ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

SAFETY REQUIREMENTS

FOR

DATA PROCESSING MACHINES

FIRE PROTECTION – PHYSICAL SAFETY
CHEMICAL SAFETY

March 1972

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BRIEF HISTORY

Technical Committee TC12 of ECMA have been set up in 1966 with a view to considering safety requirements in general, and more particularly the safety regulations of the European countries, and then to establishing appropriate safety recommendations specifically aimed at Data Processing machines or units so that they are safe for operating personnel. Standard ECMA-22, issued in June 1969 is directed to the electrical safety requirements. Standard ECMA-31 issued in June 1971 is directed to mechanical safety requirements.

This document provides a series of data in the field of fire protection, physical and chemical hazards.

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FOREWORD

This ECMA document is directed to the following subjects:

- Resistance to fire and tracking
- Physical Safety
- Chemical Safety

This field is composed of many different subjects that are already covered by numerous national and international standards.

The purpose of this document is to give a guidance to the designer and to supply him with some conservative figures accompanied by references to the more detailed standards.

PART 1

RESISTANCE TO FIRE AND TRACKING

1. Fire protection

1.1 Due to the extremely high value and the limited number of the equipment, the compliance to the clauses of this section should not be verified by destructive burning tests of complete units. Rather this should be done by test carried out on parts or sub-assemblies, or by visual inspection, or simulation, or calculation.

1.2 The fire behaviour of parts is characterized in this clause 1 by the following set of terms in decreasing order of resistance:

(1) non-combustible

(2) combustible:
- i) self-extinguishing
- ii) flame-retardant (not easily flammable)
- iii) non-flame-retardant.

Note: A test for non-combustibility of parts is under consideration.

A part is considered self-extinguishing if it extinguishes within 30 seconds after removal of the flame of a Bunsen burner which has been applied for 10 seconds.

Compliance is checked by the following test:

The part is to be held in the most adverse position regarding burning which occurs in normal use. The orifice of the burner is positioned 15 mm distant from the lower edge of the part.

The burner has (10 $\pm$ 1) mm diameter; the steady yellow blue flame is adjusted to 20 mm height; the gas used has a heating value of (40 $\pm$ 3) MJm^{-3}.

A part is considered flame-retardant (not easily flammable) if

i) it does not show any flames when exposed to air at 200°C for 15 minutes

ii) and does not show any flames higher than 5 cm if the flame of a Bunsen burner as specified above is applied to it for 10 seconds at 15 mm distance from the lower edge.

When performing tests on combustibility etc. of components, the parts shall be tested in the assembled form as installed in the machine itself, but as explained in sub-clause 1.1 not a complete machine is required for the test.

1.3 Internal Machine Design

Machines shall be so designed as to minimize the risk of fire originating within the machine itself. This shall be done by using at least flame-retardant materials and by avoiding high temperatures.

Where the use of non-flame-retardant materials is unavoidable and a fire hazard exists,

- either the individual assemblies using the materials shall be enclosed by non-combustible material, or separated from the rest of the machine by barriers or by distances, so that a fire cannot spread beyond these individual assemblies
- or the external enclosure of the whole machine must comply to sub-clause 1.4 of this particular specification.

Combustible materials used shall not be subject to temperatures due to heating in normal use within the machine higher than these specified in Standard ECMA-22, Clause 2.7.

Components working at high temperatures shall be effectively shielded to prevent overheating of their surrounding materials and components.

Materials used inside a machine should preferably not develop large volumes of smoke when exposed to fire.

Even under fault conditions, no flammable gases shall be liberated to such an extent that there is a danger of fire to the surroundings of the machine.

Unless effectively protected against being reached by fire, materials which could generate toxic fumes that may be hazardous to personnel, should be avoided as far as possible.

Note: The use of PVC and PTFE insulated wires is not prohibited by this.

Electrical components shall be designed such that their normal working temperature is less than that necessary to cause ignition to themselves, their surroundings or lubricating materials with which they are likely to come into contact. For insulating materials, the temperature limits of Standard ECMA-22, clause 2.7 must not be exceed

Where there is by special nature of the operation (e.g. heating devices in connection with paper feeding) a risk of overheating within a machine, temperature or smoke sensing devices should be incorporated, which either signalize the danger to the operator for intervention and cut-off the power supply, or release additionally automatic fire extinguishing devices.

Insulating parts directly supporting components which may overheat in the event of a fault shall at least be self-extinguishing, unless other adequate precautions have been taken.

Fluids used in machines shall have a flash point of 150°C or higher, unless special precautions are taken to prevent the fluids from reaching their flash point temperature.

Note: Built-in fire extinguishers should not employ soda acid nor carbon tetra chloride. The materials used should not be more toxic than CO_2 and should not have any detrimental influence on machine components. They should be detectable (e.g. odourized).

Machines shall be so constructed that in the event of an internal fire they shall not collapse nor distort as to allow the fire to spread externally.

1.4 Machine Enclosure

Machines containing parts of non-flame-retardant materials which are not enclosed individually, according to 1.3, second alinea, shall have an overall enclosure consisting of a material adequate to prevent spreading a fire externally long enough for complete exhaustion of combustible material in the machine, or to enable the fire to be safely extinguished. Enclosures shall be designed such that the emission of molten metal, burning insulation, flaming particles and the like in the event of fire is minimized, so that the surroundings do not ignite.

In the event of fire, covers shall not fall off, explode or distort so as to reduce their effectiveness in enclosing a fire.

Connections between machine units shall not allow a fire to spread from one unit to another.

1.4.1 Specific Requirements

External parts of insulating material, the deterioration of which might cause the equipment to become unsafe, shall be sufficiently resistant to heat.

Compliance is checked by subjecting enclosures and other external parts of insulating material to a ballpressure test by means of the apparatus shown in Figure 2.

The surface of the part to be tested is placed in the horizontal position and a steel ball of 5 mm diameter is pressed against this surface by a force of 20 N.

The test is made in a heating cabinet at a temperature of 75 $\pm$ 2°C or at a temperature which is 40 $\pm$ 2°C in excess of the temperature rise of the relevant part determined during the test of Clause 2.7 in Standard ECMA-22, whichever is the higher.

After 1 hour, the ball is removed and the diameter of the impression measured. This diameter shall not exceed 2 mm.

The test is not made on parts of ceramic material.

For materials other than ceramic, compliance is checked by the following test described in IEC publication 335-1, sub-clause 30.3. See reference 14.

2. RESISTANCE TO TRACKING

Insulating parts retaining live parts in position where breakdowns might result in a shock hazard and supplementary insulation of metal encased Class II equipments, shall be of material resistant to tracking, if they are exposed to excessive deposition of moisture or dirt in normal use, unless the creepage distances are at least equal to twice the values specified in Standard ECMA-22, sub-clause 2.6.4.

PART 2

PHYSICAL SAFETY

1. SCOPE

Most of the following subjects are considered not to be prime features of Data Processing machine and are extensively covered by International and National Standards devoted to them.

The following serves only as a guide with references to the Standards concerned.
The figures given are the most conservative ones according to present available knowledge.

If these levels are surpassed reference should be made to the Standards specifically written for these subjects.

The foregoing does not apply to 4.4, Temperature of Accessible Parts, which has been adapted from Standard ECMA-22, clause 2.7.1.

2. MEASURING CONDITIONS

Compliance with the requirements mentioned hereafter shall be checked by taking measurements under the most adverse operating conditions permitted by the manufacturers' specifications.

Note: The term "most adverse operating conditions" shall be taken to cover all factors which may influence the effect concerned such as mains supply voltage and frequency, ambient temperature, atmospheric pressure and relative humidity, conditions of air filter and operating mode.

3. RADIATION HAZARDS

3.1 Requirements

The apparatus shall be so constructed that personnel protection against radiation is provided.

3.2 Ionizing Radiation

3.2.1 Introduction

- Strong radio isotopes, neutron generators and other powerful ionizing radiation producing

sources are not normally used in Data Processing Equipment.

- Data Processing equipment with such sources of ionizing radiation will require a special Standard (see Ref. 1).

- In general the radiation in Data Processing equipment will confine to the known effects of rectifiers, cathode ray or television tubes used with 5kV or higher. (See Ref. 2).

3.2.2 Definitions

- Ionizing radiation is an electromagnetic radiation, (e.g. X-rays or γ-rays), corpuscular radiation (e.g. α particles, β particles, electrons, positrons, protons, heavy particles, etc.) which are capable of producing ions, either directly or indirectly when passing through matter.

- rem: unit of dose equivalent (DE)

  One rem: A dose of ionizing radiation which, absorbed by a human body, will produce the same biological effect as is produced in the same tissue by the absorption of one rad of X-radiation causing a specific ionizing equal to 100 ion-couples per micrometer path length in water.

- For further definitions see Ref. 3

3.2.3 General Requirements

The apparatus shall be so constructed that under any conditions operating personnel are protected against excessive ionizing radiation.

Compliance is checked by measuring the amount of radiation.

3.2.4 Maximum Permissible Dose

- The dose of any accessible point 50 mm from the outer surface of the unit shall not exceed 0,5 mr/h. The effective measuring area shall be at most 1000 mm^2. (See also Clause 119 of Ref. 4 and Ref. 5).

3.3 Ultra Violet Radiations

3.3.1 Introduction

Ultra Violet radiation can under circumstances be a hazard to personnel against which measures have to be taken. Most critical part of the range is believed to be in the area of 280 through 320 nm.

3.3.2 Definition

Ultra Violet radiation is electromagnetic radiation within the wave length range 400 nm down to 200 nm.

3.3.3 General Requirements

Ultra Violet radiation shall be shielded as to provide no hazard to personnel. Compliance is checked by measuring. (See Section 9 of Ref 6).

Note: Shielding may be effected by means of a thin sheet of ordinary glass of at least 1 mm thickness.

3.3.4 Max. Permissible Dose

Maximal allowable energy exposure is 10 mW/cm^2 in the operator access area. This maximum will normally occur at the surface of the equipment. (See Ref. 7, particularly paragraph 2.3).

3.4 Laser

3.4.1 Introduction

Laser radiation is in effect a very powerful source of electromagnetic radiation with the peculiar characteristic that it has practically no decrease in intensity with the distance.

It can burn the skin but its principal danger arises from the absorption of its energy by the eye. The concentrating effect on the lens of the eye will cause retinal burns resulting in permanent blindness at the point of incidence.

The effect of irradiation is so fast that irreparable damage occurs even before the eye closes itself by reflex. (See Ref. 8).

3.4.2 General Requirements

1. The construction of the apparatus shall be such that the Laser beam under no circumstances can emerge out of it.

2. If that is not possible along its path there is a danger zone which has to be kept free from persons or reflective objects.

3.4.3 Maximum Permissible Levels

Under consideration.

3.5 Infrared Radiation

3.5.1 Introduction

Infrared radiation can affect the human tissue. Most critical are the eyes. Of the range of infrared radiations only the waves between 0,8 and 2 nm can penetrate the eye. Further, only wave lengths in the range from 0,8 to 1,4 nm can cause permanent damage to the eye after long exposure.

3.5.2 Max. Permissible Dose

Max. permissible level in the operator access area under any conditions is 10 mW/cm^2. The maximum will normally occur at the surface of the equipment. (See Ref. 7).

3.6 Radio Frequency Radiation

3.6.1 Introduction

Electromagnetic radiation generally will be absorbed by the human body and in the process converted into heat. Except for very special situations such as close to a very strong transmitter (e.g. broadcast transmitter), below 30 MHz the absorption is too low or above 300 MHz the penetration is thought to be too shallow, for any dangerous effect. (There is now some disagreement with this view).

Between 30 and 300 MHz, the microwave range, the effect can be dangerous temperature rise inside the body.

At many places inside the body damages can occur before any warning signal is felt.

Most sensitive are the eyes and the gonads.

3.6.2 Max. Allowable Power Density

Safe under any conditions is an energy level of 10 mW/cm^2 (See Ref. 9) for any frequency averaged over any possible 0,1 hour period measured at 50 mm from the surface of the equipment.

Note: This figure is under consideration and will most probably be lowered in the future to $1mW/cm^2$.

4. PROTECTION AGAINST HEAT

4.1 Introduction

The following covers the requirements of the temperature of surface and exhausted air in operator areas.

4.2 General Requirements

- Data Processing equipment in which any sources of heat present a hazard, shall be so designed, constructed or guarded as to prevent injury.

- As operator protection against the adverse effects of excessive temperatures, the maximum allowable temperatures of accessible parts or machine heat dissipation by air in normal use are given as being practically the only causes of injury by heat caused by Data Processing equipment.

4.3 Temperature of Accessible Parts

Furthermore the temperature of accessible parts shall not exceed in normal use the following values:

	Temperature (°C)	
	Thermal Conductivity $\geq$ 0,01W (cm °C) $^{-1}$	Thermal Conductivity $<$ 0,01W (cm °C) $^{-1}$
Accessible parts which the operator needs to touch or handle for operational purposes	55	85
Other accessible parts	75	95

4.3.1 Measuring Conditions

In addition to the Measuring Conditions mentioned under clause 2, temperature shall be measured:

- in the case of appliances for short time operation at the end of the rated operating time.

- in the case of appliances of intermittent operation when the maximum values are reached.

- in all other cases when the steady state is reached, (See Ref. 10, Clause 7).

Note: In general steady state is assumed to be attained after 4 hours operation.

5. ULTRA SONICS

5.1 Introduction

Ultrasonics are considered as air vibrations above 20 kHz.

5.2 Max. Allowable Power Density

Under consideration.

6. ACOUSTIC NOISE

Under consideration.

7. SAFETY AGAINST MECHANICAL VIBRATIONS

7.1 Introduction

There is a wide variety of possible conditions and effects of human exposure to vibrations. There is a shortage of firm data on the subjects so only general guidance can be given.

The resonant frequencies of most parts of the human body lie between 1 Hz and 100 Hz and it is the range that is most important.

7.2 General Information and Definitions

For information on definitions, measurement instruments and positions, and vibrations characteristics applicable see Ref. 11.

7.3 General Requirements

Machines shall be so constructed that personnel shall be protected against contact with vibrating parts except where functionally necessary.

7.4 Maximum Permissible Levels of Vibration

The max. permissible level of vibration on any part or surface of a machine which the operator can touch during normal operation shall not exceed those given in Fig.3 .(See Ref. 12).

8. AIR POLLUTION

Care shall be taken to ensure that the Data Processing Equipment does not increase air pollution by particles e.g. dust in the operator access areas such as to create a hazard. (See also Part 3, Chemical Safety).

9. FLUIDS

The construction of all machines employing fluids shall be such as to ensure that no electrical, chemical or mechanical hazard is created by either condensation or spillage of the fluid e.g. creepage distances and clearance must not be reduced or corrosion due to the fluid result in an ultimate hazard.

Compliance shall be checked by visual inspection (for more details see Part 3, Chemical Safety).

PART 3

CHEMICAL SAFETY

1. SCOPE

Hazards arising from the presence of chemicals which may injure personnel in operator access area or may affect the electrical or mechanical safety of a data processing machine or equipment due to contamination.

This document does not cover chemical safety requirements for the functional safety of the equipment.

This document only relates to the level of safety for units used under the environment conditions specified by the manufacturer. The Standard does not cover requirements for abnormal conditions, e.g. fire.

2. DEFINITION

The word "Chemical" in this context covers substances which are present in the environment, substances which are used in or in connection with a data processing machine or equipment and substances which may also be generated under abnormal conditions.

3. GENERAL REQUIREMENTS

3.1 Risk from Inhalation

Under normal working conditions specified by the manufacturer except maintenance conditions the concentration of vapour in the air which may cause a chemical hazard shall not exceed the values given in Ref. 13.

Substances for which no values are included in the Ref. 13 must be responsibly limited by the user.

3.2 Risk from Contact

Chemicals, fluids or substances which may have detrimental effects on the health of personnel shall be housed in totally enclosed spillproof containers.

REFERENCES

Ref. 1 BSI Draft Doc. No. 69/3472, January 1969.

- Guide to the Safety of Telecommunications and Electronic Equipment and the parts used therein - Part 6, Section 1 - Ionizing Radiation.

- See also comments on this Draft in BSI Document No. 69/5383.

Ref. 2 USA September 26, 1967.

- Radiation Effects from commercial CRT Equipments by Raymond F. Foster (Issued by Control DATA).

Ref. 3 IEC Publ. 50 (66), 2nd Ed., - 1968

- International Electrotechnical Vocabulary - Group 66 - Detection and measurement of Ionizing radiation by electric means.

Ref. 4 ICRP Publ. 3 (1960)

- International Commission on Radiological Protection.

Ref. 5 ICRP Publ.

- Recommendations of ICRP.

Ref. 6 BS 3861 - Part 2, 1968

- Electrical Safety of Office Machines - Part 2 - Requirements and tests for machines presenting special hazards.

Ref. 7 BSI Draft Doc. No. 68/18635, July 1968.

- Guide to Safety of Telecommunications and Electronic Equipment and the parts used therein - Part 6, Section 2 - Protection against hazards from Light sources.

- See also comments on this Draft in BSI Documents No. 69/5383.

Ref 8. BSI Draft Doc. No. 68/18636.

- Guide to Safety of Telecommunication and Electronic Equipment and the parts used therein - Part 6, Section 4 - Recommendation for Protection against Laser Radiation.

- See also comments on this Draft in BSI Doc.No. 69/5383.

Ref. 9 USAS C 95.1, 1966

- Safety Level of Electromagnetic Radiation with respect to personnel.

Ref. 10 IEC Publ. 65, 2nd Ed., 1965

- Safety requirements for mains operated electronic and related equipment for domestic and similar general use.

Ref. 11 ISO/TC108/WG-7 (Secr. 17), Dec. 23, 1968.

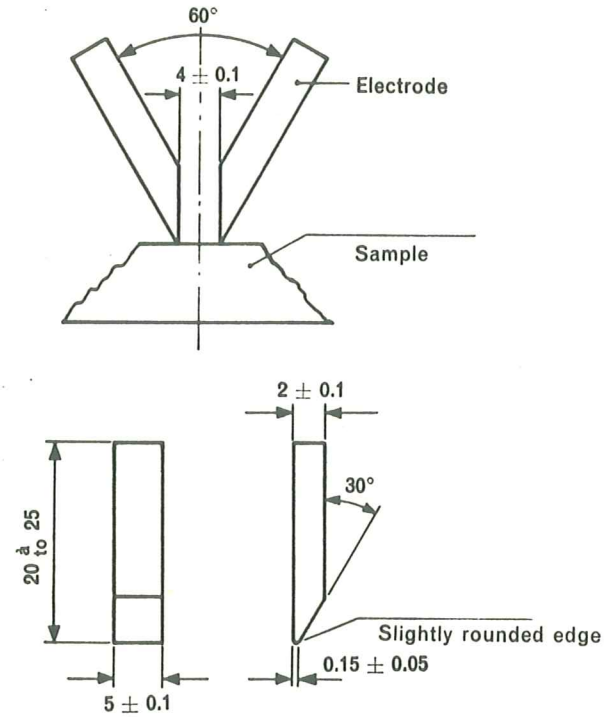
Ref. 12 ISO/TC108/WG-7, July 1969.

- Proposals: Guide for the evaluation of human exposure to whole body vibration.

Ref. 13 "MAK-Werte-Liste 1970 (Maximale Arbeitsplatz-Konzentrationen gesundheitsschädlicher Stoffe)".(Bundesinstitut für Arbeitsschutz, Schlachthofstrasse 48, D-5400 KOBLENZ, Deutschland).

Ref. 14 IEC Publication 335-1, First Ed. 1970

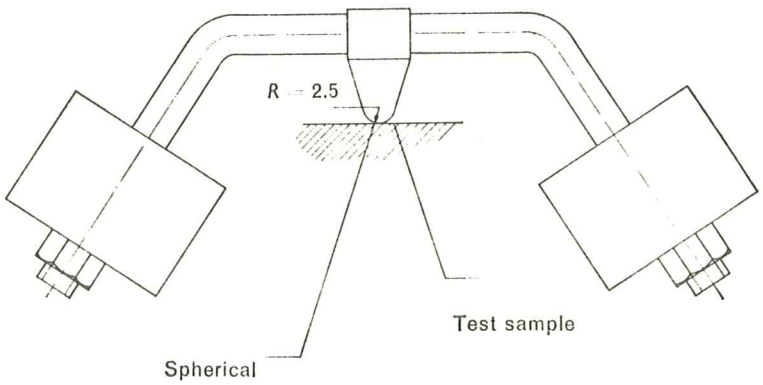
- Safety of Household and similar electrical appliances.



Dimensions in millimetres

Arrangement and dimensions of the electrodes for the tracking test.

Fig. 1



Ball-pressure apparatus.

Fig. 2

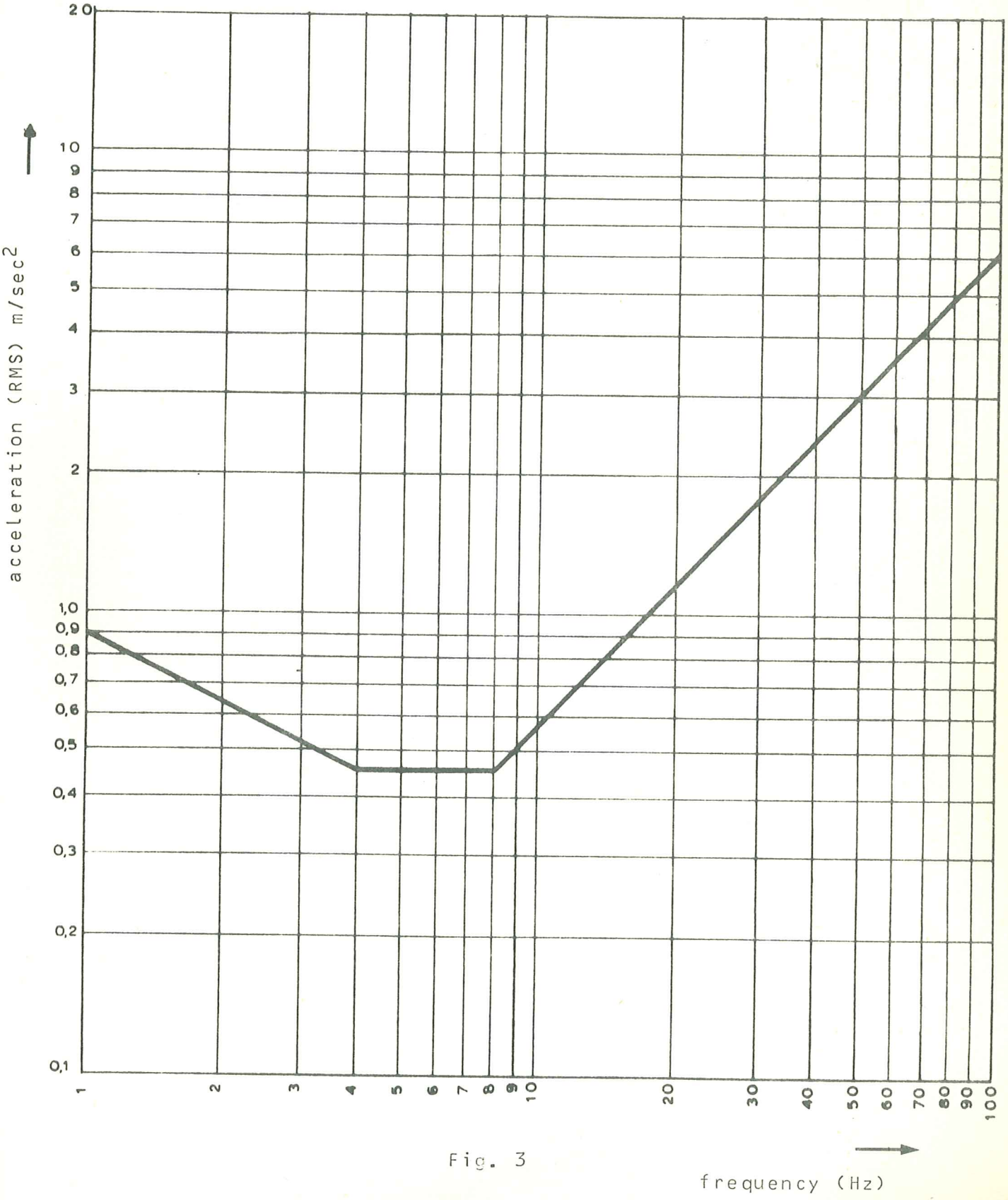


Fig. 3

MAXIMUM VIBRATION LEVELS