE RED ARROW.



ENGINEER TO WALK ALONG THE SAFEST POINT OF THE ROOF WHEN ACCESSING THE PANELS. ON A TRAPEZOIDAL SHEET, THE LIP OF THE SHEETS ARE CONNECTED BY A JOINTING SCREW WHICH PROVIDES A SEAL BETWEEN THE TWO SHEETS. THESE SCREWS ARE USUALLY OVERLAIN ON A PURLIN TO THE UNDERSIDE OF THE ROOF AND IS CONSIDERED THE STRONGEST POINTS OF THE ROOF PROFILE.

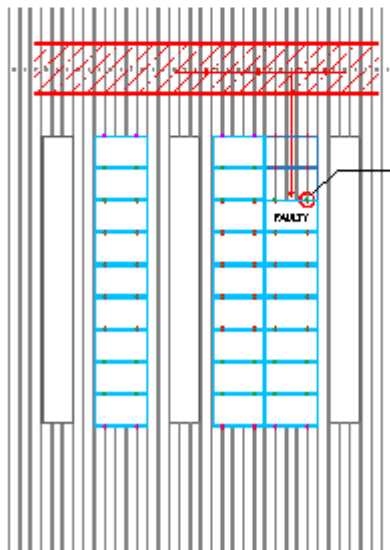
THE EXAMPLE DRAWING SHOWS A HATCHED RED ZONE WHERE THE ENGINEER IS TO WALK ALONG WHEN ACCESSING THE PANELS. AGAIN, THIS WILL BE FROM THE NEAREST AVAILABLE POINT. (NOTE: EXISTING MAN-SAFE LINES TO BE USED WHEN PRESENT, ENGINEERS NOT TO WALK BETWEEN THE GAPS ON EITHER SIDE OF THE PANELS TO GAIN ACCESS).

ONCE ARRIVING AT THE CLOSEST ROW OF PANELS, THE ENGINEER SHALL PROCEED TO REMOVE THE END PANEL TO THAT ROW.



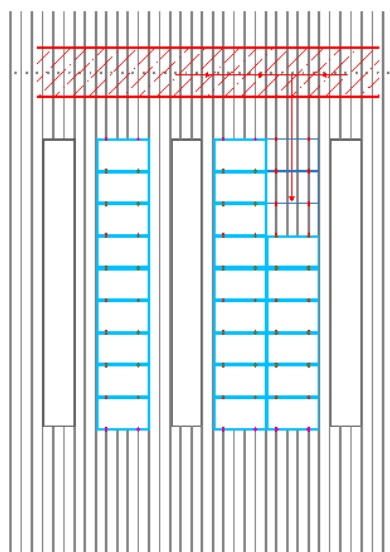
ENGINEER SHALL LOOSEN THE END CLAMPS TO THE FIRST PANEL, AND REMOVE THE PANEL FROM THAT ROW AND TEMPORARILY DISCONNECT THE DC STRINGS (PANELS WILL BE PLACED IN THE RED HATCHED ZONE TEMPORARILY, AWAY FROM ROOF LIGHTS).

THE ENGINEER WILL CONTINUE IN THIS MANNER UNTIL REACHING THE FAULTY/SOILED MODULE.



MID CLAMPS TO BE REMOVED WHEN ACCESSING EACH PANEL (AS INDICATED BY THE CIRCLE).

MID CLAMPS.



ONCE REACHING THE AFFECTED PANEL. THIS CAN BE REPLACED IF NECESSARY.

ONCE WORKS HAVE BEEN CARRIED OUT, THE ENGINEER SHALL CAREFULLY PLACE THE PANELS BACK INTO THEIR ORIGINAL POSITION AND RE-CONNECT THE STRINGS BEFORE TIGHTENING THE CLAMPS AS REQUIRED.

AT NO POINT SHOULD THE ENGINEER BE TEMPORARILY STORING OR WALKING NEAR ANY ROOF LIGHTS THROUGHOUT ANY WORKS INVOLVING PV PANELS.

ONCE STRINGS AND PANELS ARE RE-CONNECTED, THE ENGINEER CAN CARRY OUT THE RELEVANT CHECKS TO ENSURE THE SYSTEM IS WORKING CORRECTLY.

All works on the roof are to be strictly carried out in accordance with site specific risk assessments & method statements (RAMS) and any relevant permits to work please note the following statements that are also included in the risk assessment register with the main contractors O&M literature.

1. The client is strongly advised not to adapt the system in any way. If there is a need to adapt or re-locate any of the equipment in any way, the client is advised to contact the installer to ensure any required movement or modification can be approved before undertaking any works.
2. It should be noted that any changes or adaptations to the system without prior authorization from the installer would invalidate the warranty provided on the system.
3. For any further information or clarification, the client is advised to refer to the operation and maintenance manuals provided at hand over.

For any further information or clarifications, please don't hesitate to contact Ivegate who will be happy to assist in any way they can.

APPENDIX A

SOLAR PV INSPECTION REPORT TEMPLATE

SOLAR PV INSPECTION FORM



Project

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General Installation (electrical - ref IEC60364-6-61)

- ☐ Equipment Compliant with standards, correctly selected & not damaged
- ☐ Equipment accessible for operation, inspection & maintenance
- ☐ Equipment and accessories correctly connected
- ☐ Particular protective measures for special location
- ☐ Equipment and protective measures appropriate to external influences
- ☐ System installed to prevent mutual detrimental influence
- ☐ Conductors connected and identified
- ☐ Conductors selected for current carrying capacity and voltage drop
- ☐ Conductors routed in safe zone or protected against mechanical damage
- ☐ Presence of fire barriers, seals and protection against thermal effects

General Installation (Mechanical)

- ☐ Ventilation provided behind array to prevent overheating/ fire risk
- ☐ Array Frame and material corrosion proof
- ☐ Array Frame correctly fixed and stable; Roof fixings weatherproof
- ☐ Cable entry weatherproof

Protection against overvoltage/electric shock

- ☐ Live parts Insulated, protected by barrier/enclosure. Placed out of reach of class II
- ☐ Array Frame equipotential bonding present (only relevant if required). Frame clamped direct to roof.
- ☐ Surge protection devices present (only relevant if required) Integral to inverters
- ☐ RCD provided (only relevant if required)
- ☐ Frame correctly integrated with existing LPS installation. Frame clamped direct to roof sheet

DC System

- ☐ Physical separation of a.c. And d.c. Cables
- ☐ d.c. Switch disconnecter fitted (to IEC60364 - 712.536.2.2) Integral to inverter
- ☐ d.c. Cables- protective and reinforced insulation (only relevant if required)
- ☐ All d.c. Components rated for operation at max d.c. Sstem voltage (Voc stc x 1.25)
- ☐ PV strings fused or blocking diodes fitted (only relevant if required)

AC System

- ☐ a.c. Isolator lockable in off position only
- ☐ Inverter protection settings to local regulations

Labelling & Identification

- ☐ General Labelling of circuits, protective devices, switches and terminals (to IEC60.64-6-61)
- ☐ Protection settings & installer details displayed on site
- ☐ Emergency shutdown procedure displayed on site
- ☐ a.c. Isolator clearly labelled
- ☐ d.c. Isolator/ junction boxes suitably labelled
- ☐ Signs & Labels suitable affixed and durable

Comments

Inspected by:

Date:

Signed

Ivegate

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Prevention of mutual detrimental influence

A **Protection against both direct and indirect contact**

	SELV (note 1)
	Limitation of discharge of energy

B Protection against Direct Contact

	Insulation of Live Parts
	Barriers or enclosures
	Obstacles (note 3)
	Placing out of Reach (Note 4)
	PELV
	Presence of RCD for supplementary protection
C	Protection against indirect contact:
	EEBADS including:
	Presence of Earthing conductor
	Presence of circuit protective conductors
	Presence of main equipotential bonding conductors
	Presence of supplementary equipotential bonding conductors
	Presence of earthing arrangements for combined protective and functional purposes
	Presence of adequate arrangements for alternative source(s), where applicable
	Presence of residual current device(s)
	Use of class II equipment or equivalent insulation (note 5)
	Use of Class II equipment or equivalent insulation (note 5)
	Non conducting location: (note 6) absence of protective conductors
	Earth free equipotential bonding: (note 7) presence of earth free equipotential bonding conductors
	electrical Separation (note 8)

	Proximity of non electrical services and other influences
	Segregation of band I and band II circuits or band II insulation used
	Segregation of Safety Circuits

Identification

	Presence of diagrams, instructions, circuit charts and similar information
	Presence of danger notices and other warning notices
	Labelling of protective devices, switches and terminals
	Identification of Conductors

Cables and Conductors

	Routing of cables in prescribed ones or within mechanical protection
	Connection of Conductors
	Erection methods
	Selection of conductors for current carrying capacity and voltage drop
	Presence of fire barriers, suitable seals and protection against thermal effects

General

	Presence and correct location of appropriate devices for isolation and switching.
	Adequacy of access to switchgear and other equipment
	Particular protective measures for special installations and locations
	Connection of single- pole devices for protection or switching in phase conductors only.
	Correct connection of accessories and equipment
	Presence of undervoltage protective devices
	Choice and setting of protective and monitoring devices for protection against indirect contact and/or
	Selection of equipment and protective measures appropriate to external influences
	selection of appropriate functional switching devices

Inspected by:		Date:		Signed	
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Notes

✓ = to indicate an inspection has been carried out and the result is satisfactory
✗ = to indicate an inspection has been carried out and the result was unsatisfactory

N/A = to indicate the inspection is not applicable

LIM = to indicate that, exceptionally, a limitation agreed with the person ordering the work prevented the inspection of test being carried out.

1. SELV An extra - low voltage system which is electrically separated from Earth and from other systems. The particular requirements of the regulations must be checked (see regulations 411-02 and 471-06)
2. Method of protection against direct contact- will include measurement of distances where appropriate
3. Obstacles- only adopted in special circumstances (see regulations 142-04 and 471-06)
4. Placing out of Reach- Only Adopted in special Circumstances (see regulations 412-05 and 471-07)
5. Use of class II equipment- infrequently adopted and only when the installation is to be supervised (see regulations 413-03 and 471-09)
6. Non Conducting locations- not applicable in domestic premises and requiring special precautions (see regulations 413-04 and 471-10)
7. Earth free local equipotential bonding- not applicable in domestic premises, only used in special circumstances (see regulations 413-05 and 471-11)
8. Electrical separation (see regulations 413-06 and 471-12)