

## INFLUENCE OF ALTERNATING ELECTRIC FIELDS 50 Hz ON HUMAN BEINGS

R. HAUF

*The Institute for Occupational Health and Research Unit for Electropathology,  
Freiburg i. Br., F.R. Germany*

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### ABSTRACT

The author presents the results of the laboratory investigation into the effect of electric alternating current (AC) field on humans.

Clinical and laboratory tests revealed presumably an unspecific stimulatory effect of the electric field. From the results obtained it appears that exposure to an electric AC field of 50 Hz and 20 kV/m during 5 hours causes no adverse effects.

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Electric and magnetic fields pervade the world in which we live. They are of natural or man-made origin and may exert beneficial, adverse, or no effects on living systems. Naturally produced electric and magnetic fields originate from meteorological and atmospheric electrical events and may affect the growth and well-being of living systems. Man-made electromagnetic fields have a large number of varied sources in the highly developed electrical technology and are spanning all frequency ranges. We are living in the era of electricity. It is our most important energy and with increasing industrialization the need for electrical energy involves extensive and large transmission systems. They generate electric and magnetic fields. The question has been raised if these fields may influence human beings. Under special consideration is the electric AC field. We studied this problem in controlled laboratory conditions on humans.

### SUBJECTS AND METHODS

In an electrically shielded, completely air-conditioned laboratory, electrical conditions encountered beneath high-voltage overhead transmission lines were simulated. The temperature was maintained at 22 °C, the relative humidity at 50 per cent. A square ceiling electrode was set up so that no corona discharges could occur. The carefully selected subjects were seated at a table and were grounded through the feet. They had no visible or audible clues as to whether the field was turned on or off. Switching and measuring devices were in an adjacent room from which the subjects could be observed. The field intensities on which the

experiment was based refer to an undisturbed electric field strength up to 20 kV/m. The exposures lasted from 45 minutes to 5 hours. Daily rhythms were taken into account. The behaviour of ions in the air was observed as well. The individual groups included 10 to 25 persons. Control-tests under identical conditions were conducted for each exposure. The average age of the subjects was 25 years. Altogether about a hundred people were checked.

In the various series of exposures and controls the following clinical and laboratory tests were performed: ECG, EEG, pulse, blood pressure, blood picture, thrombocytes, reticulocytes, ESR, Quick's test, reaction time, electrolytes, catecholamine, enzymes and metabolic factors.

#### RESULTS AND DISCUSSION

ECG, EEG, blood pressure and pulse rate showed no differences between control and exposed groups except a decrease in pulse rate which occurred in both groups. It is attributed to the long relaxed sitting position at the table.

After exposure to an electric field leucocytes, absolute neutrophils and reticulocytes showed a somewhat greater increase in all exposed groups than in the controls. But these changes were within the limits of the physiological norm. An unspecific stimulation effect of the electric field is assumed. Such effects are known from other unspecific natural irritations.

Reaction time was measured by an automatic device. A slight decrease in response time, independent of the field strength, was observed. This is also to be considered as a non-specific stimulation effect of no great relevance.

No significant changes in electrolytes, catecholamines, enzymes and metabolic factors between the exposed and the control group were observed. Especially, there was no criterion for any stress effects.

From these results it can be concluded that electric AC fields 50 Hz up to 20 kV/m during exposure times up to 5 hours cause no ill-effects on humans.

But there are also indirect effects of electric fields. Electric fields result in a capacitive charging of ungrounded metallic objects. If a grounded person touches such objects discharges are produced.

In a separate investigation we studied the influence of discharges on humans. The grounded subject sitting in a laboratory had to touch a sphere-electrode 20 times in 15 minutes. With each contact a charge of 3  $\mu\text{C}$  took effect. The discharges were painful, but tolerable. After exposure slight stress symptoms were detected.

When biological effects of electric fields are discussed primary and secondary effects have to be distinguished. A phenomenon can only be positively attributed to an electric field when other causes can be eliminated and when the phenomenon is significant in comparison with control results. A differential diagnosis is most important. Exposed and control groups must be tested under identical conditions. Phenomena must be objectively verifiable, which is especially important when subjective symptoms and complaints are considered.