WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Company Directive

STANDARD TECHNIQUE : SD5P/3

Design of Metered and Un-metered Connections with a capacity up to 5kW

Author: **Seth Treasure**

Implementation Date: **February 2018**

Approved by

Policy Manager

Date: 9 February 2018

IMPLEMENTATION PLAN

Introduction

This document specifies the requirements for providing metered and unmetered low voltage connections. This document may be used by WPD Planners and by ICPs where the relevant criteria is met.

Main Changes

The document has been updated to align with the latest version of the Unmetered Supply Regulations version 2.0 dated March 2014. This document permits the installation of multiple unmetered connections (load points) with a demand up to and including 500W where the total demand on a single fuse way is $\leq$ 5kW.

This document improves the guidance provided to planners on the design of small metered and unmetered connections with some detail below.

The minimum cross sectional area of services conductors has been stipulated as 25mm² and all services within 20m of a suitable passing main shall have a sole use service.

The phase to neutral and phase to earth impedance targets have been prescribed in accordance with Standard Technique: SD5R. The requirements for customer earthing electrodes and typical electrode resistivities have been detailed in accordance with Standard Technique: TP21D & TP21E.

The document has also been amended to include small metered connections with a demand up to 5kW.

Implementation Actions

Managers shall ensure that all staff and contractors involved in the design of small metered and unmetered connections to WPD networks are aware of and follow the requirements of this Standard Technique.

Implementation Timetable

This document is implemented with immediate effect.

REVISION HISTORY

Document Revision & Review Table		
Date	**Comments**	**Author**
February 2018	• Clause 2.1.1 c) added - Supply point load up to 5kW per fuse way accepted for unmetered connections • Clause 2.2.1 added - Load point and Supply point definitions added • Clause 3.1.2 amended – all service cables to have a CSA of 25mm² • Clause 3.1.4 added – All new connections installed within 20m of a main shall have a dedicated service cable. • Arrangement 5 for supplies fed via MSDB removed • Table 1 added – prescribed phases to neutral and phase to earth impedances detailed • Table 2 added – Customer electrode resistance for Class I installations with PME earthing • Table 3 & 4 added – Expected resistance of installed earth electrodes • Clause 6 added – Power quality requirements to be maintained	Seth Treasure
December 2009	• Document issued	Andy Hood

1.0 INTRODUCTION

This document specifies the requirements for the design of metered and un-metered connections and includes a number of standard arrangements.

2.0 POLICY

2.1 Load Acceptance

2.1.1 The Electricity (Unmetered Supply) Regulations 2001 specify strict criteria for determining whether or not a connection can be un-metered. These criteria are described below:

a) The load must be predictable.

If the value of load or its duration cannot be readily predicted the connection must be metered. Standard electricity sockets may not be installed at an un-metered connection as equipment connected to the socket cannot be determined.

b) The demand at each load point should be rated below 500W.

In some limited circumstances, where it is not practical to install metering due to high costs, technical difficulties or legal reasons, it is acceptable for load in excess of 500W to be un-metered. All loads above 500W shall be submitted to the Un-metered Connection Team who will determine if the load can be un-metered.

c) The total combined load beyond the Supply Point (see definition below) shall not exceed 5kW (per fuse way).

Appendix A includes a list of equipment that can normally be un-metered.

2.1.2 For demands rated up to 5kW that do not comply with clause 2.1.1, the following connection arrangements may be used but the connection shall be metered.

2.1.3 For demands rated greater than 5kW, the connection design shall be determined in accordance with ST:SD5A, ST:SD5B or ST:SD5E as appropriate.

2.2 Definitions (from 'The Electricity Unmetered Supply Regulations, 2001 (2001/3263) version 2.0)

2.2.1 a) Load Point - the point at which the load of the equipment consumes electrical energy.

b) Supply Point - the point of connection to the authorised distributor's network (exit point of WPD's network e.g. outgoing fuse terminal of WPD's cut out).

3.0 STANDARD ARRANGEMENTS

3.1 There are a number of standard arrangements for providing small metered or un-metered connections. In each case a connection will only be made to a fused cut-out / distribution board housed within a secure weather proof cubicle, pillar or street lighting column. Connections will not be provided to cut-outs located within traffic bollards, roundabouts, traffic islands or to compartments placed below ground.*

3.1.1 Where a connection is required for equipment located on a motorway (or equivalent dual carriageway) e.g. lighting, signs etc. the highway authority shall provide a pillar / enclosure remote from the motorway carriageway. Access to the pillar / enclosure shall be provided from land adjacent to the motorway and not from the hard shoulder.

3.1.2 The minimum service cable sizes for new installations are 25mm^2 Copper Concentric or Split Concentric and 25mm^2 hybrid.

3.1.3 The maximum cut-out fuse size for individual items of un-metered equipment where the connection utilises a street light type cut out is 25A. Where a domestic style cut out is utilised either a 20A or 30A fuse shall be installed (E5 item number – 41930 & 31617 respectively). Cut-out fuses for new installations shall be cartridge type (e.g. BS 7654 and BS HD 60269-3).

3.1.4 Street light type cut outs shall be compliant with EE Spec 116 and domestic type cut outs shall be compliant with EE Spec 115.

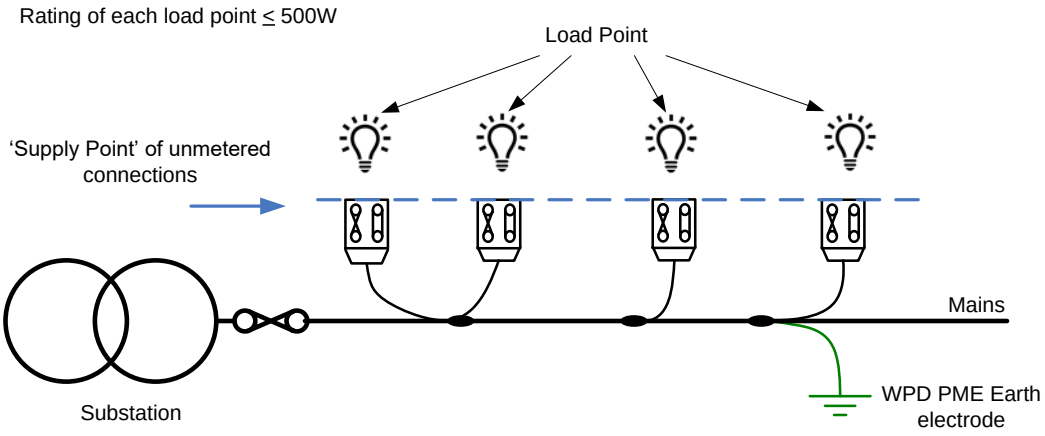
3.1.5 All new unmetered connections (including augmentations) if installed within a 20m distance from a suitable low voltage main (CSA $\geq$ 35mm^2), shall be connected with a sole use service cable (i.e. dedicated service).

* Where an existing supply is to be disconnected, the remaining WPD assets shall also be removed from the noted locations.

3.2.1 Arrangement 1

This is a commonly used arrangement and is applicable where the mains system is relatively close to the un-metered connections. A separate service is provided to each street lighting column or kiosk. Each un-metered connection has its own exit / supply point. A PME earth electrode with a resistance ≤ 100Ω (where PME is available) must be installed at, or beyond, the last service joint that connects to an un-metered connection.

The rating of each load point shall not exceed 500W.



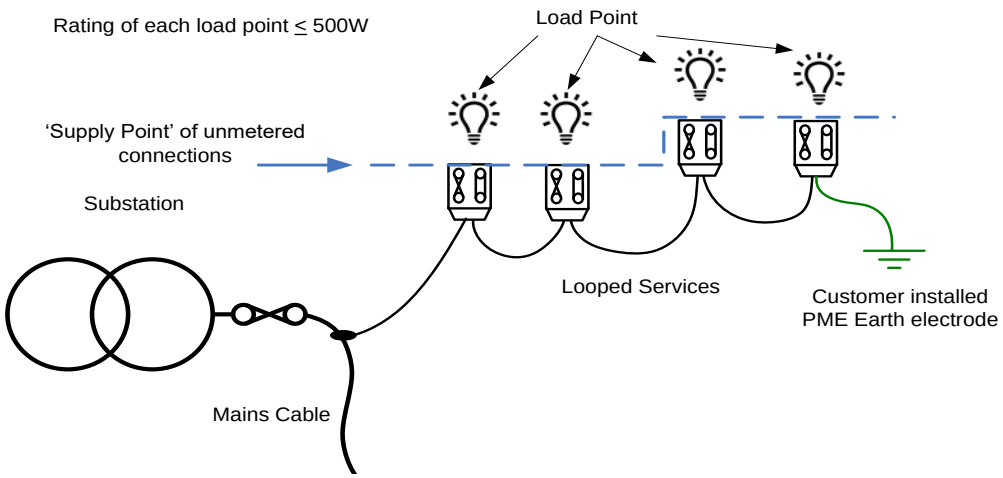
3.2.2 Arrangement 2

This is similar to Arrangement 1 but in this case a service cable is looped from the bottom of the first cut-out or service cable to the next un-metered connection. This is repeated for each subsequent connection. Each un-metered connection has a separate supply and Load point. A PME earth electrode with a rating ≤ 100Ω is required at the last un-metered connection (where PME is available).

Metered connections shall not form part of a loop of supplies with other metered or unmetered connections. Only connections fully comprising of unmetered connections can be 'looped' from either cut outs or service cables.

All new unmetered connections within 20m of a suitable 'mains cable' (CSA ≥ 35mm²) shall be connected with a sole use service cable (WPD owned connections).

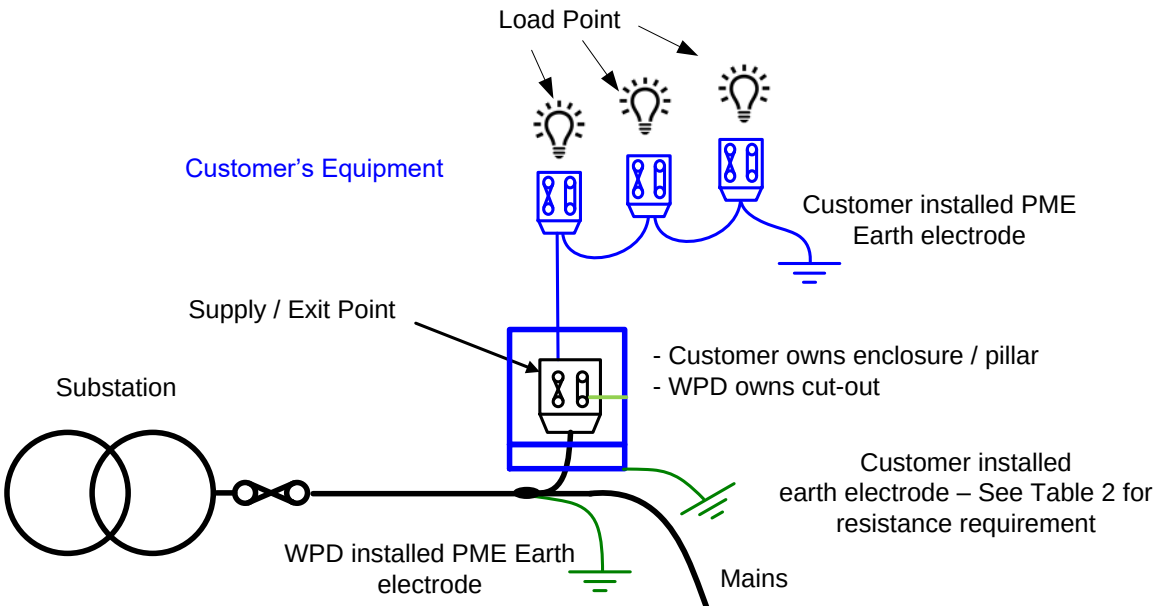
The rating of each load point shall not exceed 500W.



3.2.3 Arrangement 3

This is a commonly used arrangement, where WPD provide a single phase cut-out and provide one exit / supply point within the customer's pillar or enclosure. The customer (typically a street lighting or highway authority) installs their own cables and distributes to individual items of equipment.* Where PME is available an electrode must be installed at either the service joint which connects to the customer's pillar or at a position along the mains circuit that is more remote from the source substation than that service joint. In addition the customer shall install a PME earth electrode with a resistance ≤ 100 Ω at their most remote installation (irrespective of whether they distribute with CNE or SNE cables).

*As only one exit point is provided the total load of the connected equipment must satisfy the criteria specified within clause 2.1 (i.e. it must be predictable and with each load point having a demand ≤ 500W with a total combined supply point demand ≤ 5kW).



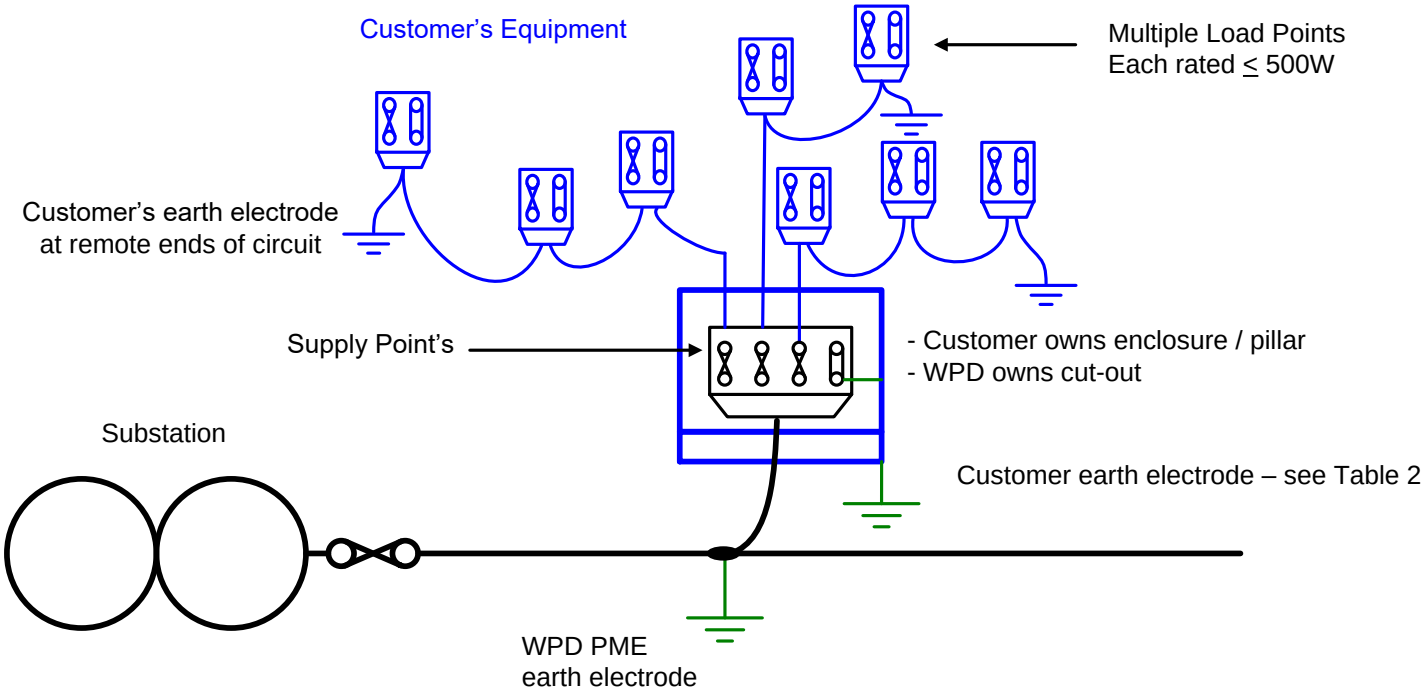
3.2.4 Arrangement 4

This is similar to Arrangement 3 but in this case a 3 phase (or split phase) connection is provided and one exit point is provided per fuse-way. This arrangement may be applicable where the customer wishes to distribute to multiple items of equipment with a total balanced load up to 15kW (maximum of 5kW per fuse way).

The customer shall install an earth electrode connected to the customer owned enclosure / pillar with a resistance requirement determined by the maximum possible unbalance of load. For example, if a three phase supply had 5kW of demand per fuse way (total of 15kW) and if one fuse operates there would be an unbalance of 5kW.

In addition, the customer shall install an earth electrode at the most remote installation on each of their circuits (each electrode having ≤ 100Ω resistance) irrespective of whether they distribute with CNE or SNE cables.

The total demand of the connected equipment must satisfy the criteria specified within clause 2.1 (i.e. it must be predictable and with each load point having a demand ≤ 500W with a total combined supply point demand per fuse way of ≤ 5kW).



4.0 DESIGN REQUIREMENTS

4.1.1 Whichever arrangement is used the planner shall ensure:

- the voltage at each exit / Supply point is within statutory limits.
- equipment (cables, overhead line etc.) are not overloaded.
- the earth fault level at each WPD owned exit / supply point is above the rating of the fuses that protect the incoming service.
- mains cable / overhead line shall be adequately protected by the source protection (i.e. the source fuses shall be capable of operating before the short circuit rating of the cable / overhead line is exceeded.
- the Phase to Neutral and Earth Fault Loop Impedances of the connections shall comply with Table 1.
- for Arrangement 1 and 2 the total length of service conductor (from the connection with the mains cable or overhead line to the most remote connection) shall not exceed 250m.
- the planner must also ensure that the installation has an earthing conductor of sufficient resistance as specified within table 2. *A standard metallic street light / pillar is deemed to have a fortuitous resistance of 100 ohms to the general mass of earth.*

Windebut can be used to check the characteristics of supply (voltage and thermal parameters) and also to check that mains cables / lines are adequately protected. Windebut can also be used to provide earth fault levels and loop impedance values. Further guidance on the use of WinDebut is provided within ST:SD5K.

4.1.2 Maximum EFLI for Metered and Unmetered Connections

EFLI requirements for new and substantially modified unmetered connections are specified within Table 1 and depend on the earthing arrangement offered. Where a maximum ELFI value is specified, this is based on a fuse operating time of 5s, which is in line with the requirements for outdoor lighting installations defined in BS7671 (EIT Wiring Regulations).

Cut-out Fuse Rating	Maximum Phase to Neutral Loop Impedance (PNLI)	Maximum Earth Fault Loop Impedance (EFLI)		
		PME / PNB Connection	SNE[2] Connection	Directly Earthed (TT) Connection
Street lighting type cut-out (i.e. 25A cut-out)				
6A	1.50 Ω[1]	As per PNLI requirement	13.50 Ω	N/A
10A	1.38 Ω[1]		7.10 Ω	N/A
16A	0.86 Ω[1]		3.80 Ω	N/A
20A	0.69 Ω[1]		2.70 Ω	N/A
25A	0.55 Ω[1]		2.10 Ω	N/A
Domestic type cut-outs fuses: [3]				
≤ 30A	0.47 Ω	As per PNLI requirement	1.92 Ω	N/A

Table 1 Maximum impedance for Metered and unmetered connections

Notes

Note 1 The phase to Neutral impedance to metered connections shall be ≤ 0.47 Ω.

Note 2 Also applies to SNE connections connected to a combined neutral and earth (CNE) network.

Note 3 Overall demand shall comply with clause 2.1.1 (less than 5kW per fuse way)

4.1.3 Earthing electrode requirement for customer's installation (Class I / metallic enclosure)

Connection	Maximum single phase load or overall unbalance on split or three phase connection	Maximum consumer earth electrode resistance bonded to main earth terminal
single phase, unbalanced split or three phase	500 W	100 Ω
	1kW	60 Ω
	2kW	20 Ω
	3kW	14 Ω
	4kW	11 Ω
	5kW	9 Ω

Table 2 Customer installation earthing requirements

Note, If the earth electrode resistance as specified above cannot be satisfied, the installation should form part of a TT system by installing a separate earth electrode and fitting a suitable protection device in accordance with BS 7671 (e.g. an RCD).

If the earth electrode resistance as specified above is unachievable and the installation of a RCD protection device is undesirable due to maintenance and nuisance tripping, the street furniture may have neither a mains derived earth terminal or residual current device (RCD) if the fixture is categorised as 'Class II' (double insulated).

Three phase or split phase installations that are not defined as Class II may only be offered a PME earth terminal if the demand is well balanced across the phases.

5.0 EXPECTED RESISTANCE OF PME EARTH ELECTRODES

5.1 Table 3 and Table 4 list the expected earth resistance afforded by horizontal conductor and single vertical earth rods. The shaded areas indicate arrangements that do not satisfy the earth resistance requirement for an individual PME earth electrode. There is no minimum surface area requirement for individual PME earth electrodes.

5.2 The expected soil resistivity of a location can be queried within the WPD mapping system (EMU V8) and the value used to identify the quantity of earth electrode required to ensure the electrode resistance is $\leq$ 100Ω. However, on site measured values may differ from that of the calculated soil resitivities.

Electrode Length (m)	Resistance (ohms)		
	Soil Resistivity 100 ohm.m	Soil Resistivity 300 ohm.m	Soil Resistivity 1000 ohm.m
1	87	260	867
2.5	44	131	437
5	26	77	257
10	15	45	149
15	11	32	108
20	9	26	85

Table 3 Resistance of a horizontal 70mm² Cu electrode (Laid 500mm Below the surface in uniform Soil)

Rod Length (m)	Resistance (ohms)		
	Soil Resistivity 100 ohm.m	Soil Resistivity 300 ohm.m	Soil Resistivity 1000 ohm.m
1.5	58	174	579
3	33	100	332
4.5	24	71	238
6	19	56	187
7.5	16	47	155
9	13	40	133
10.5	12	35	116
12	10	31	104
13.5	9	28	94
15	9	26	86

Table 4 Resistance of a single vertical PME earth rod (in Uniform Soil)

6.0 POWER QUALITY

6.1 The connected system shall comply with BS EN 61000-3-2 which relates to Harmonics for items rated up to 16A per phase.

6.2 The connected system shall comply with BS EN 61000-3-3 which relates to Flicker for items rated up to 16A per phase.

APPENDIX A

TYPES OF UNMETERED EQUIPMENT

The following list shows typical types of equipment which may be considered for unmetered connections, providing the load complies with the requirements in 2.1. The list is not exhaustive and is for illustration purposes only.

- Advertising Hoardings
- Alarm Systems
- Bus Shelters
- Cable Network Pillar
- Cathodic Protection
- Clocks
- Communication Cabinets
- Fire Warning System
- Flood Warning System
- Ice Detector
- Illuminated Bollards
- Illuminated Map Cabinets
- Information Signs
- Navigation Signal
- Pay & Display Machines
- Radio Transmitter
- Red Runner Camera
- Security Camera
- Sewage flow recorder
- Speed Camera
- Storm overflow
- Street Lighting
- Telephone Kiosk (lighting)
- Telephone Kiosk (phonecard)
- Ticket Machine
- TV Aerial
- TV Amplifier
- TV Camera
- TV Relay
- Traffic Counter
- Traffic Master Units
- Traffic Signs
- Traffic Signal/Pelican Crossing
- Warden call equipment

APPENDIX B

SUPERSEDED DOCUMENTS

This document supersedes ST:SD5P/2 dated December 2009 which has now been withdrawn

APPENDIX C

ASSOCIATED DOCUMENTS

ST:TP21E	Provision of PME earthing
ST:TP21D	HV and LV System Earthing
ST:SD5A	Design of low voltage domestic connections
ST:SD5B	The design of low voltage connections with minimal analysis
ST:SD5E	Design of low voltage commercial connections
ST:SD5F	The design of multiple low voltage connections with minimal analysis
ST:SD5K	Use of Windebut Software
ST:NC1N	Procedure for Unmetered Connections and Disconnections
BS7671	Requirements for Electrical Installations (IET Wiring Regulations)

The Electricity (Unmetered Supply) Regulations, 2001 (SI 2001/3263) Version 2.0

APPENDIX D

KEY WORDS

Un-metered, Un-metered Connection, Street Lamp, Street Light, Street Furniture