Magnetic field interference and computer screens

High magnetic fields in work areas can render VDUs unusable. Proper shielding design can solve the problem.

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Magnetic fields adversely affect the readability of computer visual display units (VDUs) by causing movement or jitter to occur on the display. The effect of this can make the VDU unusable and therefore give rise to management problems in the workplace. This occurs particularly when people refuse to occupy the workplace because of actual interference and perceived health concerns.

VDUs, which are cathode ray tube based, are the most widespread type of computer screen in use in the modern workplace. These VDUs are particularly susceptible to interference from power frequency magnetic fields, which emanate from mains carrying cables, substations, switchrooms and plantrooms.

The commonplace use of computers in the workplace has led to an expectation that any desk in the workplace is a suitable location for a computer. Most people regard VDUs as fairly rugged devices and because of this there is an expectation that the computer should be able to work anywhere. However, by any measure a VDUs is a sensitive instrument so far as magnetic fields are concerned. It takes only a small amount of current in a nearby cable to cause interference sufficient to make the screen unusable for the user. The problem is exacerbated where usage extends beyond infrequent use to a few hours usage every day.

Movement of the screen display by less than 1 mm at the mains frequency rate is sufficient to cause eye irritation to the user. Persistent use results in complaints of headaches and discomfort.

Failure to address the VDU interference problem in a timely way can lead to concerns by users about the source of the problem. Tardiness in identifying the cause and developing strategies to resolve the problem can lead to refusal to occupy the premises with all the associated inconveniences and loss of productivity. Loss of rental can also occur for property owners because of the unsuitability of the site for computer use.

The existing international guidelines for limits of exposure to power frequency magnetic fields advises a limit of 5000 milligauss for continuous exposure for occupational situations and 1000 milligauss for continuous exposure for the general public. These limits can be exceeded adjacent to substations and switchrooms and high current carrying cables. However, so far as product design of individual products is concerned there are no emission limits for 50-Hz magnetic fields. Similarly, there are no emission limits for the installed

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mains reticulation system within a building. Consequently, variations in building layout and design as well as product selection will greatly affect the magnetic field present in a workplace. For similar electrical loads one office space can have maximum levels below 10 milligauss while others may have more than 1000 milligauss.

Currently, there are no mandatory immunity levels with which VDU manufacturers are required to comply for immunity from power frequency magnetic fields. Empirical evidence from hundreds of tests has resulted in quite a widespread but not universal use of 10 milligauss as a safe level at which most VDUs will operate satisfactorily. However, this in no way can be guaranteed as testing of several types of VDU has shown.

Periodically, consulting engineers will specify even lower levels than 10 milligauss as a maximum level permissible in the workplace in the vain hope that an electrical contractor will be able to achieve such a level. The reality is that with good design and careful attenuation to detail of all the electrical reticulation, significant reductions can be achieved over equivalent situations where it is all left to chance. However, building layout plays an equally important part. The location of the substation, switchroom, plantroom, cable runs and riser ducts can determine whether office areas will be suitable for location of PCs and workstations.

The suitability of an office area for VDUs can be determined by a field survey where actual magnetic field readings are taken. This should be done with the building at full electrical load and the results of the survey can be used to determine safe, marginal and no go areas for VDUs. The benefit of this approach is that problems are avoided before the office space is committed and computers installed. It may also be possible to reduce the interference and increase the amount of usable office space.

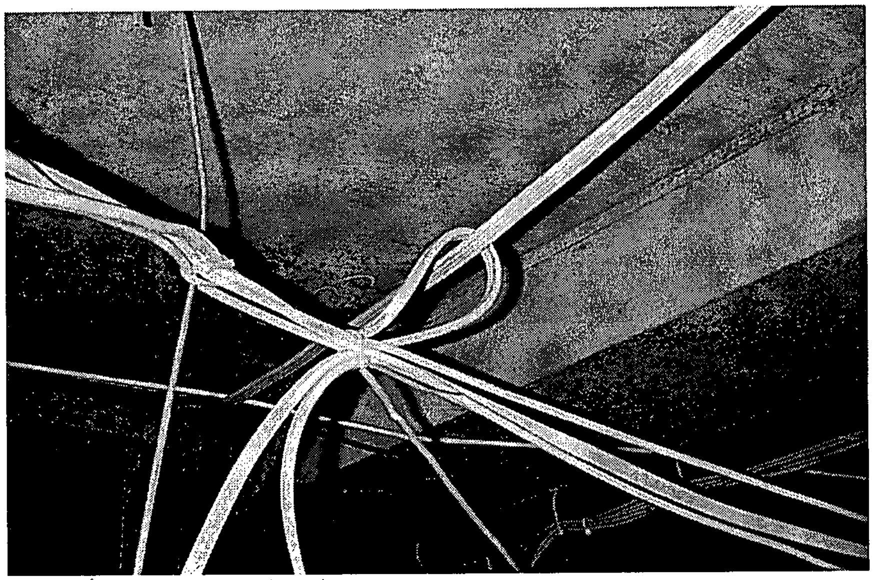


Figure 1. Disarranged cables with large separations.

"Generally, it is safe to say that smaller VDUs are less susceptibile than larger VDUs to magnetic field interference."

Generally, it is safe to say that smaller VDUs are less susceptibile than larger VDUs to magnetic field interference. Therefore, with a trend towards providing larger VDUs in the workplace, especially for all-day users, the recognition and treatment of the problem is even more important.

In existing buildings a typical case involves user complaints investigated by an information technology consultant, and in some cases, the electrical maintenance department will be requested to investigate and check that the power is satisfactory. In the meantime, the VDU screen continues to cause the user concern with little prospect of a solution in sight. When conventional avenues have been exhausted, recognition occurs that it may be caused by proximity to power cables, submains, switchroom, plantroom, substation or even a light circuit from the office floor below.

In some cases the interference source can be quickly identified and actions taken to reduce it at the source. One recent case involved the rebundling of the mains cables, which all but eliminated the source. In an office area where approximately 20 workstations were in use, several were being affected by screen jitter. Investigation revealed that the source was the power cabling which was located directly beneath the floor of the VDUs. The current being drawn was only 30 amps per phase and the cables were disarranged with large separations

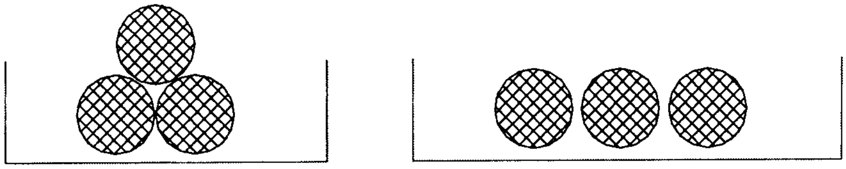


Figure 2. Closely bundled power cables.

between each cable. (Figure 1).

The effect was that the magnetic flux density measured at the VDU was over 70 millgauss. By simply rearranging the cables to maximize cancellation, it was possible to reduce the interference to less than 10 milligauss. (Figure 2). This proved to be satisfactory for all of the monitors. In another part of the office near to a power distribution board, two of the workstations required a quality monitor shield to overcome the screen jitter (Figure 3).

Other cases require the judicious placement of computers or the installation of high permeability shielding material near the source. For example, this could be on the ceiling of the switchroom or above the cables. For a new building modelling was carried out on the cable runs using maximum loads. This indicated that the magnetic flux density would be 60 milligauss. The cable layout was optimized to minimize the effect and this reduced the interference to 12 milligauss (Figure 4).

This would have been satisfactory for many types of VDUs. However, because a safety margin was needed over and above the modelling figures and to overcome the possibility that the electrical work would not be as clear cut as the model, some additional insurance was required.

Because the area was to be used for workstations, the decision was taken to install high permeability shielding on the floor above the cable tray. To ensure an adequate design safety margin, a 5 milligauss contour was chosen. This meant that the shield was about 3 meters wide. After a full load test before the building was occupied, the measurements at workstation level was measured at 5–7 milligauss, which is more than satisfactory for most VDUs.

This high permeability shielding material was chosen because it is lightweight by comparison to other metals, and it does not require any welding, which means that installation is easier. Also, because no welding is required, it does not suffer from the contraction and expansion problems associated with fully welded structures. Therefore, it is suitable either as an under carpet shield, or it can be fixed directly to the concrete over the cable tray or to the substation ceiling or wall.

In some cases high earth currents travelling through air conditioning ducts, plumbing, sprinkler pipes, or concrete reinforcement have caused large magnetic fields to interfere with VDUs. In one high rise office building, it was found that the magnetic field from the neutral bar was in excess of 3 gauss. Rectifying the out-of-balance, three-phase circuits which cause high neutral currents, can subsequently reduce interference from magnetic fields.

WHAT TO DO

In existing buildings there are a number of strategies to use. First, it is necessary to have a preliminary magnetic field survey to confirm the source of the problem. In cases where it is fairly certain that magnetic fields are the cause, it is appropriate to conduct a more detailed survey so that available options can be considered. A detailed survey should include measurements taken every 1 meter and at three heights (floor level, desk level and 2.4 meters above floor). This is necessary to ensure that, so far as is possible, all data is collected and that the actual source of the problem can be correctly identified. Office layout diagrams, building floor plans and electrical reticulation diagrams are necessary parts of the jigsaw.

A good survey should also provide practical recommendations for solving the problem. This can include changes to the cabling, increasing the distance of the VDU from the source, shielding near the source or near the VDU, or changing the type of computer display. Figure 4 shows the situation where magnetic shielding is installed above the cable tray on the level

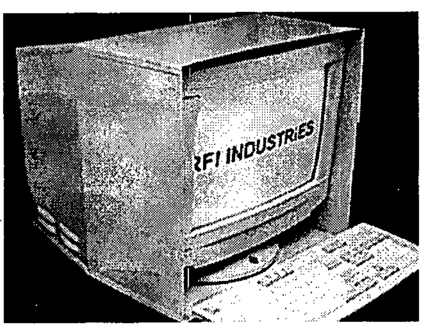
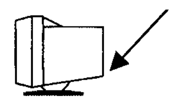


Figure 3. Magnetic monitor shield.



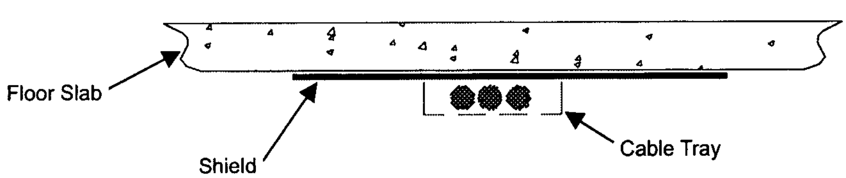


Figure 4. Shielding located under the floor.

below the occupied area. Sometimes this is not possible and it is necessary or more economical to install the shielding on the floor directly below the affected VDU. This is illustrated in Figure 5. Typically, this will be covered with a floor covering such as carpet.

For new buildings in the planning stage, the use of office space near source areas should be carefully considered. Some simple design rules can often avoid significant problems before the building is occupied. This includes the overall building layout, positioning of the substation, switchroom, cable runs and riser ducts vis-à-vis the location of people and workstations. Magnetic field modelling, particularly of cable runs, can assist, along with common sense application of fundamental principles. Shielding of substations and switchrooms should be considered as a cost-effective way of increasing the usability of areas adjacent to high source areas. A magnetic survey before the office area is occupied can identify VDU go and no-go areas.

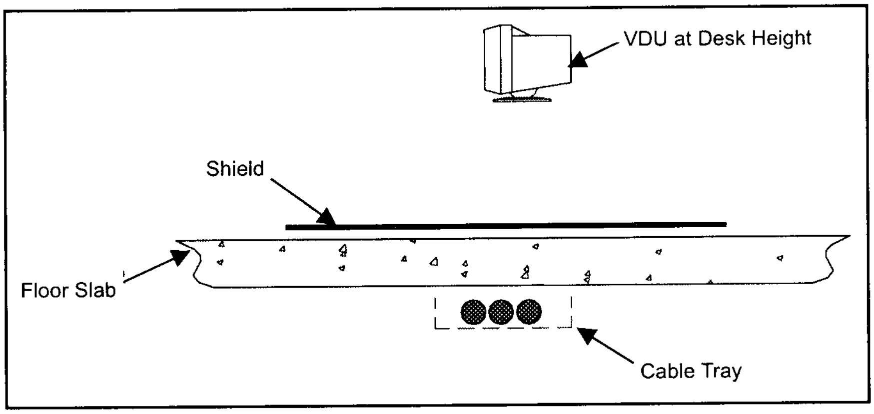


Figure 5. Shielding placed over the floor.

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