TCO labelling of visual display units – What does it mean for users and the environment?

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2007-04-18

Introduction

The TCO labelling system includes requirements within four areas. Two of these are closely connected with the computer-users' environment – ergonomics and low electromagnetic fields. The other two areas are of a broader perspective and high on the agenda of the socially-concerned – energy efficiency and the environment, both of enormous and immediate interest in the current global debate concerning climate change. The following is a brief description of the requirements concerned and the effect these have had on the market.

Energy efficiency

The requirement for energy efficiency was introduced back in the first stage of the TCO labelling system – TCO´92 – the chief aim being to reduce the energy consumption of displays. This would also lead to a lowering in operating costs and a reduction in the impact on the environment. Two requirements had to be met:

1. The display shall be equipped with an automatic cut-off function which ensures the display is switched off after a certain period of time when not being used. Displays that users forget to turn off consume a great deal of energy which leads to a wholly unnecessary increased impact on the environment.

2. The display shall be supplied with an energy declaration stating the energy consumption of the display under normal use.

These requirements were drawn up by TCO's co-operation partner Nutek. The authority's motive for promoting energy efficient displays was that, in a study, visual display units had proved to be the major energy consumers in the office environment. Nutek's requirements were part of a further assignment for which the authority was commissioned by the Swedish government and parliament concerned with contributing to energy-efficient processes and products in all social sectors. Behind this objective from the government authorities was the will to reduce the country's dependence on energy derived from nuclear power.

Nutek pointed out that automatic cut-off also contributes to an improved indoor climate and a reduction in the need for mechanical ventilation – cooling input – which also reduces energy consumption.

In TCO/SNF's document *The environmentally-friendly office (1991*), several examples are given of measures to achieve significant energy savings including automatic cut-off in computers. They emphasized that, so far, initiatives of this kind have only been *islands* in a vast ocean of the routine squandering of energy.

The TCO´92 requirement for energy efficiency was the same in TCO´95 but was intensified with the launch of TCO´99. The requirement was further defined in TCO´03 Displays when the TCO Development and Energy Star programme within the EPA (Environmental Protection Agency) in the USA agreed on a new standard. It included a standardized measuring method for energy consumption in the display's operational position (on mode) and requirements both for the on mode and power saving positions (sleep and off mode). This was the first product group for which certification requirements were set for the on mode and this has prepared the way for other product groups to move in the same direction.

A comparison between requirements in four generations of TCO labelling:

	TCO´92/TCO´95	TCO´99 CRT	TCO´03 LCD	TCO´03
Standby	30 W	15 W	4 W**	2 W**
Power down	8 W	5 W*	3 W**	1 W**
In operation (W)	-	-	-	= 28 x number of Megapixels

* Normally only a position of 5 W. In TCO'99 this is called the energy saving position

** the positions are called sleep mode and off mode

The change in display technology from CRT to LCD that occurred in the first few years of 2000 has been hugely important in terms of energy consumption. A 17-inch CRT display in operation today uses approximately 65 W while an LCD display uses approximately 30 W.

It is worth pointing out that CRT has virtually disappeared as a certification object for TCO Development. The production of CRT is in free fall and the number of LCD displays produced each year continues to grow. In Sweden, and many other countries, sales of CRT displays have as good as ceased.

The size of the displays also has an impact on energy consumption. When, in 1986, TCO devised its screen checker, displays measuring a minimum of14 inches were recommended for intensive reading and writing work. Today, the recommended size is at least 17 inches, often 19 inches.

For LCD displays today, the consumption of power is often less than 1 watt in "sleep mode". (Corresponding power consumption for CRT is less than 4 w.)

How much energy then has been saved in total in the course of the past few years thanks to the TCO label? The major saving has probably been due to the change in technology to LCD and the requirements set out in TCO'03. These requirements have set the norm for the industry and have certainly contributed to significant volumes of energy being saved. A comparison can be made with TV where no requirements for energy efficiency have been articulated and no label has influenced technical developments in that field.

(Source: TCO Development, Boivie, Workplace development)

Estimated energy savings and reduced carbon dioxide emissions

The basis for estimating total energy savings and reduced carbon dioxide emissions through the TCO label's automatic cut-off function requirement:

1. The total number of displays in use in 2006 is estimated at 1 billion units measuring 15 inches and above. Of these, 65% are estimated to be CRT and 35% LCD. Of these 1 billion desktop displays in use in workplaces, schools and in the home all over the world, 500 million are estimated to have the TCO label.
2. TCO-labelled displays have been on the market since 1993. Up to now, more than 7,000 models have received certification.
3. We assume that the 500 million desktop TCO displays are used for an average of 3 hours a

day. If there is no energy-saving position, it is estimated that the displays have been in the operational position for a further 5 hours per day.

4. In the presentation of Energy Star in the mid 1990s, it was said that 30-40% of computers were left on all night and that a computer is in waiting mode more than 50% of the time. Studies at Dalarna University in various offices during the 1990s, confirmed this assessment. Very few chose to turn off their computers during their lunch break, for example. In a study in 1998 at Scania in Falun, the researchers came to the conclusion that a computer stands in the rest position for approximately 5 hours per 24 hours. With these studies as a starting point **annual global savings due to TCO-labelled automatic switch-off displays will be at least 25 TWh for 2006. This corresponds to approximately 4 nuclear power reactors of a standard size for Sweden**. Throughout the world today, there are 400 reactors in operation. (Source: Dr Göran Bryntse, senior lecturer at Dalarna University).

5. As electricity production in the world generally has coal-condensing power plants on the margins, 1 kWh of saved electricity involves a saving of 1 kg of CO2. Thus, TCO displays should have **saved approximately 25 million tons of carbon dioxide** last year, corresponding to half the total Swedish emissions of carbon dioxide. *(Source: Bryntse)*

Ecology/environmental adaptation

Brominated and chlorinated flame retardants

TCO´95 introduced the requirement that no brominated or chlorinated flame retardants should be present in plastic components. It was not possible for the requirement to be met regarding printed circuit cards but in all other respects the TCO label has resulted in the fact that plastics used in certified displays today are free from the aforementioned flame retardants.

Brominated and chlorinated flame retardants share similarities with PCBs and are extremely damaging to people's health as well as the environment. All plastics containing chlorine or bromine can also give rise to highly dangerous dioxines when burned.

When TCO introduced its requirements 12 years ago, levels of the above flame retardants continued to rise in wildlife such as fish, seals and birds' eggs in the Baltic sea area. This has also been the case with the presence of these substances in humans. Levels found in human breast milk have doubled every five years since the beginning of the 1970s.

Most brominated flame retardants are fat-soluble, difficult to break down and lead to serious health risks. In mammals, it has been shown that these types of flame retardant affect liver enzymes, thyroid gland hormones, the immune system and neurological development. They can also lead to changes in motor activity and have been shown to have an adverse effect on learning and memory in laboratory animals.

Since 1995, thanks to TCO's global environmental labelling, people and the environment have been saved from the damaging effects of approximately 50,000 tons of brominated and chlorinated flame retardants (the equivalent of a large tanker). *(Source: Semko and TCO Development)*

Due to the fact that requirements were set in order to remove these substances, levels of certain flame retardants have also started to fall in Sweden. Since 1 July 2006, the polybrominated

diphenyl (PBDE) and polybrominated biphenyl (PBB) sub-groups of flame retardants have been banned in electrical and electronic products within the EU through the ROHS directive. When these bans were introduced, these substances had already been banned in TCO-labelled products for more than 10 years. The TCO label bans the use of several brominated flame retardants, including DecaBDE which is still permitted within the EU despite the evidence of several studies which indicate damaging effects of various kinds.

Brominated flame retardants are not manufactured in Sweden. The bulk of the brominated flame retardants we use are present in goods that we import. These are goods that contain electronic or flame-resistant plastic and textile components in, for example, cars.

Visual ergonomics and picture quality

> Picture quality has developed dramatically in desktop displays as a consequence of the increased demands for visual ergonomic properties that have been introduced by degrees as conditions for the TCO certification of displays since the first visual ergonomic requirement was

introduced in the label (TCO´95).

With TCO´03 Displays, specific visual ergonomic requirements were introduced for flat displays which included colour reproduction, requirements which are far more stringent that those contained in international standards (ISO).

Poor visual ergonomics increase problems of various kinds with the eyes and vision which, in turn, affect productivity. In addition, a connection exists between poor visual ergonomics and strain trouble. The user often adopts postures unconsciously to help them see as well as possible. A classic example is the "vulture neck" attitude in which the use of ordinary varifocal spectacles results in the neck being bent backwards in order to see the display through the lower part of the spectacle lens while, at the same time, the head is set in a forward position to increase the relative size of the characters. Poor visual ergonomics can, however, also lead to problems with the neck and shoulders without
any change in posture.

> In TCO’s experience, without any demands being made by users concerning, for example, visual ergonomics manufacturers will not voluntarily develop their products in the right direction but in more gratuitous directions which are more fashionable at the time.

Helge Tiainen was responsible for the development of Nokia’s displays in the 1990s and was the person behind the company becoming the first to TCO certify a display model (February 1993). At the turn of the century, Tiainen expressed himself in the following way about the importance of the TCO label for visual ergonomics:

"When TCO began its work on visual ergonomics at the beginning of the 1980s, displays were so bad that if they were compared with today’s displays, it would be like comparing a radio from the 1920s with a current model. TCO has had an enormous effect on product development."

Electrical and magnetic fields

Through the TCO labelling system, electrical and magnetic fields from computer displays have reduced significantly compared with normally occurring “radiation levels” before 1991. That was the year TCO introduced its requirements for recommended values in the publication “Facts about

displays", requirements which were put into the first stage of certification of displays - TCO´92. This is concerned with a reduction of between 5 and 10 times for the electrical fields and a reduction by half for the magnetic fields.

	Before 1991	**After 1991**
Electrical alternating fields/ELF Band I	100-200 V/m	10 V/m
Electrical alternating fields/VLF Band II	5 V/m	1 V/m
Magnetic alternating fields/ELF Band I	300 – 400 nT	200 nT
Magnetic alternating fields/VLF Band II	20-30 nT	25 nT

The recommended values did not changed appreciably from TCO´92 to TCO´03. The changes that have been made are that the measuring methods have been changed since the introduction of TCO´99 which in practice involves stricter requirements. Requirements were also introduced to eliminate the effect of external magnetic fields on displays.

The level of the recommended values for fields was set on the basis of TCO's ambition to reduce exposure to current fields provided it was technically feasible to reduce the risks to health. It was not then a matter of so-called hygienic limit values set on the basis of scientifically-supported facts about harmful effects.

The change in technology during the first few years of 2000 has meant that the magnetic fields generated from the "fat screens" (CRT) that dominated the market in the 1980s and 1990s barely occur in the flat LCD displays which are the wholly dominant technology of today. It should be noted, however, that the electrical alternating fields can be 10 - 100 times higher in non TCO-certified LCD displays or laptops as these are often not earthed. The requirement for low electrical fields is indirectly leading to requirements being more difficult to meet without protective earthing.
It is difficult to say what the effects of the dramatic reduction in exposure to electrical and magnetic fields are for computer users. However, it is clear that the number of reported health problems, including skin problems, has fallen dramatically compared with those that were the focus of the debate concerning computer displays during the 1980s and the beginning of the 1990s.

It is probable that the reduction in fields combined with the ban on the use of brominated flame retardants contained in plastic components in TCO displays have played an important part in the reduction of the aforementioned health problems. The change in technology from CRT to LCD may also have been an influential factor.

Four generations of TCO labelling of visual display units

1050	**2094**	**3282**	**881**

Number of certified models 3 April 2007

Overview of the label's content: see www.boivie.se