

ELECTROMAGNETIC FIELD AND HEATING MEASURING RESULTS OF LAP TOPS

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Abstract. *The rapid growth of lap tops has led to increasing exposure to electromagnetic fields and heating which is emitted by lap tops, so there is a logical question of health risk to users of lap tops. It is especially important for young male users of lap tops because they put lap tops in their laps for the duration of their use, keeping them near their reproductive organs. This paper presents the results of an study carried out on sample of 212 male lap top users (elementary and middle school pupils and students) and the results of electromagnetic field and temperature measurements of 12 different lap tops types during the time of their use and the results of the measuring of the temperature of the users' testicle area by means of a thermal camera.*

Key words: *lap top, electromagnetic field, heating, measuring*

1. INTRODUCTION

The great possibilities of lap top use have made them a necessary and important segment of the modern life of many adults and children in the last several years. The lap top is a portable device with its own power supply and many of lap top users are using lap tops by putting them on their laps. From year to year, the duration of the average time of use in one day has increased. That leads us to the very important fact that a lap top emits determinate electromagnetic fields and a determinate quantity of heat and has some influence on that part of the lap top user's body, especially the testicles of male users. Because of that, it is necessary to measure the electric field strength and magnetic field strength in a certain user's body region as the temperature of some parts of the lap top user's body increases during the period of its use. It is very important, especially for male users elementary and middle school children and students because a certain number of them do not have completely formed reproductive organs (related in particular to elementary school users) and a certain number of them do not have children yet (none of the studied users had children). In addition to lap tops, there are some other devices with similar effects on their users (mobile phones etc.) [1], [2], [3], [10].

2. THE RESEARCH

The research was realized in Niš in 2009 and 2010 in the "Ćele Kula" elementary school, "Nikola Tesla" middle school, the Faculty of Electronics, the Faculty of Medicine, the Faculty of Law, the Faculty of Economy and the Faculty of Environmental Protection, on a sample of 650 male users aged 7 to 20. The research included a number of children that use lap tops (the results are presented in figure 1.a), the manner in which the lap top was used (the results are presented in figure 1.b), the duration of the average time of lap top use (the results are presented in figure 2.a) and the purpose of the use of the lap top (the results are presented in figure 2.b). The research was realized in the form of a poll, where the polled individuals answered questions regarding four noticed items. The number of lap top users was 212, which means that only 32,6% of all of the participants (650) used lap tops. If compared to lap top users in some other countries, the result is very low (for example, in Denmark, Sweden, Norway and Germany the number of lap top users exceeds 95% of the participants included in similar polls), which was probably the result of the financial crisis at the time the research was done. It has been noticed that the realized results have become better and that the number of lap top users is constantly increasing.

According to the results of the research, it was decided to choose 12 models of lap tops which were used to measure temperature: Lenovo G550, Asus eee PC 1215N, Fujitsu AH550, HP 4520s, Fujitsu Siemens V5535, HP dv6-1350ex, Asus A52JR, Lenovo X100e 3508, Toshiba Satellite C650D, Toshiba Satellite L30, Dell inspiron 1100 and Dell latitude D630. The named lap tops were the most frequently used in the sample of 212 male lap top users. It is important to note that the results of the poll presented a subjective evaluation of the participants. The results show that most of the lap top users placed their lap tops on their laps (195 from 212), during a period of time up to 45 minutes (52 from 212) and for internet use (113 from 212).

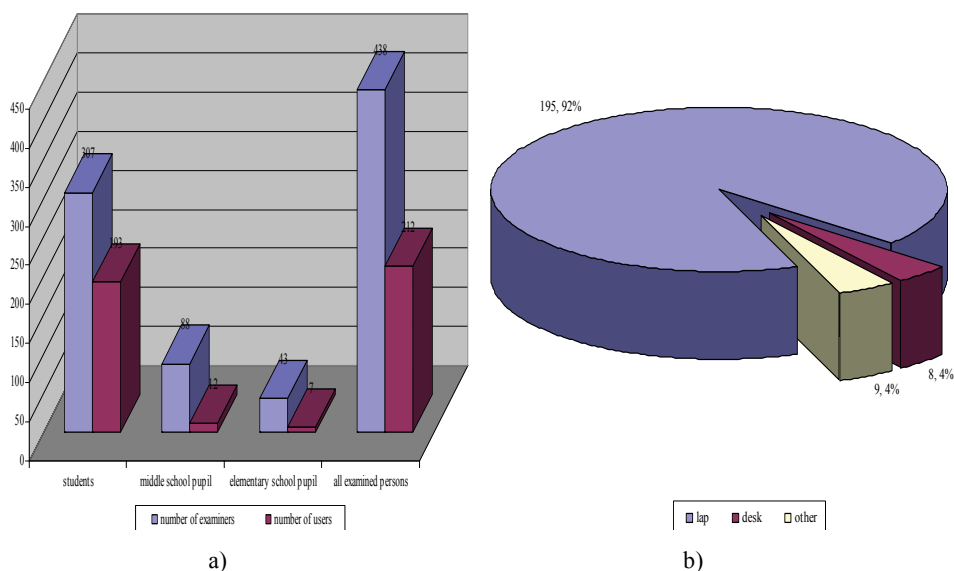


Fig. 1. The number of lap top users with different levels of education (a) and the way the lap top was used (the number of lap top users according to where lap top was placed during use) (b)

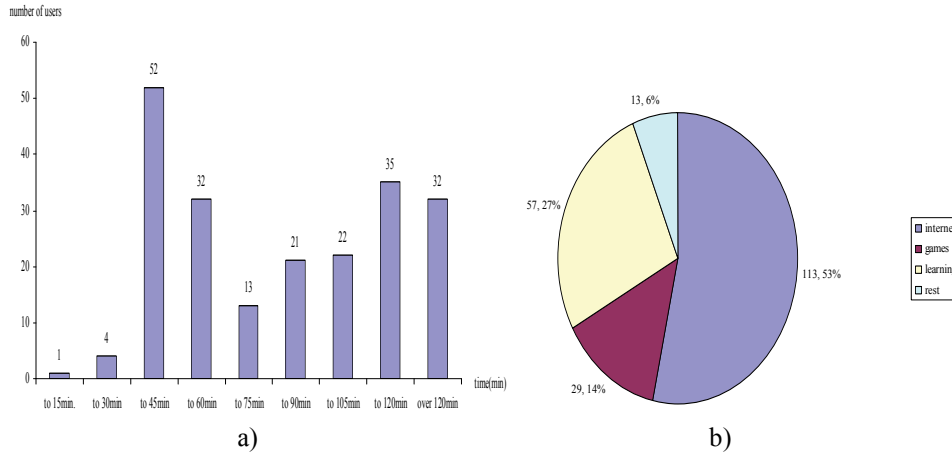


Fig. 2. Average time of the duration of lap tops use (a) and the purpose of lap top use (b)

3. THE RESULTS OF THE MEASURING

The measuring of the electric field strength and magnetic field strength of the named models of lap tops was carried out with a SPECTRAN NF 5020 SN 00610 and EMF-823, the instruments were designed for low frequency electromagnetic field measuring. The measurements were done in a laboratory and under laboratory conditions – temperature, pressure and humidity. The presence of other electric and magnetic fields in the laboratory was disregarded. Each measuring was repeated several times [4], [6].

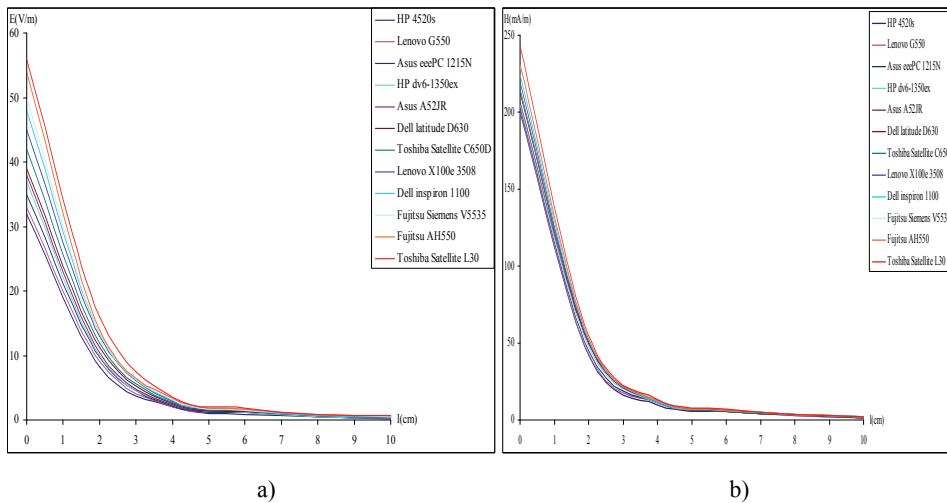


Fig. 3. The dependence of the electric field strength on distance for all twelve models of lap tops (a) and dependence of the electric magnetic strength on distance for all twelve models of lap tops (b)

The electric field and magnetic field around the lap tops did not have similar values in the same directions. It was shown that the point of the greatest electric field strength and magnetic field strength was the point around the power supply and cooler, so the measuring for every tested lap top was done from those points, with the highest measured value for the electric field strength and magnetic field strength. The measuring distances were from 0 to 10 cm, at a distance of 2 cm. The main reason for those distances was that most of the lap tops had been placed on the user's lap during use. The values from the other points on the tested lap tops for the electric field strength and magnetic field strength were several times smaller. It should be noticed that every tested lap top had its own power supply, and that the results of electric field strength and magnetic field strength would definitely have been higher, if the power supply from the electric network had been connected.

The measurements of the temperature and the changes in temperature of the lap tops and the human body during use were recorded by the thermal camera VARIOSCAN hr compact 3021ST. This camera provides a visualization of the thermal presentation of the human body according to the detection of infrared heat waves. It can be set to record a certain number of pictures in one second and to show the place with the biggest and the lowest temperature. The same camera was used for some similar measurements on mobile phones. [9], [13].

The first step in the measurement process was to measure the temperature distribution for every lap top from the surface and the background before the lap top was turned on. The next step was to properly place the lap top on the user's lap, and that moment was taken as the start of the measurement. The participant used lap top for 45 minutes, a period which was scanned by a thermal camera (figures 4.a and 4.b). Before that, the place around the user's testicles and the lap top surface and background were scanned by a thermal camera and the temperature of these parts was measured and noted (figures 5.a and 5.b). This was repeated for each 12 tested lap tops and the results were measured and noticed on several thousand pictures. The lap tops were used to play video games and work in some programs because that was a reliable way to realize the highest temperatures.

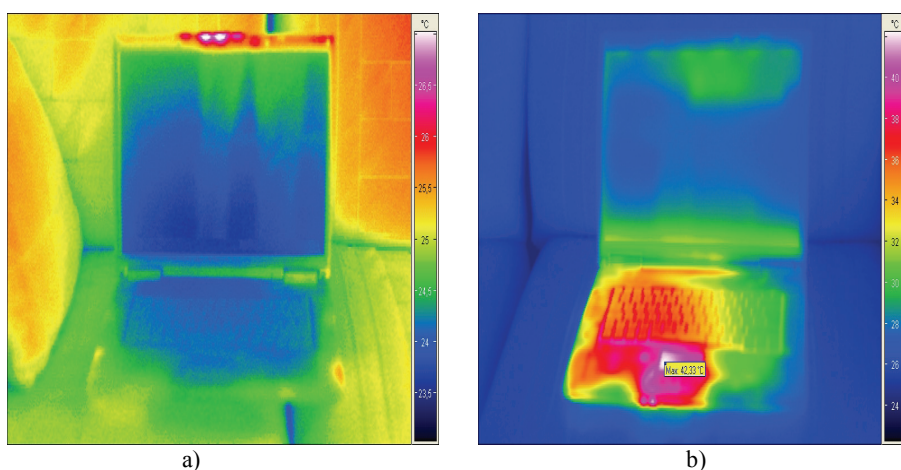


Fig. 4. The temperature distribution example of a lap top surface before measuring (a) and after measuring (b) (as example Fujitsu Siemens V5535)

It is very important to note that every new measuring was realized after a period of 24 hours because that was the way that cumulative effects of heating on the lap top user's body should have been disabled. The camera was set to scan five pictures in one minute. The temperature of the environment was approximately 24 C°. The software EVEREST ultimate edition 2007 was used to determine the temperature of the central processor unit and motherboard. The point with the most temperature value on the lap tops was the power supply region.

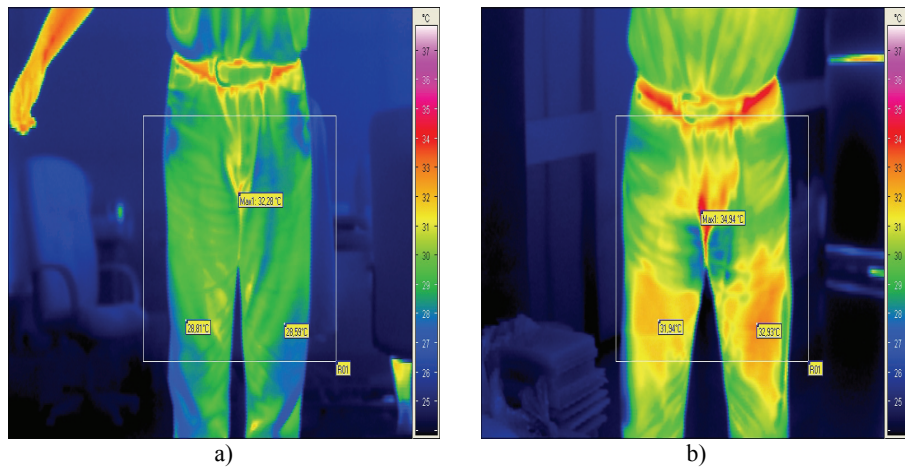


Fig. 5. An example of temperature distribution of the user's body before measuring (a) with marked temperatures and after measuring (b) with marked temperatures

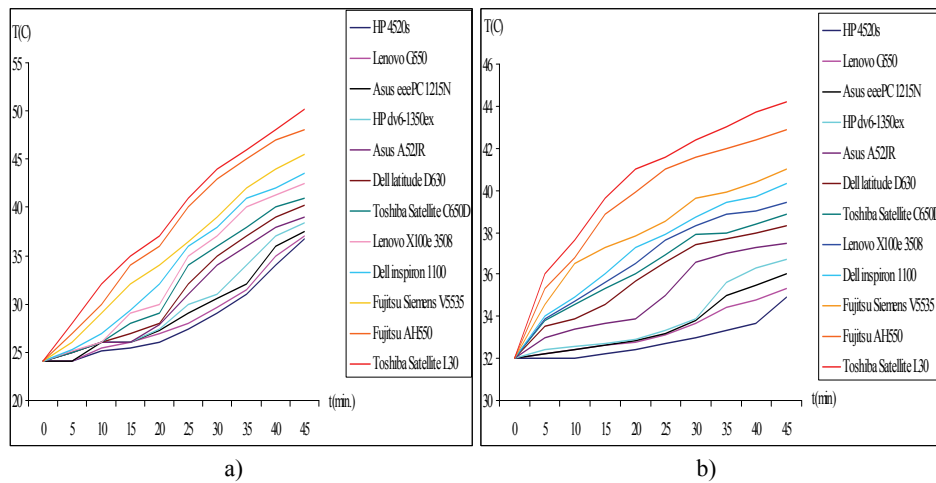


Fig. 6. Temperature increase during the use of lap tops (a) and the testicle region temperature increase during the use of lap tops (b)

All of the measuring results for all 12 lap tops are presented in figures 6.a and 6.b. where can be seen that the increase in the temperature of the complete lap region includ-

ing the testicle region is a irrefutable fact. The lap top with the biggest heating extent was the Toshiba Satellite L30 (50.2 C° - lap top temperature after 45 minutes and 44.2 C°- the testicle region after 45 minutes) and the lap top with the smallest heating extent was HP 4520s (36.7 C° - lap top temperature after 45 minutes and 34.94 C° - the testicles region after 45 minutes). Figures 6.a and 6.b. also show that the temperature slightly rose after the measuring time of 45 minutes, and it could achieve high values after a measuring time of several hours [8].

4. CONCLUSION

The measuring results for the electromagnetic field that were realized in this paper show that the values for electric field strength and magnetic field strength lie below the permitted values according to the value standards. For example, according to the Russian standard, the highest value for low frequency electric field strength for non-limited exposition is 5kV/m.

The measuring results for heating that were obtained in this paper show that the increase in temperature in the lap and testicle region is high, and can range from 2.94 C° for a lap top with the smallest heating degree to 12.2 C° for a lap top with the biggest heating degree for a measuring time of 45 minutes. It can be seen that after 45 minutes of measuring, the temperature is still rising. It is a very important fact that the average temperature of the male testicles should be 33 C°. The reproductive organs, the testicles are a complex organ where a lot of biochemical processes and reactions take place, which depend on a lot of factors (psychological and physical, internal and external) including temperature. A change in only one factor could cause very serious problems in the functioning of the whole system. For example, the process of liquid faction or the process of sperm dilution, which takes place through the influence of prostate enzymes, is also temperature-dependant. Under normal conditions this process develops quickly (at a maximum of 60 minutes) with an optimal temperature range from 20 C° to 37 C°, where all of enzymes are active, thus, the change in only a few degrees can cause problems.

The influence of temperature could be relieved using the lap top on some other place such as a desk, bench, floor; also, lap top pods can be used if the lap is the only place where the lap top can be placed, but pods can raise the temperature of the lap top. [5], [7], [11], [12].

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REZULTATI MERENJA ELEKTROMAGNETNOG POLJA I ZAGREVANJA LAP TOPOVA

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Sve veća upotreba lap topova dovodi do povećanog izlaganja elektromagnetnom zračenju i zagrevanju koje je emitovano od strane lap topova, pa se postavlja logično pitanje rizika po zdravlje korisnika lap topova. To je naročito važno za mlade korisnike lap topova zato što oni često stavljaju lap topove u svoja krila u blizini njihovih reproduktivnih organa. Ovaj rad predstavlja rezultate istraživanja na uzorku od 212 muških korisnika lap topova (đaci iz osnovne i srednje škole i studenti) i rezultate merenja elektromagnetnog polja i zagrevanja 12 različitih lap topova za vreme njihove upotrebe kao i rezultate merenja temperature u regionu testisa korisnika lap topa termalnom kamerom.

Ključne reči: *lap top, elektromagnetno polje, zagrevanje, merenje*