SLOVENSKI STANDARD
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Ugotovitve o referenį nih impedancah in impedancah javnega napajalnega omreģja za doloį anje znaį ilnosti motenj elektriį ne opreme z nazivnim faznim tokom do vkljuį no 75 A

Consideration of reference impedances and public supply network impedances for use in determining disturbance characteristics of electrical equipment having a rated current = < 75 A per phase

Etude des impédances de référence et des impédances des réseaux publics d'alimentation aux fins de la détermination des caractéristiques de perturbation des équipements électriques utilisant un courant nominal = < 75 A par phase

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Etude des impédances de référence et des impédances des réseaux publics d'alimentation aux fins de la détermination des caractéristiques de perturbation des équipements électriques utilisant un courant nominal ≤75 A par phase

Consideration of reference impedances and public supply network impedances for use in determining disturbance characteristics of electrical equipment having a rated current ≤75 A per phase

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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IEC 60725, which is a technical report, has been prepared by subcommittee 77A: Low frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

This second edition cancels and replaces the first edition published in 1981. This second edition constitutes a technical revision in which the major change is the definition of a method to assess the 3 phase-impedance value in order to apply more easily IEC 61000-3-11.

The text of this technical report is based on the following documents:

DTR	Report on voting
77A/460/DTR	77A/485/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

CONSIDERATION OF REFERENCE IMPEDANCES AND PUBLIC SUPPLY NETWORK IMPEDANCES FOR USE IN DETERMINING DISTURBANCE CHARACTERISTICS OF ELECTRICAL EQUIPMENT HAVING A RATED CURRENT ≤ 75A PER PHASE

1 Scope

This technical report records the information that was available and the factors that were taken into account in arriving at the reference impedances that were formerly incorporated in IEC 60555 [1)], but which are now incorporated into some sections of IEC 61000-3.

In addition, information is given on the impedances of public supply networks associated with service current capacities ≥100 A per phase.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61000-3-3, *Electromagnetic compatibility (EMC) – Part 3: Limits – Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A* [2)]
Amendment 1 (2001)

IEC 61000-3-11, *Electromagnetic compatibility (EMC) – Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤ 75 A and subject to conditional connection*

IEC 61000-3-12, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*

3 Systems of supply

3.1 Three-phase supply systems

Three-phase, four-wire, distribution systems are used worldwide to supply low-voltage consumers, with nominal voltages in the region of 230/400 V.

To conform with IEC standard voltages, these system are described as 230/400 V throughout this report.

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1) IEC 60555 (all parts), *Disturbances in supply systems caused by household appliances and similar electrical equipment* (withdrawn)

2) A consolidated edition 1.1 (2002) exists, including IEC 61000-3-3:1994 and its Amendment 1 (2001). It has been published under the title of *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection*

There is considerable variation in the way in which the supplies to individual consumers are connected to three-phase systems.

In some countries, all four wires are taken into the consumer's premises, allowing the use of three-phase 400 V for large loads, with small appliances and lighting circuits connected between one line and neutral at 230 V.

In other countries, three wires are taken into the consumer's premises, allowing the use of 400 V across two phases for large loads, with small appliances and lighting circuits connected between one line and neutral at 230 V.

In other countries, of which the United Kingdom is an example, it is unusual to take more than one phase into a residential consumer's premises. Consequently both large loads less than 15 kVA and lighting circuits are supplied between line and neutral at 230 V.

3.2 Single-phase supply systems

In some countries, of which the United States of America and Japan are examples, a single-phase, three-wire distribution is used. Large loads are connected across the outer wires at 230 V whilst small appliances and lighting circuits are connected between one outer and the centre wire at 115 V. This leads to quite different supply impedances from those of three-phase distribution systems and may require different reference impedances.

Recommended values of reference impedances appropriate to single-phase three-wire distribution systems and all systems operating at a fundamental frequency of 60 Hz, are not provided in this document; this subject is to receive further study when sufficient technical information is released by countries operating such systems.

4 Supply impedances

4.1 Typical residential premises

The supply system impedance associated with the supply to the premises of a typical residential consumer is determined by the average value of maximum power demand of all the consumers connected to a typical network and the steady state voltage drop at maximum load used to design the system.

Information on the supply system impedance was collected from as many countries as possible and is presented in Table 1. The impedance to be considered was the impedance up to the point of common coupling with other consumers. However, in many systems, particularly where there were several apartments in the same building, the point of common coupling was close to the metering point. Hence the impedance figures obtained usually included both the supply system impedance and the service connection impedance.

The phase-to-neutral impedance characteristics of three-phase supply systems, in which each consumer is supplied at 230 V, 50 Hz, differ widely between countries as shown in Table 1.

Table 1 – 1980 International survey of residential consumers' complex supply impedances, in ohms, for single-phase connections at 50 Hz

Country	Percentage of consumers having supply impedances equal to or less than the listed complex values			
	98 %	95 %	90 %	85 %
Belgium	–	0,63 + j0,33	0,32 + j0,17	0,28 + j0,15
France	–	0,55 + j0,34	0,45 + j0,25	0,34 + j0,21
Germany	–	0,45 + j0,25	0,36 + j0,21	0,31 + j0,17
Ireland [a]	1,47 + j0,64	1,26 + j0,60	1,03 + j0,55	0,94 + j0,43
Italy	–	0,59 + j0,32	0,48 + j0,26	0,44 + j0,24
Netherlands	–	0,70 + j0,25	0,41 + j0.21	0,32 + j0,17
Switzerland	–	0,60 + j0,36	0,42 + j0,25	0,30 + j0,18
United Kingdom	0,46 + j0,45	–	0,25 + j0,23	–
USSR	–	0,63 + j0,30	0,50 + j0,26	–
[a] System impedances for residential consumers in Poland are similar to those in Ireland.				

Since 1981 when the impedance survey was published as Table 1, there has been natural development and reinforcement of public supply networks and the values in the 90 % column, on which the reference impedances for residential supplies were based, are now more relevant to the 95 % column because supply impedances have been reduced overall.

The Korean Agency for Technology and Standards completed a comprehensive national survey of network impedances associated with 60 Hz, 380/220 V low-voltage supply systems in March 2004 and provides information that the following, 95% probability, network impedances are appropriate to Korea:

- single-phase two-wire 220 V, service capacities < 100 A per phase, (0,67 + j0,37) Ω;
- three-phase four-wire 380 V, service capacities < 100 A per phase, (0,33 + j0,20) Ω .

4.2 Large residential, commercial and light industrial premises

The premises considered in this clause have service current capacities equal to or in excess of 100 A per phase.

It is anticipated that the number of requests from consumers and their agents to distribution network operators for information relating to the system impedance at their supply terminals will increase as a consequence of the publication of IEC 61000-3-11 and the procedure for the conditional connection of equipment that it promulgates.

In order to assist distribution network operating companies worldwide in determining a practical value of actual supply impedance at a particular consumers' premises and to assist manufacturers in assessing the marketability of their products in particular countries worldwide, a basic approach to the determination of maximum supply impedance has been developed and is given in Annex A.

The following values of supply impedance have been obtained by application of the method given in Annex A, based on the assumptions that:

a) the distribution transformer has a rating of 500 kVA, a 3 % voltage regulation or a 2,68 % reactance;
b) there is 95 % probability of occurrence, i.e. 5 % of consumers, are likely to have a supply system impedance greater than the tabled values.

If necessary, these supply impedances, or the maximum supply impedances listed in Tables A.1 and A.2, may be amended to represent national or particular public supply networks by use of Clause A.5.

The Korean Agency for Technology and Standards completed a comprehensive national survey of network impedances associated with 60 Hz, 380/220 V low-voltage supply systems in March 2004 and provides information that the following, 95% probability, network impedances are appropriate to Korea:

– single-phase two-wire 220 V, service capacities ≥100 A per phase, (0,29 + j0,33) Ω;
– three-phase four-wire 380 V, service capacities ≥100 A per phase, (0,26 + j0,30) Ω.

4.2.1 Supply impedances relevant to the connection of three-phase equipment

Table 2 contains, under the assumptions stated in 4.2, the values of the modulus, in ohms, of the supply impedance of the line-conductors of 230/400 V, 50 Hz public electricity supply networks relevant to three-phase services, the various statutory voltage ranges declared to consumers and service capacities in common use.

Table 2 – Modulus values of supply impedance, in ohms at 50 Hz, relevant to the connection of three-phase equipment and having a 95 % probability of not being exceeded

Declared voltage range in per cent	Service capacity in amperes per phase				
	150 A	200 A	300 A	400 A	600 A
8	0,09	0,06	0,04	0,03	0,02
9	0,10	0,07	0,05	0,04	0,03
10	0,11	0,08	0,05	0,04	0,03
11	0,12	0,09	0,06	0,05	0,03
12	0,14	0,10	0,07	0,05	0,03
13	0,15	0,11	0,08	0,06	0,04
14	0,17	0,13	0,08	0,07	0,04
15	0,18	0,14	0,09	0,07	0,05
16	0,20	0,15	0,10	0,08	0,05
17	0,21	0,16	0,10	0,08	0,05
18	0,22	0,17	0,11	0,09	0,06
19	0,24	0,18	0,12	0,09	0,06
20	0,25	0,19	0,13	0,10	0,06

4.2.2 Supply impedances relevant to the connection of single-phase equipment

Table 3 contains, under the assumptions stated in 4.2, the values of the modulus, in ohms, of the supply impedance of the line-to-neutral conductors of 230/400 V, 50 Hz public electricity supply networks relevant to the connection of single-phase equipment to three-phase 4-wire services.

Table 3 – Modulus values of supply impedance, in ohms at 50 Hz, relevant to the connection of single-phase equipment and having a 95 % probably of not being exceeded

Declared voltage range in per cent	Service capacity in amperes per phase				
	150 A	200 A	300 A	400 A	600 A
8	0,13	0,10	0,06	0,05	0,03
9	0,15	0,12	0,08	0,06	0,04
10	0,18	0,13	0,09	0,07	0,04
11	0,20	0,15	0,10	0,08	0,05
12	0,23	0,17	0,11	0,08	0,06
13	0,25	0,19	0,12	0,09	0,06
14	0,27	0,20	0,14	0,10	0,07
15	0,30	0,22	0,15	0,11	0,07
16	0,32	0,24	0,16	0,12	0,08
17	0,34	0,26	0,17	0,13	0,09
18	0,37	0,28	0,18	0,14	0,09
19	0,39	0,29	0,20	0,15	0,10
20	0,42	0,31	0,21	0,16	0,10

5 Reference impedances

Recommended values of reference impedances appropriate to distribution systems operating at a fundamental frequency of 60 Hz are not provided in this document; this subject is to receive further study when sufficient technical information is released by countries operating such systems.

5.1 Reference impedances for equipment with current ratings ≤16 A

Equipment having current ratings ≤16 A is mainly connected in premises having service current capacities less than 100 A per phase. Such premises are predominantly in residential supply areas, which were surveyed in 1980, and reference impedances relevant to the connection of equipment having current ratings ≤16 A have therefore been derived from the values given in Table 1.

It was intended that the reference impedances should represent existing system impedances and have values that could be used to assess the emissions of equipment against voltage limits with a view to ensuring that connection of equipment to a public supply network would not cause undue voltage disturbance and distortion.