Swedish Standards on VDU Emissions Testing

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INTRODUCTION

Since the early 1970s, concerns have been voiced about visual display units (VDUs) as the cause of occupational health problems. A wide spectrum of possible hazards are referenced based on different indications found in early studies of VDU users. Today, questions continue to persist about the scientific link between VDU work and different types of health hazards. A great deal of research in this area is underway, but experts still have not found the mechanisms to describe cause and effect for most of the problems reported.

Much of the debate focuses on health hazards caused by emissions, but other major concerns are the visual ergonomics. This article will concentrate on the emissions aspect of the Swedish standards, but readers should remember that the visual ergonomic tests are also central to the Swedish methods.

As a result of the expressed opinions and anxiety among an increasing number of VDU users, the Swedish government, in September 1985, assigned to the Swedish National Board of Occupational Safety and Health (ASS) the task of evaluating the possibilities and the need for VDU testing. In April 1986, the evaluation was completed. The report concluded that a voluntary test program was needed. Non-mandatory testing was recommended based on the lack of definitive scientific knowledge about the possible health hazards. Mandatory testing would have posed a number of additional issues, including discrepancies with international standards and trade barrier questions. The non-mandatory status prevented all these problems.

The new Swedish methods are expected to form a basis for international standards in the measurement of VDU emissions.

MPR 1

In May 1986, the Swedish government instructed the Swedish National Board for Measurement and Testing (MPR) to develop and establish testing rules. A separate group consisting of interested parties was formed to assist in the method development. Experts from the Swedish National Institute of Radiation Protection (SSI) were engaged both in method development and the preliminary evaluation of suggested methods to determine emission parameters.

The first generation of test methods (MPR 1) was introduced in February 1987. Recommended values for different emission parameters were established in mid-1987 and a number of "low radiation" monitors started to appear on the market. At the same time, two Swedish laboratories (SSI and SEMKO) were accredited to perform the complete spectrum of tests. Several international computer manufacturers also became involved because some major Swedish government contracts mandated tests and performance requirements according to the newly developed methods.

After a three-year test period during which the first generation of methods was used, a revision, planned from the outset, became effective on January 1, 1991. This revision is referred to as the new MPR 2 methods. During the current transition period, which expires June 31, 1991, the MPR 1 methods can still be used. These new Swedish methods are expected to form a basis for international standards in the measurement of VDU emissions and work in that direction is already in progress.

Experience from the trial period indicated that:

- Most of the interest among users concentrated on different emission parameters.
- During the test period, VDUs were developed to give both better visual ergonomic performance and significantly lower emission levels.
- Some of the tests included in existing MPR 1 methods were unnecessary because

the data was readily available from manufacturer specifications or with the use of a simple test.

- The complete test procedure was too diversified and complex, making the test unnecessarily expensive.

- The results were difficult to compare and interpret, and some new types of VDUs were not addressed in the test procedures.

MPR 2

The new test methods, known as MPR 2, mitigated some of these problems. MPR 2 methods:

- Reduced the number of characteristics tested.

- Simplifed many test procedures.

- Adapted methods to new VDU sizes and types.

To achieve continuity in the methods, efforts have been made to compare the specific changes.

- A new extremely low frequency (ELF) range (5 Hz to 2,000 Hz) was introduced as a complement to the very low frequency (VLF) range (2 kHz to 400 kHz). To achieve better separation of fields in the two ranges, the VLF lower frequency limit was altered from 1 kHz to 2 kHz (Figure 1).

- The measurement of alternating electric fields is another major new parameter. This parameter was considered in 1987 but accurate measurement techniques and test experience did not exist at that time.

Many minor changes to the methods have also been made to simplify testing and to increase the precision and reliability of the test results.

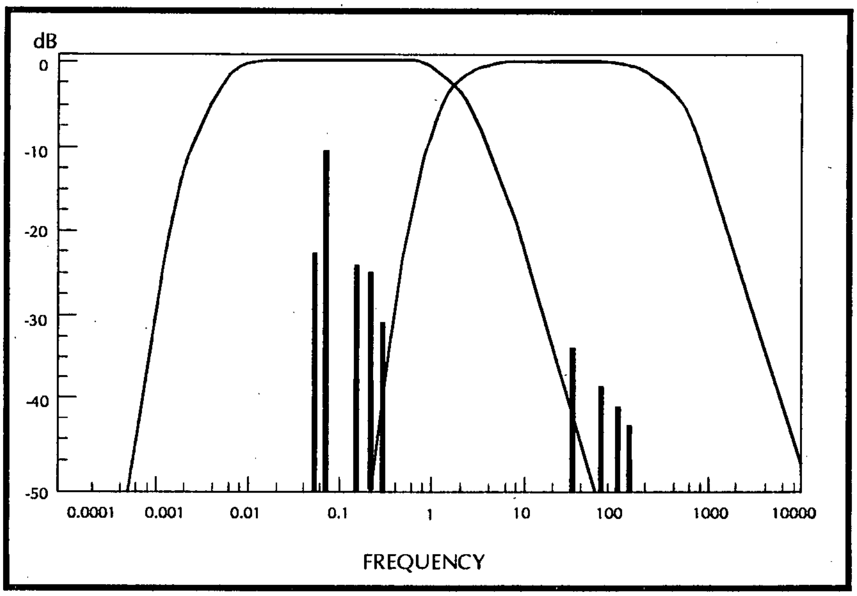

FIGURE 1. Specified Frequency Response for ELF and VLF in the MPR 2 Methods.

The following summarized descriptions of the new test methods does not give all data needed to perform the actual tests. Complete information is given in the method description (Test Methods for Visual Display Units, MPR 1990:8, 1990-12-01, which can be purchased from MPR, Box 878, S-501 15 Boras, Sweden.)

X-RAY RADIATION

X-ray radiation is produced in a CRT-type VDU by the collision of electrons on the inside of the front glass. However, no radiation is detected from any known CRT tube because the tube glass is sufficiently thick to absorb all radiation from the inside of the tube.

The Swedish standard specifies that the x-ray radiation test be performed according to Standard IEC-950 (Appendix H) with the exception that the SI unit "kerma rate in air" (Gy/h) should be used instead of the "exposition rate" (As/kg h).

Background radiation in the laboratory should not exceed 100 nGy/h. Generally, radiation above the background level is not found. The result should be reported as "less than 100 nGy/h," which indicates that x-ray radiation is not detectable.

ELECTROSTATIC POTENTIAL

An electrostatic potential from a VDU is caused by the high voltage applied in CRT tubes to accelerate electrons. With a nonconductive front glass and no power ground connection, a surface potential of several kilovolts can be created.

The test method presented in MPR 2 measures the electrostatic field against a grounded square metal plate (0.5*0.5 m) with a field strength meter in the center. The measurement is taken at a distance of 0.1 m from the screen surface.

The equivalent surface potential is calculated using an approximate formula which accounts for different tube sizes.

Special precautions regarding the pre-treatment of the VDU and the climate control of the test laboratory are necessary to achieve accurate results, which are influenced by humidity, temperature, air velocity and ion concentration in the air.

The recommended value and the lower measurement limit to be reported is ±500 V in equivalent surface potential.

Reduction of the electrostatic potential is normally achieved by a conductive surface coating on the screen, which is connected to power ground.

ELECTROSTATIC DISCHARGE

Having the electrostatic potential as a parameter in the emission testing is, of course, only half the answer to reducing the electrostatic field between the VDU and an operator. A similar field is created if the operator is charged to a high potential. If no means are created to discharge the operator, the reduction of the electrostatic field from the VDU results in little or no effect on the field strength surrounding the operator. A simple way to automatically discharge the operator is to provide a discharge path through a commonly used key on the keyboard.

The same types of laboratory and test precautions recommended for the electrostatic potential should be applied for ESD to obtain accurate results. The test method for electrostatic discharge through the keyboard measures the resistance in the provided path. The recommended value for the resistance is between 10 and 500 Mohms.

ALTERNATING ELECTRIC FIELDS

All improperly shielded electric and electronic products emit electrostatic and alternating electric fields. The main sources for the alternating fields from a VDT are power supply and vertical deflection circuits in the ELF (5 Hz to 2,000 Hz) range and horizontal deflection circuits in the VLF (2 kHz to 400 kHz) range.

The term electric field in this context is related to a specific probe, positioned in front of the VDU, and connected to the same power ground as the VDU itself. The measurements made should be true rms readings within the specified frequency ranges.

To avoid interference from background fields in the test laboratory, a simple shielded room is normally required. This reduces background levels to 2 V/m in the ELF range and 0.2 V/m in the VLF range.

Measurements in the ELF range are only made in front of the VDU at a distance of 0.5 m. The valid measurement range is 10 V/m to 1000 V/m and the recommended value is 25 V/m.

Measurements in the VLF range are made in front of the VDU, at both sides and at the back, at a distance of 0.5 m. The valid measurement range is 1 V/m to 100 V/m and the recommended value is 2.5 V/m.

To reduce the alternating electric field, the same procedures used to control electrostatic potential are implemented, as well as proper shielding.

MAGNETIC FIELDS

All electric and electronic products emit magnetic fields. The main sources for the fields from a VDT are power supply and vertical deflection circuits in the ELF range, and horizontal deflection circuits in the VLF range. The term magnetic field is used in this context for the magnetic flux density, expressed in tesla (T).

Measurements are made with specific types of antennas consisting of three perpendicular circular coils. With proper measurement electronics, this type of antenna can give a direction-independent true rms value for the magnetic field.

A special cylindrical measurement geometry with 48 measurement points around the VDU is used in the magnetic field test (Figure 2).

To achieve accurate readings, the background emission level in the test laboratory must be below 40 nT in the ELF range and 5 nT in the VLF range. The method is valid in the ranges 200 nT to 2,000 nT for ELF and 10 nT to 1000 nT for VLF. Recommended values are 250 nT in the ELF and 25 nT in the VLF frequency range.

The described types of magnetic fields are difficult to reduce by magnetic shielding alone. Different types of compensating coils are used with very good results to reduce the magnetic fields down to and below the recommended values.

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EMISSION MEASUREMENT TECHNIQUES

Only some of the more important aspects of the measurement techniques and antennas

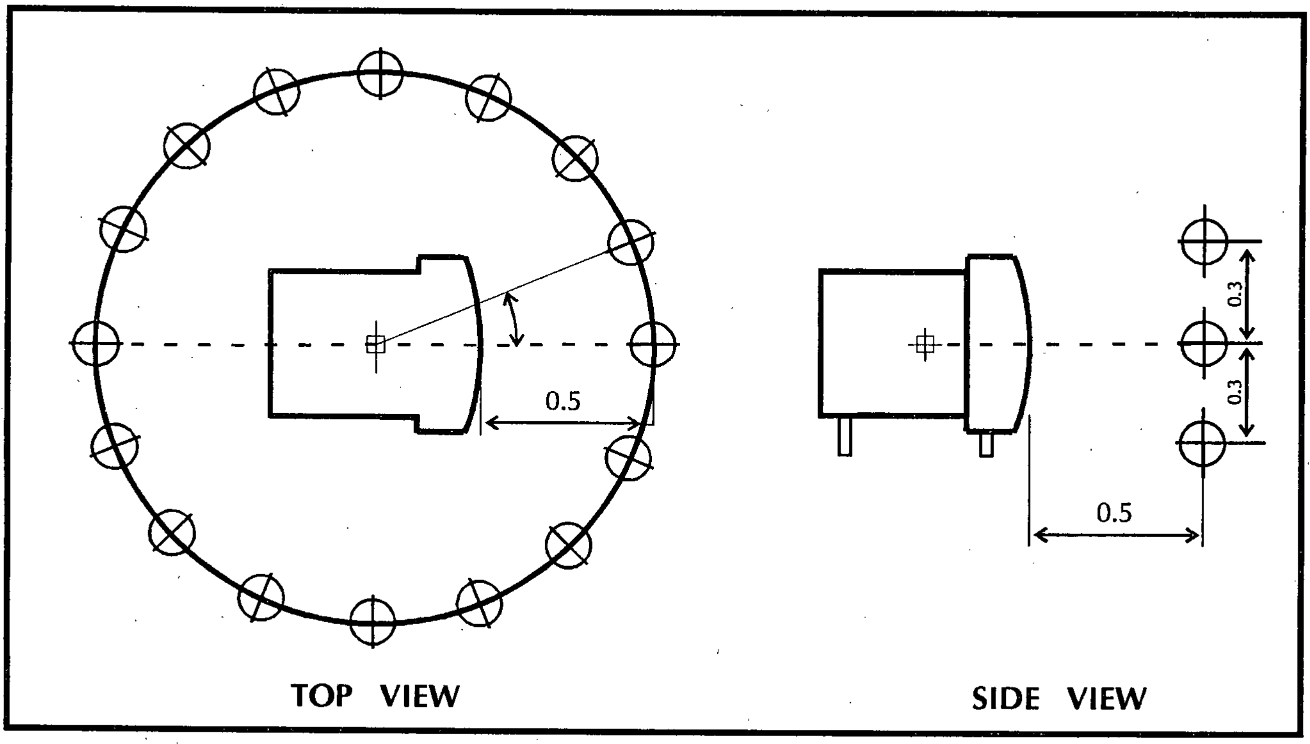

FIGURE 2. *Cylindrical Measurement Geometry.*

used to make low frequency emission instruments are covered in this article.

At first glance, all the test methods described seem quite simple. However, with the rather complex signals involved, measurement errors can easily occur. Some of these can be avoided with the instrumentation and measurement solutions described here.

Three-dimensional antennas. For magnetic fields that can have any direction in space, a special type of antenna is preferable. All errors related to field direction can easily be eliminated with a three-dimensional coil, using the same coil size in three perpendicular directions with a common coil center. No operator skill is needed to position the coil antenna in the measured field.

Combined analog-digital techniques. With a combination of analog and digital measurement techniques, the complex non-sinusoidal emission signals from a VDU can be accurately measured. Linear amplifiers, combined with digital sampling methods, can be used to provide detailed knowledge about signal wave shapes. Sampling rates should, of course, be much higher than the upper frequency for the measurement. The use of microprocessors to make data collection and calculations ensures high accuracy and stability.

Frequency measurements. Additional information about the signal is easily obtained with a digital sampling technique. For example, the calculation and display of the main frequency in the signal is very useful to identify the signal source.

Calibration. Analog amplifiers using passive components to control the gain always create the need for calibration. Digital calibration methods, where factors are stored in a non-volatile memory, are the best way to avoid manual errors and unintentional changes. This arrangement will give long-term stability without the need for regular recalibration.

CONCLUSION

The new MPR 2 test program represents an improvement and broadening of previous emission test programs. As such, it is expected to form the basis for the development of international standards. The new test method addresses, among other areas, x-ray radiation, electrostatic potential, electrostatic discharge, and alternating electric field and magnetic fields.

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