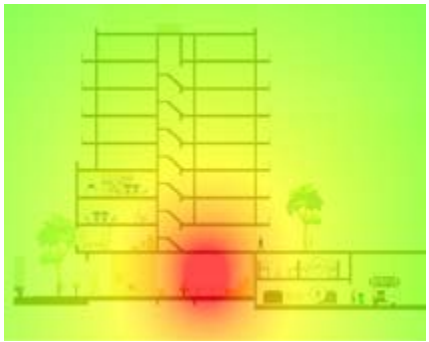
Holland Shielding Systems BV

Exposure to electromagnetic fields

Guidelines and control measures in the Netherlands



Information collection with the most relevant legislation, guidelines and advice, including solutions to meet the agreed values.

info@hollandshielding.com | hollandshielding.com | +31(0)78- 204 90 00

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Introduction

There are several recommendations and guidelines regarding public exposure to electromagnetic fields. The Dutch government advises to avoid long-term exposure to magnetic fields with an annual average that is higher than 0.4 microtesla. The NEN standards require that project developers, building managers, property owners, and occupants ensure that spaces adjacent to medium-voltage rooms are not designated or used for long-term stay.

Holland Shielding Systems B.V. is an expert in the field of electromagnetism and we can calculate, simulate and predict the expected magnetic fields based on the available data. In many cases, the transformer has not yet been installed, or the low-voltage cable layout is not (fully) loaded. Thanks to our calculations and professional knowledge, we can provide insight into the expected level of magnetic fields and exposure to them in advance, as well as potential ways to shield these fields. In this way we ensure that the prevailing magnetic field levels remain below the immunity limits set by the CE standards. This ensures that electronic equipment is not disrupted and that human exposure can also be kept to a minimum. Choosing the right control measure is essential in this process. Holland Shielding Systems B.V. specializes in shielding magnetic fields with special techniques, such as Eddy Current Cancelling and Flux Shunting. These are combined in our MuFerro shielding solutions. This document focuses on the 50 Hz frequency. However, our knowledge and activities cover the entire frequency range from 0 to 300 GHz.

Shielded floor in a transformer room on the roof.

1. Regulations on exposure to electromagnetic fields

There are various national and international guidelines and recommendations applicable when it comes to electromagnetic radiation. There is uncertainty about which guidelines apply and who is responsible. The following overview contains the most important guidelines and recommendations.

1.1. NEN guideline NPR 8799 (2014)

In accordance with the NEN standards, specific guidelines apply to the placement of transformer rooms and the permitted use of adjacent rooms. Compliance with these guidelines is the responsibility of the project developer and the building manager, owner and user.

Page 23, article 5.5.5: The NEN stipulates that the project developer must ensure that the safety risk due to EM fields remains within the standard levels. In addition, adjacent rooms should not be intended for EM-sensitive equipment (computers, data centers, sound studios, medical equipment) or long-term residence (home, daycare center).

Page 23, article 5.5.6: The building manager, owner and user may not use rooms adjacent to transformer rooms for EM-sensitive equipment or long-term residence, such as the above-mentioned examples.

* Due to copyright restrictions, it is not permitted to quote directly from NPR 8799. For specific guidelines, please refer to the document: NPR 8799 Distribution stations for electrical energy supply at special locations.

1.2. Recalibration of precautionary policy (Herijking voorzorgbeleid), 21-4-2023

1.2.1. Information letter recalibration precautionary policy

Appendix 1: Explanation of the precautionary policy for magnetic fields

The appendix starts on **page 3 of the information letter** (translated from Dutch): "*The EU recommendation on magnetic fields is a guideline for the Dutch government. The recommended exposure limit for magnetic fields (of 50 hertz) for the population is 100 microtesla.*"

Page 3 (translated from Dutch): "*The State advises the competent authority for spatial planning and electricity grid operators, when establishing spatial plans and the routes of overhead high-voltage power lines, to avoid, as far as reasonably possible, new situations arising in which children stay for long periods in areas within which the annual average magnetic field can be higher than 0.4 microtesla (the magnetic field zone). The same advice applies to changes to existing spatial plans or existing high-voltage power lines.*"

Page 9: "*Because research by the Health Council in 2022 has shown that adults may also have an increased risk of leukemia in the vicinity of overhead high-voltage power lines, the concept of sensitive destinations has been broadened in the revised precautionary policy. In addition to homes, other types of housing where people stay for long periods of time (such as nursing homes and institutions for people with disabilities) are also included in the concept.*"

1.3. 1999/519/EG: Council Recommendation of July 12, 1999

Limitation of exposure of the population to electromagnetic fields from 0 Hz- 300 GHz:

Page 8: *Table 2 - Reference levels for electric, magnetic and electromagnetic fields (0 Hz-300 GHz, undisturbed mean values)*. See table 1.

1.4. ICNIRP Guidelines

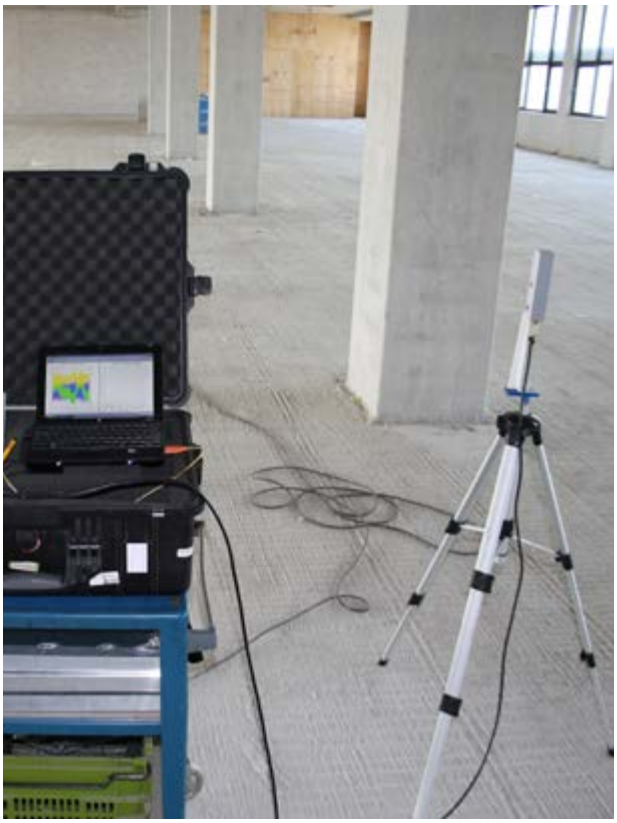
For limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz) (1998)

Page 19: *Table 7. Reference levels for general public exposure to time-varying electric and magnetic fields (unperturbed rms values).* See table 1.

Frequency range	E-field strength ($V\ m^{-1}$)	H-field strength ($A\ m^{-1}$)	B-field (μT)	Equivalent plane wave power density S_{eq} ($W\ m^{-2}$)
0-1 Hz	-	$3{,}2 \times 10^4$	4×10^4	-
1-8 Hz	10 000	$3{,}2 \times 10^4 / f^2$	$4 \times 10^4 / f^2$	-
8-25 Hz	10 000	4 000 / f	5 000 / f	-
0,025-0,8 kHz	250 / f	4 / f	5 / f	-
0,8-3 kHz	250 / f	5	6,25	-
3-150 kHz	87	5	6,25	-
0,15-1 MHz	87	0,73 / f	0,92 / f	-
1-10 MHz	$87 / f^{½}$	0,73 / f	0,92 / f	-
10-400 MHz	28	0,073	0,092	2
400-2 000 MHz	$1{,}375\ f^{½}$	$0{,}0037\ f^{½}$	$0{,}0046\ f^{½}$	f / 200
2-300 GHz	61	0,16	0,20	10

Table 1. Reference levels for general public exposure to time-varying electric and magnetic fields (unperturbed rms values). The B-field (μT) at a frequency of 0.05 kHz (50 Hz) is 100, because 5 ÷ 0.05 = 100 microtesla.

Indoor transformer room with electromagnetic shielding



Measuring radiation in adjacent room

2. Solutions and control measures

There are various control measures to ensure that people do not stay within an EMF for long periods of time: distance, placement and shielding. The best solution can be advised by first measuring or calculating how large the magnetic field is.

2.1. Control measures

2.1.1. Increase distance to source

EM fields decrease rapidly as the distance increases. Even at a few metres distance, the field strength is already much lower. To create sufficient distance, it may be necessary to change the placement or purpose of adjacent rooms.

2.1.2. Placement and purpose of rooms

Avoid using rooms adjacent to a transformer room for long-term residence (living, school, daycare centre). The standard therefore prescribes that a bedroom should not be placed directly next to a transformer room.

2.1.3. Shielding with MuFerro

If keeping a distance is not sufficient or not possible, then shielding is the best solution. By shielding the space properly, exposure to electromagnetic fields is kept to a minimum for residents and equipment. In the case of a magnetic field around low voltage, the room can best be shielded with MuFerro. This magnetic shielding material is also used to ensure that rooms with electron microscopes, industry (according to manufacturer specifications), military applications and medical rooms (according to NEN1010, section 710) meet the desired limit values. To shield entire buildings or rooms, the shielding material is applied to walls, ceilings and/or floors. This protects both people and electronics. The images below show how adequate shielding limits the magnetic field of a transformer. Holland Shielding Systems B.V. guarantees a value of less than 0.4 µT, with the correct shielding.

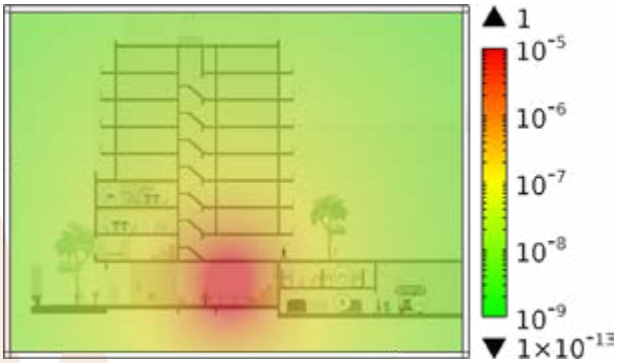
2.2. Measurements and calculations

2.2.1. Risk calculation with software

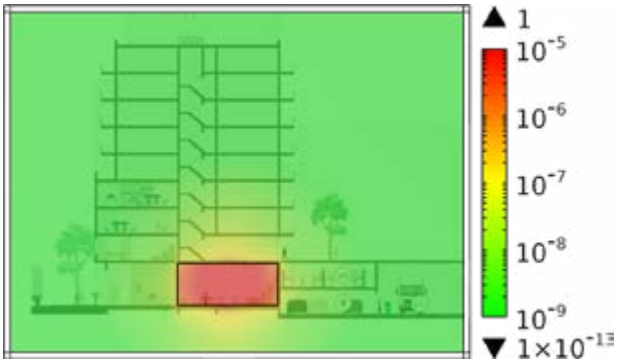
In the design phase of a building or space, it is not possible to measure on location to determine the electromagnetic field around a transformer. In that case, Holland Shielding Systems B.V. can calculate these fields accurately with software. With data from the manufacturer and our many years of experience with electromagnetic radiation, we can determine which shielding is needed to meet the desired values.

2.2.2. On-site measurements

In an existing situation, Holland Shielding Systems B.V. can perform on-site measurements (site survey) to determine the magnetic fields around a transformer.



Non-shielded transformer room



Transformer room adequately shielded with MuFerro

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2.3. Professional advice

Holland Shielding Systems B.V. has been manufacturing high-quality shielding solutions since 1995 for various applications, including EMC (Electromagnetic Compatibility), EMI (Electromagnetic Interference), RFI (Radio Frequency Interference), and EMP (Electromagnetic Pulse). We deliver worldwide and have decades of experience in shielding electromagnetic fields, including those in and around transformer rooms. With our expertise and a wide range of successfully completed projects globally, we know exactly how to effectively reduce disruptive fields. Whether it's new construction or existing situations: we always provide a suitable solution.

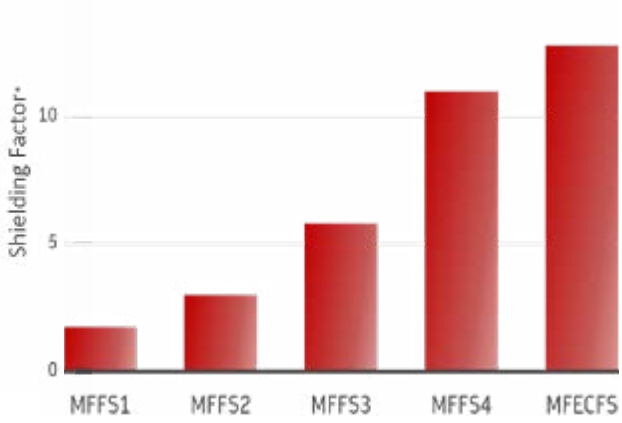


Table 2. Shielding factor MuFerro

2.4. Applications for MuFerro shielding

MuFerro is suitable for magnetic shielding in the frequency range of DC to 100 kHz and is optimized for 50/60 Hz. Holland Shielding Systems B.V. offers two types of MuFerro shielding: MuFerro-FS and MuFerro-ECFS. MuFerro-FS (MF-FS) combines permeability and saturation properties, making it extremely suitable for shielding low-frequency magnetic fields. MuFerro-ECFS (MFECFS) has the same properties, enhanced with Eddy Current performance. Table 3 shows the different properties of the two MuFerro types.

The effectiveness of the shielding is expressed as the shielding factor. Different results in shielding effectiveness can be achieved with different configurations. MF-FS can be applied in multiple layers to increase the shielding factor: the more layers, the higher the shielding factor. The shielding factor for 1 to 4 layers of MuFerro (MF-FS) and with Eddy Current (MFECFS) can be seen in table 2.

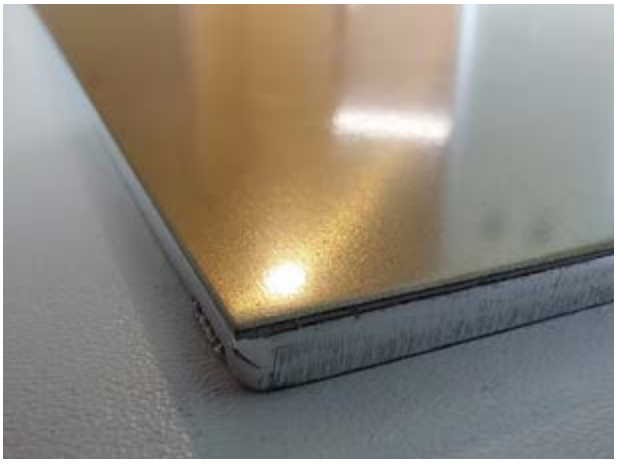
After applying the shielding, the space can be finished completely to your wishes. This will make it look and feel like a normal room again.

Property	Unit	MuFerro-FS Value	MuFerro-ECFS Value
Density	g/cm³	8	4
Thickness	mm	0,7	4,7
Resistivity	Ohm·m	5E-7	3E-07
Curie temperature	°C	400	400
Max. µr @ DC	-	3800	3800
Max. µr @ 50 Hz	-	3750	3750
Max. µr @ 60 Hz	-	3700	3700
Min. yield strength	N/mm²	300	105
Min. tensile strength	N/mm²	400	85
Hardness	N/mm²	150	30

Table 3. MuFerro specifications

MuFerro shielding is used for various applications, such as:

- *Transformer rooms (indoor or outdoor);*
- *Power plants;*
- *Aluminium smelting / production;*
- *High current applications that create strong magnetic fields;*
- *Induction heating;*
- *Scientific laboratory;*
- *Busbars / cabling / rail trunking;*
- *Reduction of ambient fields to below the recommended exposure limit.*



Detailed photo of a sheet MuFerro-ECFS

Customer-specific ceiling shielding with MuFerro

Specially tuned MuFerro shielding

Customised shielding, according to client specifications

MuFerro 6800 metal shielding structure transformer room

Shielded transformer room on hospital roof

2.4.1. Featured project: From storage space to safe workplace

One of the customers of Holland Shielding Systems B.V. was forced, by lack of space, to create a workplace in a space that was previously used for storage. However, that room was located above several transformer rooms. Our measurements showed that the magnetic field strength was far above the agreed standard. With a hat construction of MuFerro 6800, the magnetic field of each transformer room was successfully reduced to well below the agreed limit value. The space was then completely finished so that the shielding was no longer visible.

MuFerro shielding of a power distribution station

2.4.2. Featured project: Shielding of hospital transformer room

Holland Shielding Systems B.V. installed shielding in the transformer room on the roof of a hospital. The transformer created an electromagnetic field that could cause interference with pacemakers and other sensitive equipment. Thanks to the professional shielding, the floor below is unaffected by the magnetic fields. The work was carried out carefully without disrupting the daily hospital activities, ensuring the safety of both patients and staff, as well as medical equipment. This project highlights the importance of effective EMI shielding in critical healthcare environments.

2.5. Need shielding or advice?

Are you looking for an effective and cost-efficient solution for electromagnetic shielding? Our team of experts is ready to advise you on the best products and applications for your situation. Our expertise and services cover the entire frequency spectrum from 0 to 300 GHz. Whether it's for protecting sensitive (measuring) equipment, military, scientific, industrial or medical applications, residential or office buildings: we can assist from an early stage and provide customized solutions.

Contact us today for personal advice or a free quote!