

ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-31

FOR

MECHANICAL SAFETY REQUIREMENTS
FOR DATA PROCESSING MACHINES

September 1971

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ECMA European Computer Manufacturers Association
114 Rue du Rhône — 1204 Geneva (Switzerland)

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BRIEF HISTORY

Technical Committee TC 12 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.

This Standard ECMA-31 is directed to mechanical safety requirements.

Adopted as Standard ECMA-31 by the General Assembly of June 2-3, 1971.

1. INTRODUCTION

1.1 Foreword

These requirements cover electrically operated machine units which, separately or assembled in systems, electronically accumulate, process, and/or store data without the interposition of an operator. Acceptance and divulgence of data may or may not be by electronic means. These requirements cover units rated at 440 volt or less.

1.2 Scope

Purpose of this Standard ECMA-31 is to establish appropriate safety recommendations for data processing machines or units so that operating personnel is not submitted to mechanical hazards, i.e. to any condition in the equipment which would allow an operator to receive an injury which is directly attributable to the particular equipment.

2. STABILITY

Each unit of an electronic data processing system shall not become physically unstable to the degree that it becomes a hazard to operators under all conditions of normal use.

2.1 Each unit shall satisfy the requirements of 2.1.1. Additionally, each unit shall satisfy the requirements of 2.1.2 or alternatively both the requirements of 2.1.3.

2.1.1 The unit shall not overbalance when a constant vertical force of 800 N is applied at the point of maximum moment to any horizontal working surface or surface offering a foothold at a height not exceeding 1 m from the floor.

2.1.2 The unit shall not overbalance when tilted 20 degrees from its normal, upright, freestanding position.

2.1.3 The unit shall not overbalance in each of the following cases:

- (i) when tilted 10 degrees from its normal, upright, freestanding position
- (ii) when a force of 250 N is applied to the unit (while standing in its normal position) in any direction at the point of maximum moment at a height not exceeding 2 m from the floor.

- Notes:
1. The tilt requirements in 2.1.2. and 2.1.3 (i) shall not apply to units secured to the building structure.
 2. Where units are designed to be fixed together on-site and not used individually, the stability of individual units need not be considered but the whole assembly shall meet the requirements of 2.1.
 3. The requirements of 2.1 shall be met with castors, jacks and all doors, drawers, etc. which may be opened by the operator, in their most unfavourable positions.
 4. An equipment shall not become unstable when doors, gates, etc. are opened by the service engineer.

3. MECHANICAL STRENGTH

- 3.1 Each equipment shall have sufficient mechanical strength and be so constructed as to prevent the occurrence of hazards due to the rigours of normal use.

External covers and guards in operator access areas shall withstand a steady force of 250 N applied to any external surface through a surface of 30 mm diameter.

External covers and guards in operator access areas shall withstand an impact energy of $0,5 \pm 0,05$ Nm applied from a spherical surface having a Rockwell hardness of R 100 and a radius of 10 mm. Both during and after this impact the equipment shall meet all other requirements of this Standard.

Compliance is checked by applying blows to the sample by means of the spring-operated impact-test apparatus shown in Figure 1.

The apparatus consists of three main parts, the body, the striking element and the spring-loaded release cone.

The body comprises the housing, the striking element guide, the release mechanism and all parts rigidly fixed thereto. The mass of this assembly is 1,25 kg.

The striking element comprises the hammer head, the hammer shaft and the cocking knob. The mass of this assembly is 250 g.

The hammer head has a hemispherical face of polyamide having a Rockwell hardness of R 100, with a radius of 10 mm; it is fixed to the hammer shaft in such a way that the distance from its tip to the plane of the front of the cone when the striking element is on the point of release, is 20 mm.

The cone has a mass of 60 g and the cone spring is such that it exerts a force of 20 N when the release jaws are on the point of releasing the striking element.

The hammer spring is adjusted so that the product of the compression, in millimetre, and the force exerted, in newton, equals 1000, the compression being approx. 20 mm. With this adjustment, the impact energy is $0,5 \pm 0,05$ Nm.

The release mechanism springs are adjusted so that they exert just sufficient pressure to keep the release jaws in the engaged position.

The apparatus is cocked by pulling the cocking knob until the release jaws engage with the groove in the hammer shaft.

The blows are applied by pushing the release cone against the sample in a direction perpendicular to the surface at the point to be tested.

The pressure is slowly increased so that the cone moves back until it is in contact with the release bars, which then move to operate the release mechanism and allow the hammer to strike.

The sample as a whole is rigidly supported and three blows are applied to every point of the enclosure that is likely to be weak. If necessary, the blows are also applied to handles, levers, knobs and the like, and to signal lamps and their covers, but only if the lamps or covers protrude from the enclosure by more than 10 mm or if their surface area exceeds 4 cm². Lamps within the equipment, and their covers, are only tested if they are likely to be damaged in normal use.

After the test, the sample shall show no damage within the meaning of this specification; in particular, live parts shall not have become accessible, so as to cause non compliance with the requirements of Standard ECMA-22. In case of doubt, supplementary insulation or reinforced insulation is subjected to an electric strength test as specified in said Standard.

When applying the release cone to the guard of a heating element which glows visibly in normal use, care is taken that the hammer head passing through the guard does not strike the heating element.

The requirements of this paragraph are not applied to transparent or translucent covers or enclosures of indicating and measuring devices unless parts at dangerous voltages are accessible by means of the test finger (Fig.2) if the cover or enclosure is removed.

If figure indicating tubes are not covered, but arranged in such a way that damage to them is unlikely to occur in normal use, they are only tested with the rigid test finger applying a force of 30 N.

Damage to the finish, small dents which do not reduce creepage distances and clearances below the values specified in Standard ECMA-22 and small chips which do not adversely affect the protection against electrical shock or moisture are neglected.

Cracks not visibly to the naked eye and surface cracks in fibre reinforced mouldings and the like are ignored.

If a decorative cover is backed by an inner cover, fracture of the decorative cover is neglected if the inner cover withstands the test after removal of the decorative cover.

3.2 Screwed glands and shoulders in conduit entries shall have adequate mechanical strength.

3.2.1 Compliance is checked, for screwed glands, by the test of sub-clause 3.2.1 and for shoulders in entries for conduit sizes 16 mm and 19 mm, by the test of sub-clause 3.2.2.

After the tests, glands, enclosures and conduit entries shall show no significant deformation or damage.

For shoulders in entries for conduit sizes over 19 mm, the test is under consideration.

The screwed gland is fitted with a cylindrical metal rod having a diameter in millimetre, equal to the nearest whole number below the internal diameter of the packing, in millimetre. The gland is then tightened by means of a suitable spanner, the force shown in the following Table I being applied to the spanner for 1 minute, at a point 25 cm from the axis of the gland.

TABLE I

Diameter of test rod (mm)	Force (N)	
	Metal glands	Glands of moulded material
Up to and including 20	30	20
Over 20	40	30

3.2.2 The equipment is rigidly supported so that the axis of the conduit entry is vertical.

A test device as shown in Figure 3 is placed on the shoulder in the manner shown in this figure, and a mass of 250 g is allowed to fall 10 times from a height of 15 cm onto the test device.

3.3 The means of securing guards and covers which prevent operator access to hazardous parts, and which are fitted with handles or handholds to facilitate removal or opening by the engineer, shall withstand a total forcible-entry opening force of 250 N applied to anyone of the handles or handholds when the cover or guard is fitted for normal operation of the equipment.

3.4 Equipment frameworks shall withstand on site operation and handling without fracture or deformation which would result in a hazard in the complete machine. (Test under consideration)

3.5 Covers and guards in operator access areas within the unit shall have adequate mechanical strength and rigidity.

4. GUARDS AND COVERS

4.1 Definitions

4.1.1 Fixed Guard

A barrier which by the nature of its design and construction prohibits access to a dangerous part, and remains securely in position after installation.

4.1.2 Interlocking Guard

A non-fixed guard electrically or mechanically linked to the control device of the dangerous part to prevent access except when that part is at rest.

4.1.3 Automatic Guard

A barrier or device which automatically prevents an operator from coming into contact with the dangerous part, either by enclosing the part or by withdrawing the operator from the space traversed by the dangerous part.

4.1.4 Trip Guard

A barrier or device arranged so that approach beyond a safe limit causes the equipment to stop before a person can come into contact with the dangerous part.

4.2 General

It is not possible to define practical means of measuring mechanical hazards. Where a hazard is judged accessible by the means described in 4.3.5 guarding must be provided. The following are known to have caused accidents and should therefore be regarded as potential hazards, when associated with the operation of data processing equipment. The parts of a machine or equipment thus concerned should be guarded, unless those parts are safe by virtue of their position, construction or limitation of available energy. The examples given are not necessarily exhaustive.

- 4.2.1 Revolving shafts, wheels and drums, e.g. hand-wheels, flywheels, printer barrels, feed rollers and cylinders.

- 4.2.2 In-running nips between rotating parts, e.g. feed rollers, friction wheels, belts and pulleys, gearwheels.
- 4.2.3 Projection or edges on rotating parts, e.g. keyheads, setscrews, fan blades, spoked wheels.
- 4.2.4 Revolving or reciprocating cutting tools, e.g. paper trimmers, punches.
- 4.2.5 Nips between pairs of moving, or moving and fixed parts, e.g. mechanism linkages, traversing carriages, type bars, spring or gravity closed covers.

Note: Where it can be shown that the combination of type of hazard and available energy cannot cause an injury, guarding need not be provided.

4.3 Types of Guard

Where a dangerous part has to be guarded, the application of a fixed guard shall be considered first. If a fixed guard is not practicable, an interlocking guard shall then be considered. Finally, failing the practicability of both these types, automatic guards or trip guards may be used.

4.3.1 Fixed Guard

The guard must always be in position during operation, and must not be capable of removal without the use of a tool. Fixed guards must meet the requirements of 4.3.5. Guards with adjustable parts are necessary on some machines where the work varies in size. Means of adjustment intended for operator use shall not be situated so as to permit or cause a hazard.

4.3.2 Interlocking Guard

An interlocking guard may be used to guard parts to which the operator must have access. An interlocking guard must guard the dangerous part before the equipment can be operated, maintain the guarding until the dangerous parts are at rest, and must in the event of failure in any part of the system continue to safeguard against the danger. The guard interlock switches shall be so arranged that inadvertent operation is prevented. Where it may be necessary to over-ride an interlock switch for servicing purposes, an over-ride system shall be

provided which cannot be left on, when the unit is returned to normal usage.

Over-ride devices shall not be in the operator access area unless the use of a tool is required for operation. For the purpose of this sub-clause slotted type over-ride devices operable with commonly available objects like coins, shall not be used.

4.3.3 Automatic Guard

A guard which operates automatically must not itself present a hazard, by virtue of its speed of operation, closing force or physical shape. This type of guard shall have sufficient strength and rigidity for the purpose intended.

4.3.4 Trip Guard

This type of guard which may utilize mechanical, electrical, optical or any other form of sensing, must prevent any part of a person reaching the hazard. The guard must prevent a danger existing due to the machine re-starting whilst any part of a person is at risk. The trip guard must be designed to fail to safety. The trip guard must ensure that the hazard is removed by the time it can be touched by any part of a person, e.g. an efficient braking system for moving parts may be required. Compliance for accessibility may be checked by the test devices described in 4.3.5.

4.3.5 Test for Accessibility

Accessibility shall be tested by means of the Standard Test Finger (Fig.2). Where the hazard is beyond the reach of the Standard Test Finger the following shall apply:

Maximum size of unrestricted human access	50 mm x 25 mm	75 mm diameter
Minimum distance of hazard from the aperture	0,5 m	1,0 m

4.4 Construction of Guards

4.4.1 Fixed and Interlocking Guards must meet the requirements of clauses 2 and 3.

4.4.2 Where visual inspection through the guard is necessary, permanently fixed panels of safety glass or other suitable non-combustible or self-extinguishing transparent material must be provided.

4.4.3 Where one guard cannot be designed to cover all circumstances of use, provision must be made to facilitate the fitting of alternative guards. Where the guard may be changed by the operator provision, e.g. interlocks must be made to ensure that the operator is not exposed to a hazard.

Guards with adjustable parts are necessary on some machines where the work varies in size. The means of adjustment shall be remote from the danger zone. (This only applies to guards which can be adjusted without the use of a tool).

4.4.4 Guards must not themselves constitute a hazard.

4.5 Controls

Controls which may impair mechanical safety shall be situated in areas not accessible to the operator. The operation of controls mounted in operator access areas shall not impair the safety of the operator. Controls necessary to stop in part or in whole the operation of the machine shall be clearly marked and their function indicated.

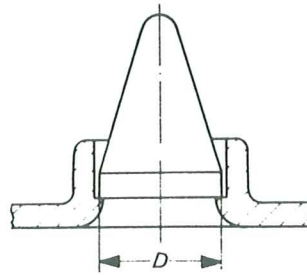
4.6 Implosion

The display tube of a visual display equipment with max. screen dimension exceeding 160 mm shall either be intrinsically safe with respect to implosion effects, or the enclosure shall provide protection against the effects of an implosion of the tube.

Note: The tests to be applied shall be those of IEC 65, Section 18 "Implosion Test Methods", in which a hardened steel ball is allowed to strike either the face of the tube or the implosion guard, whichever is applicable, with a specified impact energy.

4.7 Vibration

Externally generated vibrations within the levels specified by the manufacturer, or internally generated vibrations shall not give rise to a hazard.



Size of conduit	Diameter <i>D</i> mm	Tolerance mm
16	15.7	+0.2 -0
19	18.7	+0.2 -0

Device for testing shoulders in conduit entries.

Fig. 3

