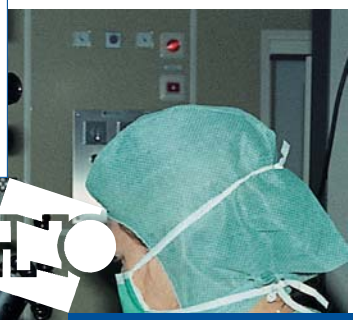
A profession in itself

Faraday cages in Health Care



TNO can provide support and advice in the design and construction phases.

Health care institutions are becoming increasingly aware of the adverse effects of electromagnetic disturbances on electromedical equipment.

Electromagnetic interference

This particularly plays a role in areas where sensitive neurophysiological recordings are made, for example electromyography (EMG), various types of evoked potential recordings (EVP) and electroencephalograms (EEG). It is very important to shield such areas against electromagnetic interference from outside. Equipment in laboratories and pharmacies sometimes has to be shielded as well. Occasionally it is advisable to encapsulate the source of interference instead of the sensitive equipment. This is the general rule for physiotherapy equipment in particular. TNO provides various kinds of support in solving problems encountered in this field.

Assessment of building plans

The most important aspects here are the identification of potential sources of interference and the distance between potential sources of interference and sensitive equipment. This assessment is based on building plans.

Practical measurements using a test subject

With the sources of interference owned by the health care institution - mostly electrosurgical and physiotherapy equipment - and a few sensitive neurophysiological recording apparatuses, the practical situation expected can be simulated and assessed in terms of interference aspects. During these measurements a volunteering test subject replaces the patient. Sometimes an investigation is required to localize a source of interference apparently present.

Whether or not to apply protection

Before deciding whether to take protective measures against interference, it may be necessary to have TNO take orientational high frequency measurements first and to base the required specification for protective measures on this. It would specify which degree of attenuation is required for which frequency range. Advice can be given on the design and construction of the cage, the choice of materials and the construction of the floor, doors, wall finish, cable entries and ducts and low-pass filters to be used. It may sometimes suffice to simply move or protect cables in the installation and fit them with filters to avoid electromagnetic interference (EMI) instead of installing a complete Faraday cage. If it is decided to opt for the full protection of a room, there are two possibilities:

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'DIY' cages
During construction protective material has to be incorporated into walls, floor, ceiling and doors, which has sufficient attenuation to the fields causing interference. Interfering fields ranging from approximately 100 kHz to 100 MHz can easily be attenuated by 30 to 40 dB. This will usually be sufficient for hospital purposes.

Prefabricated cages
For some applications the above-mentioned 'DIY' cage will not provide the requisite degree of attenuation. TNO offers support in answering the question of whether in such cases a relatively expensive prefab Faraday cage will have to be purchased, such as the ones the armed forces have been using for decades. The choice will have to be made if the higher attenuation balances against the negative aspects of this type of cage. For example the door/threshold is not constructed to make it easy to wheel a bed inside. Another disadvantage can be that the patient will feel 'caged in' as a result of the unfriendly appearance of the door in particular. TNO has broad experience with this type of decision process.

In addition to the choice between building a cage oneself or buying one, a decision must be made as to whether the room with the source of interference should be screened off or the interference-sensitive equipment:

Screening off the interference source
Screening off an operating theatre is particularly complicated because of the stringent safety requirements set for the equipment in that room. A physiotherapy department, on the other hand, can be screened off quite easily.

Protecting interference-sensitive equipment
Rooms for clinical neurophysiology can be screened off in such a way that interference-free recording is no problem.

Support during the construction phase

If it is decided to build a cage, TNO can provide support and advice in the design and construction phases. Special attention is paid to the choice of materials, construction of floor, doors, and windows (if required), cable ducts and filters to be used, connection techniques and wall finish. Measurements are taken at certain stages during construction.

Verification measurements on a finished cage

An attenuation measurement sometimes will bring imperfections to light such as a high frequency leak at a door that does not close properly, or a faulty earth connection. The attenuation measurement is performed using high frequency transmitting and receiving antennas according to international standards [1]). The practical measurements mentioned above using a test subject representing the patient could be repeated to confirm interference-free registrations.

1)
TNO is accredited by the Netherlands Council for Accreditation (RvA): STERIN Accreditation No. I 053.

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A neurophysiological recording in a faraday cage.