

Guide for the application of the European Standard EN 50160

ICS 29.020; 71.100.60

Confirmed January 2010

National foreword

This Published Document is the official English language version of CLC/TR 50422:2003, including Corrigendum June 2005.

The UK participation in its preparation was entrusted to Technical Committee GEL/8, Standardisation matters related to electricity supply, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Summary of pages

This document comprises a front cover, an inside front cover, the CLC/TR title page, pages 2 to 24, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 12 February 2004

© BSI 7 December 2005

ISBN 0 580 43393 5

Amendments issued since publication

Amd. No.	Date	Comments
16120	7 December 2005	Incorporates CENELEC Corrigendum June 2005

English version

**Guide for the application
of the European Standard EN 50160**

This Technical Report was approved by CENELEC on 2003-11-01.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Lithuania, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

This Technical Report has been prepared by BTTF 68-6 and finalized by CENELEC TC 8X/WG1 based on an application guide written by the former UNIPEDE Group of Experts NORMCOMP: "Electricity Product Characteristics and Electromagnetic Compatibility"[1].

The text of the draft was submitted to the formal vote and was approved by CENELEC as CLC/TR 50422 on 2003-11-01.

The contents of the corrigendum of June 2005 have been included in this copy.

Contents

	Page
1 Background	4
1.1 General.....	4
1.2 Background of the definition of supply voltage characteristics.....	4
2 Application of the European Standard EN 50160	5
2.1 Introduction.....	5
2.2 Scope of the European Standard.....	5
2.3 Definitions.....	8
2.4 Groups of voltage characteristics	9
2.4.1 Definite values.....	10
2.4.2 Indicative values.....	10
2.5 Voltage terminology	11
3 Description of main voltage characteristics	11
3.1 Power frequency.....	11
3.2 Magnitude of the supply voltage	12
3.3 Supply voltage variations	12
3.4 Rapid voltage changes	13
3.4.1 Magnitude of rapid voltage changes.....	13
3.4.2 Flicker severity	13
3.4.3 Supply voltage dips	14
3.5 Short and long interruptions of the supply voltage.....	16
3.6 Temporary (power frequency) overvoltages between live conductors and earth	17
3.6.1 LV distribution systems	18
3.6.2 MV distribution systems	18
3.7 Transient overvoltages between live conductors and earth.....	19
3.7.1 LV distribution system	19
3.7.2 MV distribution systems	20
3.8 Supply voltage unbalance.....	21
3.9 Harmonic voltage.....	22
3.10 Interharmonic voltage	23
3.11 Mains signalling voltage on the supply voltage	23
4 References	24

1 Background

1.1 General

This guide has been prepared by BTTF 68-6 and finalized by CENELEC TC 8X/WG1 based on an application guide written by the former UNIPEDE Group of Experts NORMCOMP: "Electricity Product Characteristics and Electromagnetic Compatibility"[1].

The aim of this guide is to provide some background information and explanation on the standard EN 50160 "Voltage characteristics of electricity supplied by public distribution systems" [2].

By its very nature, a standard has to be concise and cannot give a comprehensive background of the subject being dealt with. It was accordingly decided to prepare a guide providing additional information and clarification of the standard.

1.2 Background of the definition of supply voltage characteristics

From the very beginning of their association, the Member States of the European Communities decided to create a wide economic area without barriers to internal trade.

For this purpose a number of directives have been issued by the Commission of the European Community (EC), to remove the differences in the legislation of the Member States, which could affect the free exchange of goods and services.

One such directive is the Directive 85/374 on Product Liability [3]. This states in Article 2 that "product" includes electricity for the purpose of the directive. Consequently, it was considered necessary to define the essential characteristics of the electricity supply.

The task of preparing a standard, based on the UNIPEDE document DISNORM 12 [4], was assigned to CENELEC (European Committee for Electrotechnical Standardisation). The request specified the different aspects to be covered, which were exclusively related to the following characteristics of the supply voltage: **frequency**, **magnitude**, **waveform** and **symmetry** of the three-phase-voltages.

For this task CENELEC set up a new task force, BTTF 68-6, in which representatives of most of its member countries participated. EN 50160 was prepared by this task force, and was duly ratified by CENELEC.

2 Application of the European Standard EN 50160

2.1 Introduction

The standard takes account of the fact that electricity distribution systems have to be developed taking into account the problem of providing adequate conditions for the operation of customers' equipment and, at the same time, avoiding unnecessary increases in the cost of the electricity supply. There is an economic balance to be struck between the costs attributable to creating a more benign environment for the use of equipment connected to the public electricity network which will be borne by all customers and the costs of achieving immunity of the equipment to the environment in which it is intended to be used which will rightly be borne by the customer purchasing the equipment.

2.2 Scope of the European Standard

It is important to note that the scope of the standard is confined to the electricity supplied at the supply terminals, and does not deal with the supply system or the customer's installation or equipment. The diagram below in Figure 1 illustrates the point which is defined in EN 50160 as "the supply terminals" and also the relationship between the impulse withstand requirements of the supply terminals, the customer's installation and the customer's electrical equipment. The appropriate categories of impulse voltage withstand for each zone are also highlighted. It should be stressed that the supply terminals, referred to in both the standard and this application guide, and the origin of the installation, referred to in both IEC 60664-1, Insulation coordination for equipment within low-voltage systems [5], and IEC 60364-4-44, Electrical Installations of buildings – Part 4 Protection for Safety Chapter 44 Protection against overvoltages (HD 384-4-443) [6], are one and the same point.

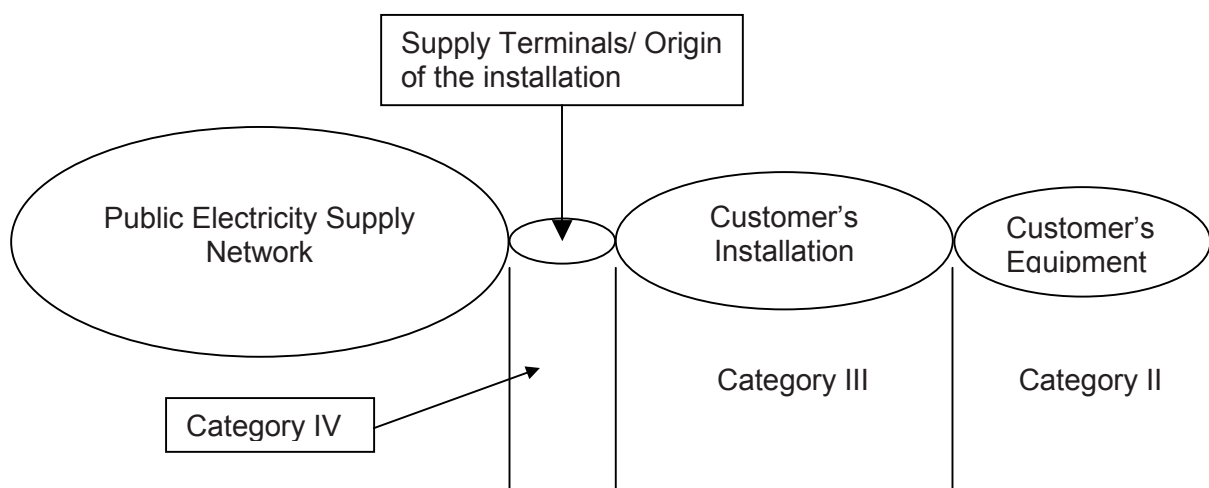


Figure 1 – Illustration of location of supply terminals

As the standard is intended to deal only with the characteristics of the voltage at specified points on the public distribution networks, it does not deal directly with the characteristics of networks themselves, such as short circuit power. Clearly, however, the network characteristics will have an effect upon the magnitude of several of the phenomena described by the standard.

The standard is applicable only under **normal operating conditions** of the supply system. This **includes** also the correct operation of protection devices in the case of a fault in the network (blowing of a fuse, operation of a circuit-breaker etc.); the operation of loads agreed between customer and distribution network operator (DNO – see clause 2.3 below) and changes in network configuration.

When energy is supplied to the public networks from small private generators, it is important to keep the level of disturbances within acceptable limits. In this context private generation is in the same position as any customer's installation and therefore has to comply with the related emission standards and agreed limits for the voltage supplied. As such the voltage supplied from the generator must comply with the requirements of EN 50160.

The standard lists several specific examples of exceptional conditions which are beyond the DNO's control and which can cause one or more of the characteristics to depart from the values given. Under such conditions EN 50160 does not apply. The following table lists the exceptional conditions and gives some examples of the cause:

Table 1 – Non-exhaustive list of exceptional conditions and examples

Exceptional condition:	Example of cause:
Extreme weather conditions and other natural disasters	Storms of extreme severity, landslides, earthquakes, avalanches, floods
Third party interference	Sabotage, vandalism
Acts by public authorities	Constraints imposed by government for public safety concerns
Industrial action	Withdrawal of labour, strike
Force majeure	Major accidents
Power shortages resulting from external events	Generation restrictions or interruption of transmission lines

Exceptional weather conditions are for example conditions where the severity exceeds the legally required design conditions of the network equipment. Another example would be conditions under which the DNO is prevented from carrying out repair or maintenance work due to weather conditions of extreme severity or duration (long lasting blizzards, flood situations, landslides, extreme wind conditions etc.).

The standard also does not apply if the DNO is prevented from carrying out necessary alterations to the supply system, by government or other public authorities.

An example of a condition in which the standard is not applicable, is when a part of the supply system is out of operation, due either to a fault of large impact or to the need to carry out maintenance or construction work. Under these circumstances, if supply can be maintained to all or as many customers as possible, even at the expense of some deterioration of one or more of the voltage characteristics, this is generally accepted to be preferable to an outright interruption.

Because the public distribution networks are the unintended carriers of electromagnetic disturbances emitted by equipment within the customers' installations, it is necessary that such emissions be subject to appropriate limits. These limits are either specified in relevant product standards or prescribed for particular installations by the public authorities or the DNO. Compliance with these limits by the customers' installations and equipment is a necessary precondition to keep the voltage characteristics at the supply terminals within the given values of EN 50160. The same principle applies to all connections to the supply system, including private generation embedded in it.

The standard allows for its requirements to be superseded by terms of a contract between a customer and the electricity DNO. In this case the values of voltage characteristics are a matter of mutual agreement between customer and DNO.

Such a contract is most likely to arise for customers with relatively large electricity demand, supplied from the MV network. It may also arise in sparsely populated or difficult terrain, such as mountain regions, where supply costs are high. In such an area a customer may be willing to accept a supply, at lower cost, which does not entirely comply with EN 50160.

EN 50160 is a product standard giving the voltage characteristics which can be expected at the supply terminals in low voltage and medium voltage public networks. This standard does not describe the average situation in the public supply networks but the maximum values or variations of the voltage characteristics under normal operating conditions which can be expected by a customer to be present at their supply terminals at any point on the network.

The standard does not have the function of specifying the requirements for electrical equipment or network impedance.

Although the standard handles some of the phenomena dealt with by the EN 61000 series of standards it merely describes the possible variations of these phenomena at the supply terminals of the public electricity system.

The stated voltage characteristics define the conditions at the supply terminals. Care should be taken to ensure co-ordination between the characteristics of the supply voltage, any voltage changes within the installation, and the requirements of the equipment within the installation. In the case of any mismatch between the characteristics of the supply and the requirements of the equipment, the opportunity to either improve the resilience of the equipment or to improve the quality of the supply voltage provided by the DNO should be investigated.

EN 50160 details the characteristics of the voltage waveform at the supply terminals, it does not detail how to measure these characteristics. Specific methods describing how to measure voltage and other power quality parameters may be found in IEC 61000-4-30 Testing and Measurement Techniques – Power Quality Measurement Methods [7].