Introduction

INFORMATION SHEET LVD ADCO

Fusing resistor applications

LED lamps, CFL lamps and SMPS, etc.

For a longer time the use of fusing resistors is discussed and it showed that its correct application is still not clear to all stakeholders. Specific European and/or IEC standards for fusing resistors are not available yet. This information sheet is based on the experiences of market surveillance authorities gained during inspections and testing of especially LED and Compact Fluorescence Lamps (CFL) and switch mode power supplies (SMPS), but does not exclude other product categories. This information sheet aims to provide more clarity for all.

This document is in detail prepared by the chair of LVD AdCo and is based on the input of several member states. A mandate was given to the chair by LVD AdCo member states and the content for a draft was discussed during the LVD AdCo meeting in January 2014.

The information sheet provides detailed information for all member states, economic operators and all other relevant stakeholders. It is published to make it available to all and be as transparent as possible as LVD AdCo.

This information sheet is a non binding document and intended to provide guidance to help Member States and all stakeholders to facilitate the decision-making process. Part of that process must be a risk assessment in order to draw the correct conclusions. Based on Union legislation one must proceed on a case-by-case basis, taking account of all the characteristics of the product and all accessories.

If you have any questions you can contact the Market Surveillance Authority in your member state or address the chairman of LVD AdCo.

May 2014

Chairman LVD AdCo

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1. Introduction

The objective of this document is to made information available for stakeholders over the common understanding amongst market surveillance authorities (MSA) of the applicable requirements for the correct application of fusing resistors used as a (safety) component in products that are subjected to the Low Voltage Directive 2006/95/EC and are sold on the European market. This initiative is undertaken for the reason that suitable specific standards for the described component and application are not available and the selection of relevant requirements is complex. This document is informative and written in a way that it is considered suitable to make it available to all interested stakeholders.

This information sheet is based on the experiences of market surveillance authorities gained during inspections and testing of especially LED and Compact fluorescence lamps and switch mode power supplies (SMPS), but does not exclude other product categories. In addition some aspects of the use of non harmonized miniature fuses in relation to the use of a fusing resistor will be handled.

The fusing resistor is not defined in a general or any specific harmonized European or IEC standard. The fusing resistor is in at least one standard only mentioned (EN 60065). A well known definition is part of standard UL 1412: 1999 incl. revision 2004 and 2012. The scope for the use of a fusing resistor considers the purpose. The requirements in that standard aim to reduce the risk of fire or electric shock by use of those resistors. However, the compliance of a resistor with these requirements does not mean that it is acceptable for all applications without evaluation in the appliance.

It is sometimes difficult to distinguish visually between a standard resistor and a fusing resistor. Market Surveillance Authorities noticed that some manufacturers even use standard resistors for a fusing function in the appliance and that such resistors normally are not capable to withstand the required tests. The technical file must provide more detailed information about the use of a fusing resistor.

2. Position of the administration

All economic operators placing an electro technical product on the European market must take account of the requirements of the Low Voltage Directive. More specific they have to comply with the national law of the member states that implement that Directive and to which the products are sold.

Therefore it is important for the producer to decide before placing his product on the market, whether his product in question is in compliance with the Low Voltage Directive. That decision must be based on evidence and show that the information provided in this information sheet is taken into account. Based on the Low Voltage Directive Annex IV all evidence and information must be a part of the technical file.

3. Background

The last few years market surveillance authorities experienced that the use of fusing resistors increased, especially in product categories where innovations and developments are in movement. Examples are LED lamps, LED tubes, CFL lamps and SMPS. Several accidents and incidents are brought forward to market surveillance authorities and determined as caused by the application of fusing resistors.

Basically the information given in this information sheet was already passed on to the sector during an international symposium “Unsafe Light Sources” that was organized by LVD AdCo (NL-chair) and held 8th March 2012 in the Netherlands. Via this way economic operators and stakeholders were made aware of the situation at that time. The stakeholders were recommended to make changes in the production of those products as soon as possible in order to comply with the relevant legislation.

A fusing resistor is a resistor enclosed in a housing that will reduce the risk of fire. In a high overload condition the housing of a normal resistor might explode or burst. Energy cumulated in a fusing resistor is in practice better absorbed. When a fusing resistor is exposed to a higher energy compared to normal load in a limited time the housing of an fusing resistor will start to heat up, but due to the limited time the resistor track will normally break down before the housing will be damaged. In such case it will function more or less like a commonly known fuse.

If a designer decide to restrict the maximum current in a circuit during failure mode it is expected that he uses for that purpose a miniature fuse accordingly EN 60127 series. Another (non-harmonized) type of fuse is considered only acceptable if the designer can show evidence that the component is as safe or perform better than the harmonized version.

MSA noticed several objections to use a fusing resistor as a fuse or placed in a circuit where it will behave as a fuse. Some of the accidents and incidents mentioned before are caused by the use of a fusing resistor based on causal evidence. The following has to be taken into account:

- If a fusing resistor is used and functions as a fuse in the circuit where due to a possible or unforeseen failure a short cut or over current can flow, the fusing resistor should withstand the same tests as for fuses designed accordingly EN 60127 series.

- Based on design principles a fusing resistor should not be used outside its scope and/or intended purpose and destination. While EN (or IEC) standards do not define the fusing resistor it seems appropriate to restrict the use to the definition of standard UL 1412. Under certain terms and conditions a limited wider use is acceptable (see rules for application). A problem to be tackled is that the behaviour of the fusing resistor is not predictable enough in all short circuit situations or during long time overload conditions.

- There is causal evidence that due to the behaviour of a fusing resistor in an appliance several accidents caused fire and that dangerous tensional voltages became touchable. This is caused by two factors.

The first is that the housing of the fusing resistor is of (special) material that is able to withstand higher temperatures. Benefits are that at short time limited high overload the fusing resistor housing can withstand the internal developed heat and that the housing will stay intact and only the resistance track will open. However, the behaviour of the fusing resistor depends on the specifications and it must be able to shut down the maximum current that can occur safely. Test and casual evidence shows that fusing resistors can explode during short circuit tests.

Secondly, it is important to know that in standards the (specific) behaviour of the fusing resistor for small overloads is not taken into account. The positive behaviour during a short cut in a limited time can create danger during overload conditions that occur for a longer time. Out of daily practice is known, from several investigated accidents, that there are situations where the current through the fusing resistor just left the resistor intact, but the temperature rise in the resistor was enormous. The reasons why such currents can exist is not investigated, but it is presumed that other components fail partly or completely, after which the current increase without reaching a short cut mode. The fire resistance housing of the fusing resistor, created to withstand the heat dissipation during short cuts, can withstand also higher currents than during normal use occur. It is presumed that more often a so-called snowball effect caused accidents. It starts with a higher current caused e.g. by the failure of a component. The temperature of the fusing resistor housing increases and temperatures inside the housing of the product become higher. This influences sometimes other components or the failing component (including connections and printed circuit board) and can increase the current through the fusing resistor again and causes a higher temperature of the fusing resistor housing; and so on.

It showed that during test conditions temperatures of fusing resistor housings for a longer time operate at higher temperatures than 300^{o}C before the fusing resistor shuts down. In the accidents the users are endangered before that final stage is reached by holes burned in the housing of the product, mains shortcuts occurred with sparks reaching outside the housing, fires started or explosions happened. As a consequence of overheating, flammable gasses might play a role. The accidents reported can be reproduced and explained in this way.

This is brought to the attention of CENELEC.

OSM Decision

The OSM decision 99/1 regarding EN 60950 clause 1.5.1, is considered not acceptable as proof of evidence for compliance of a fusing resistor used as protective device. It is not enough to show compliance when the fusing resistor is only checked by repeating at least 10 times during worst case fault condition test. The OSM decision gives no further interpretation what these conditions are. Also the overload condition and a temperature rise of the fusing resistor as described before, which could influence other components, is not taken into account in the OSM decision.

LED and CFL lamps

In general the requirement for the creepage and clearance distances are to be determined based on the relevant standard. Special is that for Compact Fluorescence Lamps (CFL) a requirement is missing for the creepage and clearance distance between phase and neutral. This is notified to CENELEC and for the time being the reference (by MSA's) is taken from another standard (EN 61347-1).

The standard EN 62560 for LED lamps refer for creepage and clearance distances to the standard EN 61347-1. It is by the standard EN 61347-1 for lamp controlgear (par. 14) accepted that the creepage and clearances distances are decreased to a certain minimum if precautions are taken. In order to comply with the design principles for safe products such precautions must be deliberate designed and obligatory described in the technical file. The precautionary measures must be fit to perform correctly and must be able to create a safe shut down. If a fusing resistor (sometimes in combination with a non-harmonised miniature fuse) is used, the standards for lamp controlgear take only into account open or short circuit failures and not other overload conditions. Manufacturers are responsible for safe use and must perform therefore additional tests in order to be sure that the fusing resistor behaves also safe under all overload conditions.

Fuses

Fuses used shall be in compliance with standard EN 60127 series. If other type of non-harmonised fuses are used manufacturers are responsible for safe use and must perform therefore additional tests in order to be sure that the fuse behaves safe under short circuit and all overload conditions.

4. Rules for application of fusing resistors

The conclusion should be that fuses, other as described and defined in EN 60127, and thus fusing resistor in general, can not be used outside the scope in the standard and their own specifications without taking additional precautions.

Because it is not obligatory to use only harmonised standards like EN 60127 there is a small escape. Only if the manufacturer can provide evidence that the product is safe under all foreseeable conditions during normal use and all abnormal conditions during the whole life time of the product the use of components as fusing resistors and non harmonised fuses might be acceptable.

The manufacturer must in that case describe the use of the precautionary measure and all the tests performed and include a declaration in the technical file that the product cannot become unsafe undue the use of those components. All specifications of the product and safety components must be directly available in the technical file. The technical file must contain the results of the additional tests. The declaration of conformity cannot simply mention the standards used, but must contain an additional declaration in the paragraph of the mentioned standards which explain the exemption to the standard and additional used references.

A case-by-case approach based on the content of this information sheet can help in the decision process in order to define whether a product is non-compliant with the Low Voltage Directive. Technical non-compliances or incomplete technical files or declarations of conformity can lead to measures taken by MSA.

5. Remarks

Where can one find more information?

Documents on the subject, including all relevant amendments:

- EN 61347-1 : 2008
- EN 62560 : 2012
- EN 60968 : 2013
- EN 60950-1 : 2006
- EN 60065 : 2002

Or in a (harmonized) version of the standard which is later published.
Standards can be purchased at national standardization bodies.

The European legislation in the field can be found through following internet links:

http://ec.europa.eu/enterprise/sectors/electrical/index_en.htm

http://ec.europa.eu/enterprise/sectors/electrical/lvd/

http://ec.europa.eu/enterprise/sectors/electrical/documents/additional-legislation/index_en.htm

Starting from this last link, it is possible to find the list of the notified bodies:

http://ec.europa.eu/enterprise/sectors/electrical/documents/lvd/notified-bodies/index_en.htm

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Stakeholders are invited to contact the chairman of LVD AdCo if this document needs to be improved or updated.

This information sheet in its latest version will be considered applicable as long as no harmonized document is established at European level, among others in the field of standardization. In order to protect consumers in a responsible way and knowing that establishing such a harmonizing document takes time, it is necessary that meanwhile necessary measures are taken on the national markets of the Member States.