ENGINEERING COMMISSIONING PROCESS

ECP 11-0008

LV CABLE TESTING PROCEDURE

Network(s): EPN, LPN, SPN & Private Networks

Summary: This procedure details the requirements for the on-site testing of all new and existing low voltage cables prior to their connection to the network.

Owner: Paul Williams Date: 10/02/2016

Approved By: Sotiris Georgiopoulos Approved Date: 28/03/2016

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# Revision Record

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<td>4.0</td>
<td>04/12/2020</td>
<td>10/02/2016</td>
<td>Stephen Tucker</td>
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Why has the document been updated: Updated re business feedback.

What has changed:
- Authorised Person replaced with Competent Person (Section 1).
- Pilot and multi-core cables removed from the scope (Section 2).
No change to Test form ECP 11-0008a

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<td>3.0</td>
<td>04/12/2020</td>
<td>04/12/2015</td>
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Why has the document been updated: Document renumbered to align with other commissioning documents.

What has changed:
- Renumbered from EOS 09-0010 and reformatted as a commissioning procedure.
- Appendix A form moved to new test form ECP 11-0008a.

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<td>2.0</td>
<td>12/06/2018</td>
<td>05/05/2015</td>
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Why has the document been updated: Periodic review.

What has changed: No content change, new template inserted and rules applied

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Document reviewed for publishing on G81 website

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Original
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1 Introduction

1.1 This procedure details the on-site insulation and continuity testing requirements for low voltage cables. The purpose of such testing is to demonstrate that low voltage cables can be safely connected to the system.

1.2 The testing regime detailed in this procedure is designed to avoid unnecessary overstressing and to prolong the life of the apparatus. It should identify any gross defect, damage or earths left connected at a remote end. The testing regime is based on current practice from the relevant British and International standards together with current practice used on the three networks. Consideration has been given to the safety of field staff and the availability of test equipment.

1.3 This procedure shall be carried out by a Competent Person having appropriate training and experience.

1.4 This procedure shall be carried out in accordance with the requirements of the UK Power Networks Distribution Safety Rules.

1.5 This procedure assumes that the underground cable has been installed in accordance with ECS 02-0019 (Installation of Underground cables LV to 132kV).

1.6 The results of all tests, adjustments and all relevant remarks shall be recorded on the appropriate test form.

1.7 This procedure supersedes the following documents:

- LPN: E5-6-3 – Tests Associated with the Connection or Re-connection of Low Voltage Services.
- LPN: E5-6-3-1 – Low Voltage Service Tests.
- SPN: Section 3.2.2 of the SPN Cable Jointing Manual.

2 Scope

2.1 This procedure and the associated test form applies to the insulation and continuity testing of LV cables (600/1000V) cables in EPN, LPN, SPN and private networks and includes:

- New underground LV cable before it is connected to the system for the first time.
- Existing underground LV cable with no services connected to it after it has been de-energised for more than one month.
- New overhead insulated LV cable before it is connected to the system for the first time.
- Existing overhead insulated LV cable\(^1\) after it has been modified, repaired or diverted.
- Existing overhead insulated LV cable\(^1\) after it has been de-energised for more than one month.

\(^1\) For the purpose of this procedure overhead insulated LV cable includes aerial bundled conductor (ABC), concentric service cable and any other overhead line conductor covered in permanent insulation.
3 References
3.1 This procedure should be read in conjunction with the following references:
   - UK Power Networks’ Distribution Safety Rules
3.2 This procedure should be used with the following test forms:
   - ECP 11-0008a LV Cable Test Form.

4 Abbreviations and Definitions
4.1 The following abbreviations are used throughout this procedure.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>LV</td>
<td>Low voltage. Refers to voltages below 1000V.</td>
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5 Equipment
5.1 The following test equipment is required to carry out the tests detailed in this procedure:
   - An approved insulation testing instrument, capable of applying 500V or 1000V dc for insulation testing.
5.2 Before use the test instrument shall be checked to ensure that it is in a satisfactory and safe working condition:
   - Ensure that the instrument contains charged batteries by pressing the battery test button
   - If the instrument is equipped with more than one voltage range, select the 500V range.
   - Connect an approved set of test leads to the instrument and with the leads held apart, select the Megohms range (MΩ).
   - Operate the instrument. The reading obtained should be infinity (∞).
   - Connect the ends of the test leads together; select the ohms range (Ω).
   - Operate the instrument. The reading obtained should be zero (0).
6  General

6.1 Testing of LV cables shall be carried out on each section of cable before it is connected to another:

- After the cable is installed (or re-installed) and before energisation for the first time.
- After the cable has been intentionally left de-energised for more than one month or sooner if there is any question as to its integrity.

6.2 For new and re-commissioned equipment the interval between testing and energisation from the system should be the minimum practicable.

6.3 All new LV cable should, following installation, be successfully tested once at the voltage specified in this procedure.

6.4 All LV cable which has been de-energised and has knowingly had the insulation affected or altered shall be subjected to an insulation test as specified in this procedure.

Dispensation to vary from the test methods and voltage levels set out in this standard can be granted by the UK Power Networks’ Head of Engineering Standards

7  Continuity Test

7.1 Preparation

7.1.1 It is essential before energisation to ensure the cable is continuous from end to end. This will check that the cable is laid as planned and that any route joints have been completed.

7.1.2 This test shall be carried out prior to a new section of cable being pot ended. If the section of cable is to be energised at a later date or has been installed by a third party, the results of the continuity test shall be recorded on test form ECP 11-0008a and passed to the UK Power Networks person or third party who is responsible for carrying out the insulation test in Section 8 and the final electrical LIVE connection. In this case, it is not necessary to carry out an additional continuity test on the previously tested cable.

7.1.3 This is also an important check to ensure that no customers or street furniture are connected to cable under test before an insulation test is carried as specified in Section 8.

7.1.4 All cables shall be treated as LIVE until proved DEAD.

7.1.5 Personal protective equipment (PPE) and safety equipment appropriate for LIVE LV jointing shall be worn at all times.

7.1.6 Before a continuity test is carried out the cable shall be tested with an approved voltage testing device (i.e. Drummond test lamp) to ensure that it is dead.

7.1.7 The conductors of all ends of the cable to be tested shall initially be separated at all ends and an approved method of temporary insulation shall be applied to the remote end(s) of the cable.
7.2 Test Method

7.2.1 Connect the test leads of the test instrument between the phase conductor to be tested and the neutral/earth or earthed metallic sheath and select the ohms range (Ω).

7.2.2 Operate the instrument. The reading obtained should be infinity (∞) Ω.

7.2.3 Repeat the test for each phase conductor in turn.

7.2.4 If on a new section of cable with no customers connected, the results show that a direct connection exists between any of the phases and neutral/earth or the earthed metallic sheath, the cable shall not be energised and a fault location shall be carried out.

7.2.5 If for an existing section of cable, which has been left de-energised for more than 1 month, the results show that a direct connection exists between any of the phases and neutral/earth or the earthed metallic sheath, the first assumption must be that a service must be connected and this must be located and the cut-out fuse removed.

7.2.6 The test must then be repeated until the cable is proven to have no connection between a phase and neutral/earth or the earthed metallic sheath. If after all cut-out fuses have been located and removed, the cable under test still has a connection between a phase and neutral/earth or the earthed metallic sheath, the cable shall not be energised and a fault location shall be carried out.

7.2.7 At the remote end of the cable under test, connect the phase conductor to be tested, to either the neutral/earth conductor or the earthed metallic sheath. For a cable with more than one end, this test needs to be completed on each remote end.

7.2.8 Operate the instrument. The reading obtained should be zero (0) Ω.

7.2.9 Repeat the test for each phase conductor. Below is an example of the test sequence to be carried out on a three-phase service plastic concentric service or four-core ABC cable:

- L1 phase and neutral/earth conductors.
- L2 phase and neutral/earth conductors.
- L3 phase and neutral/earth conductors.

7.2.10 On completion of the test remove the connection between the phase and neutral/earth or earthed metallic sheath prior to making the connection to the network.
8 Insulation Test

8.1 Preparation

8.1.1 All cables shall be treated as LIVE until proved DEAD.

8.1.2 Personal protective equipment (PPE) and safety equipment appropriate for LIVE LV jointing shall be worn at all times.

8.1.3 Before an insulation test is carried out the cable shall be tested with an approved voltage testing device (i.e. Drummond test lamp) to ensure that it is dead.

8.1.4 The conductors of all ends of the cable to be tested shall be separated at all ends and an approved method of temporary insulation shall be applied to the remote end(s) of the cable. Particular attention shall be paid to possible connection between the cable under test and any part of a customer’s installation, earth and any third party that may be in the vicinity.

8.2 Test Method

8.2.1 An insulation test shall be carried out between every pair of conductors and each conductor and earth or neutral/earth.

8.2.2 Connect the test leads of the test instrument between a pair of conductors on the cable to be tested and select the Megohms range (MΩ).

8.2.3 Operate the instrument. The reading obtained should be greater than 50MΩ.

8.2.4 Repeat the test for every combination of phase neutral and earth conductors. Below is an example of the test sequence to be carried out on a three-phase service plastic concentric service or four-core ABC cable:

- L1 phase and L2 phase conductors.
- L2 phase and L3 phase conductors.
- L3 phase and L1 phase conductors.
- L1 phase and neutral/earth conductors.
- L2 phase and neutral/earth conductors.
- L3 phase and neutral/earth conductors.

8.2.5 On completion of each test ensure that the test leads are not removed from the cable until the test button on the megger has been released and the test lead connected to the phase conductor has been connected to the neutral/earth conductor to discharge any stored charge to earth.
9 Results and Remedial Action

9.1 If the required values for the insulation and/or continuity test cannot be obtained on site, the LV cable shall not be connected to the network, until the defect causing the results has been located and repaired.

9.2 When an LV cable is to be installed and tested by another member of UK Power Networks staff or a third party, the results shall be recorded, kept with the project file and passed to the UK Power Networks person or third party responsible for making the final electrical LIVE connection.

10 Test Equipment

10.1 Record the make, type, serial or asset number and calibration date of all test equipment used during commissioning on the test form.

11 Certification

11.1 When all the tests have been satisfactorily completed, sign and date the test form. The complete test form should be filed with the relevant job pack.