



SKUDOTECH[®]:

AN ADVANCED MATERIAL

FOR LOW-THICKNESS EFFECTIVE SHIELDING,

FROM ELF TO RF.



SELITE

SECURITY LIFE TECHNOLOGY



MANAGEMENT SUMMARY

As widely known, the effective shielding of Electro-Magnetic Fields at very low (industrial) frequencies, is quite complex due to the inability of most materials to properly shield the B-field at practical thickness compatible with weight, cost and industrial processes. **SKUDOTECH®**, an innovative, high grade ferromagnetic alloy, has been submitted to shielding effectiveness tests in independent test laboratories, showing reductions of more than 20 dB for a B-field value of up to .5mT and frequencies up to 1000 Hz. The possible applications range from the shielding of mobile and cordless phones, home appliance, IT equipment, generators and data lines on trains, to homes and buildings from overhead power lines.

A broad range of product codes, like coils, flat or moulded sheets, couplings with slabs, wires, or specials, can be supplied by SELITE.

SELITE's capabilities also include consulting, site mapping, support to design and certification.

SKUDOTECH® is a **Registered Trade Mark** of SELITE Srl.

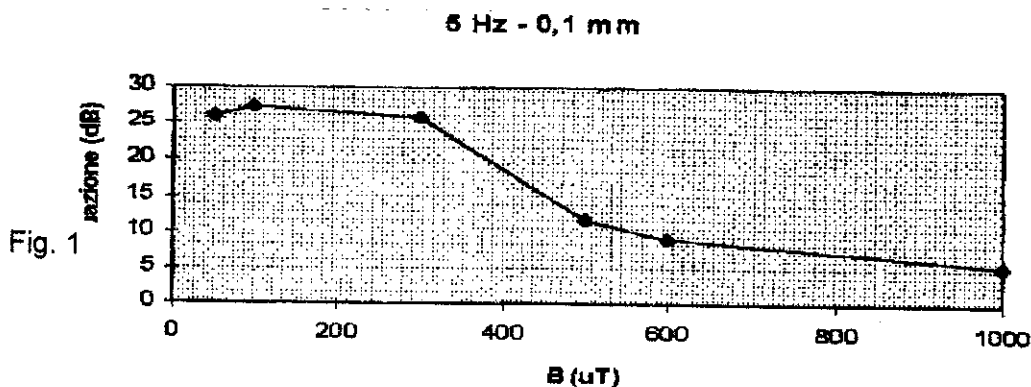


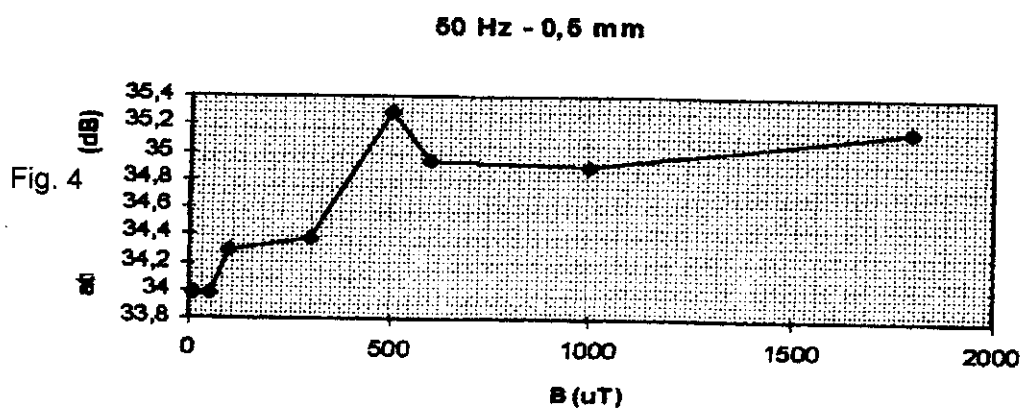
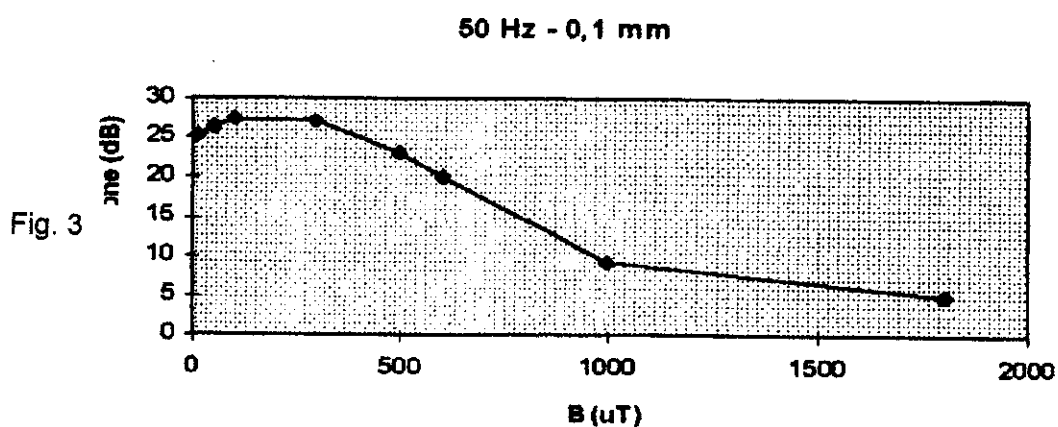
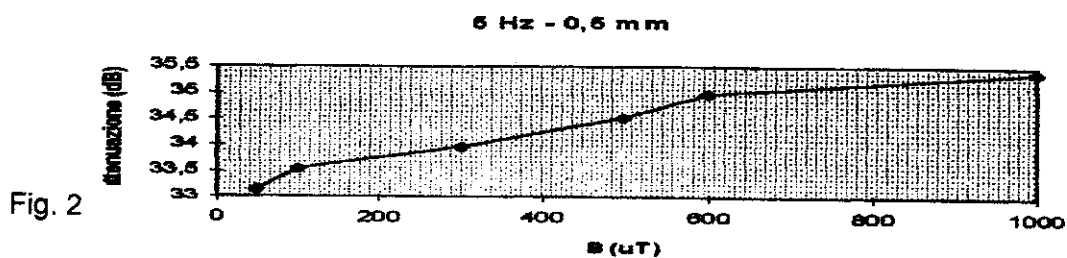
ELF MAGNETIC FIELD SHIELDING EFFECTIVENESS OF SKUDOTECH® : AN EXPERIMENTAL APPRAISAL

Some experimental tests regarding the **shielding effectiveness** of the material called **SKUDOTECH®** in variable thickness sheets, have been carried out in February, 1998 at "C.E.S.I." (Centro Elettrotecnico Sperimentale Italiano) in Milan, in December, 1998, at the University of L'Aquila, upon endorsement of the Ministry of Public Health, and at "Istituto Galileo Ferraris" in Turin, during January, 1999.

The material sheets have been exposed to alternate Magnetic Fields of effective induction **B**, ranging between **0.01 mT** and **2 mT**, and at frequencies variable between **50 Hz** and **2 kHz**. The averaged results obtained, do not show significant statistical differences within the testing sites, and are outlined in the attached graphs.

Available data, clearly show that, up to **0.6 mT** and regardless of the frequency, any thickness ≥ 0.2 mm, yields an attenuation greater than **98%**, namely around **35-40 dB**, while a **0.1 mm** thick sheet, up to **1000 Hz** and **0.5 mT**, grants an attenuation over **90%**, or over **20 dB** anyway (See Fig. 1 to 4) .

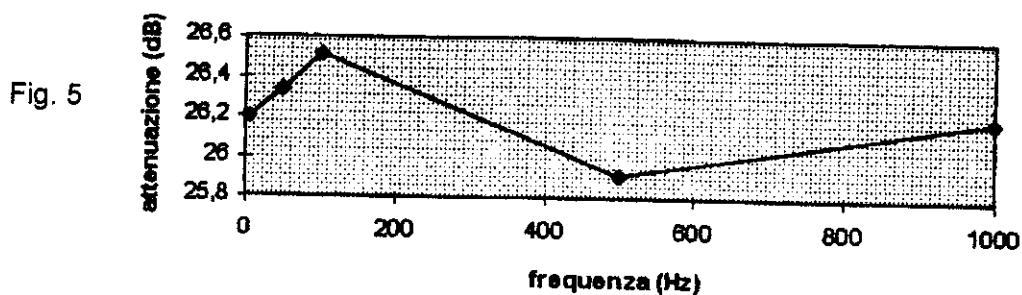




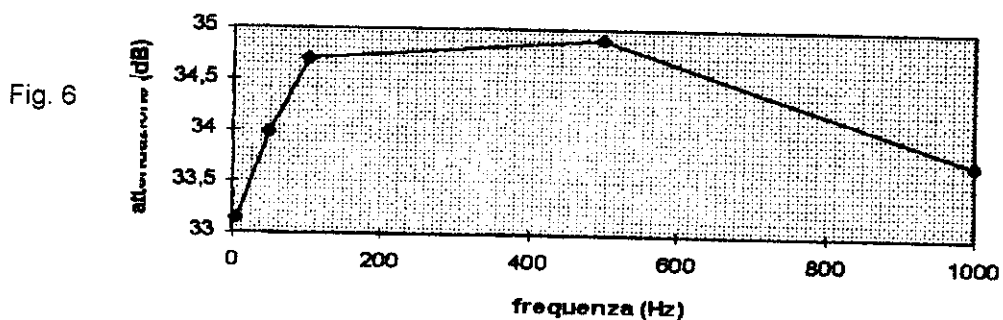
Such **shielding effectiveness**, shows up to be rather **frequency independent**. In the following two charts (Fig. 5 & 6), the **shielding effectiveness** values, for frequencies ranging from **10Hz** to **1000Hz**, and an applied field effective value $B_{eff} = 50 \mu T$, are displayed.



B = 50 μ T - 0,1 mm



B = 50 μ T - 0,5 mm



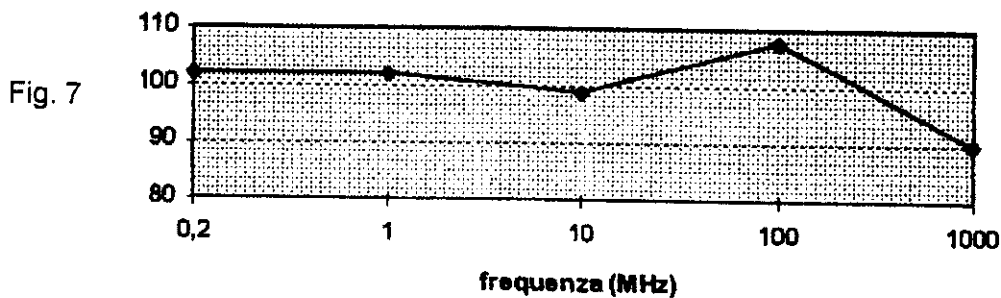
The following chart, reports the Electric Field Shielding Effectiveness at RF, up to 1 GHz.

0,2 MHz \rightarrow 30 MHz

S.E. = 99 dB \rightarrow 105 dB

50 MHz \rightarrow 1000 MHz

S.E. = 90 dB \rightarrow 104 dB





Finally, the **Magnetic Field Shielding Effectiveness** at RF, was also performed.

0.1 MHz → 30 MHz

S.E. = 55 dB → 105 dB

Such data can be deemed of great interest.

It is broadly known, infact, that magnetic fields in the proximity of the source (“Near or Close Fields”) can hardly be shielded, and the difficulty is directly proportional to the occurrence of the following events:

α) decreasing frequency. For sake of example, a *0.5 mm* thick Aluminum plate, placed *10 cm* far from a *50 Hz* source, yields an attenuation definitely lower than *50%*, while the attenuation grows up to *80-90%* at *1 kHz*, and to *99.9%* at *100 kHz*. A ferromagnetic metal, like steel, shows some minor advantages, that can be enhanced increasing the thickness: an attenuation of *99%* at *50 Hz*, can be obtained by a *3.5 mm* steel plate, at *10 cm*.

β) decreasing shield thickness. Still making reference to Aluminum, a *5 mm* plate, placed at *10 cm* distance, yields an attenuation of *60-70%* at *50 Hz*, and an attenuation of *99%* at *1 kHz*. Please, compare these data with those of the previous Paragraph.

γ) decreasing shield-to-source distance. A *0.5 mm* Aluminum plate placed *1 m* far, yields the same attenuation as that of a *5 mm* plate, *10 cm* apart.

The results obtained so far, allow to state that **SKUDOTECH®** represents a **substantial step forward** in the shielding technology, with main emphasis on the **thickness values** used in the experiments (*0.2 mm* only, allow an attenuation that usually overrides *98%*) and on the **shield-to-source** distance, experimentally set at *5 cm*, against twice as much used as reference in points **α**, **β** and **γ**.



Moreover, we intend to point out that:

1) Using fields with constant effective values (0.1 mT and 0.5 mT , respectively) and with frequencies ranging from 50 Hz to 1 kHz , the attenuation associated with the various thickness', is almost independent of the signal frequency (See graphs #5 and #6). Therefore, a further step in the experimental evaluation of **SKUDOTECH®**, will plan raising the test frequencies around 15 kHz , a frequency typical of the CRT (TV sets and PC monitors) magnetic emission. Needless to say, in the HF range, the shielding effectiveness is excellent.

2) **SKUDOTECH®** confirms the multiple reflection contribution to shielding effectiveness of multiple layers: keeping the overall thickness constant, the shielding effectiveness of the plate obtained by the stacking of several layers, is greater (for instance, two 0.1 mm stacked layers, show a higher shielding effectiveness than a 0.2 mm plate, as can be appreciated from Graphs #7, #8, #9 at 50 , 500 and 1000 Hz , respectively).

The static Magnetic Hysteresis curve of **SKUDOTECH®**, and a resume of its physical characteristics, is included at the end of this brief.

In conclusion, the **remarkable potentials** of **SKUDOTECH®** are definitely confirmed by even preliminary experimental tests.

We intend to point out, that the values of Magnetic Fields used in the experiments reported, are in general greater than, or of the same order of magnitude of, those usually deemed hazardous, when encountered by operators in most working locations, and typical of a significant fraction of electric utilities like electric boards, high current-density power lines, electric motors etc., all producing magnetic fields with high proximity values. Moreover, such fields, are broadly consistent with those produced by most common home appliances, at centimetre distance.



SELITE and the coordinators of this set of experimental measurements, do not intend to express a position about several statistical models, associating a health risk with low-frequency magnetic fields, nor to the correlation levels that some of such models claim.

However, they intend to stress that both scientific as well as medical authorities, have been pointing out for a long time, that there is evidence of the opportunity to self-protect **anyway**, from artificially-produced magnetic fields, that are daily met by all individuals living and working in modern industrial as well as domestic environments.



SKUDOTECH® MAIN TECHNICAL SPECIFICATIONS

SKUDOTECH® is a soft ferromagnetic alloy, where the basic component is nickel. It shows superior performance in the ability to provide effective shielding of ELF B and E fields.

The material can be rolled in few steps down to .01 mm thickness, and can be subject to any of the usual production steps typical of a metal sheet: bending, forming, punching, drawing, soldering. A subsequent anneal restores the shielding property in case of plastic deformation.

MAIN PHYSICAL PARAMETERS

1-Static Hysteresis Cycle

- Maximum Permeability $\mu_{max} = 327,000$
- Top Cycle Induction Value $B_v = 0.8 \text{ T}$
- Top Cycle Magnetic Field $H_v = 1,500 \text{ A/m}$
- Residual Induction $B_r = 0.475 \text{ T}$
- Coercive Magnetic Field $H_c = 0.75 \text{ A/m}$
- Initial Permeability $\mu_{in} = 33,000$

2-Resistivity

- $\rho = 0.566 \text{ } \Omega \cdot \text{mm}^2 / \text{m} @ 21.1 \text{ } ^\circ\text{C}$
- $\rho = 0.626 \text{ } \Omega \cdot \text{mm}^2 / \text{m} @ 100 \text{ } ^\circ\text{C}$
- Conductivity, vs Cu $\sigma = 0.034 @ 20 \text{ } ^\circ\text{C}$

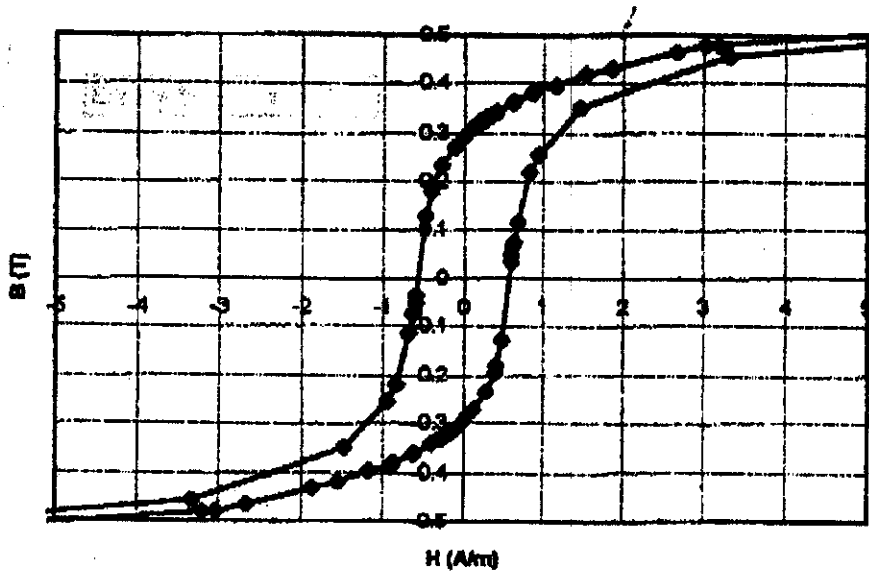
3-Curie Point $\cong 350 \text{ } ^\circ\text{C}$

4-Density $= 8.9 \text{ g/cm}^3$



5-Surface Resistance

$$R_s = 0.025 \Omega/\square$$



Hysteresis Cycle