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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

(affiliée à l'Organisation Internationale de Normalisation — ISO)

RECOMMANDATION DE LA CEI

INTERNATIONAL ELECTROTECHNICAL COMMISSION

(affiliated to the International Organization for Standardization — ISO)

IEC RECOMMENDATION

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Auxiliaires de commande (appareils de connexion à basse tension pour des circuits de commande et des circuits auxiliaires, y compris les contacteurs auxiliaires)

Deuxième partie : Prescriptions particulières pour des types déterminés d'auxiliaires de commande

Section Un : Boutons-poussoirs et auxiliaires de commande analogues

Control switches (low-voltage switching devices for control and auxiliary circuits, including contactor relays)

Part 2 : Special requirements for specific types of control switches

Section One : Push-buttons and related control switches

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SECTION ONE: PUSH-BUTTONS AND RELATED CONTROL SWITCHES

FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
3) In order to promote this international unification, the IEC expresses the wish that all National Committees having as yet no national rules, when preparing such rules, should use the IEC recommendations as the fundamental basis for these rules in so far as national conditions will permit.
4) The desirability is recognized of extending international agreement on these matters through an endeavour to harmonize national standardization rules with these recommendations in so far as national conditions will permit. The National Committees pledge their influence towards that end.

PREFACE

This Recommendation has been prepared by Sub-Committee 17B, Low-voltage Switchgear and Controlgear, of IEC Technical Committee No. 17, Switchgear and Controlgear.

Work was commenced in July 1966; two other drafts were elaborated in February 1968 and February 1969. As a result of the meeting held in Washington in 1970, a final draft was submitted to the National Committees for approval under the Six Months' Rule in October 1970. An amendment was submitted to the National Committees for approval under the Two Months' Procedure in January 1972.

The following countries voted explicitly in favour of publication:

Australia	Netherlands
Austria	Norway
Belgium	Poland *
Canada	Portugal
Czechoslovakia	Romania
Denmark	South Africa
Finland	Sweden
France	Switzerland
Germany	Turkey
Hungary	Union of Soviet Socialist Republics
Israel	United Kingdom
Italy	United States of America
Japan	Yugoslavia

* With the exception of the limit figures for rectilinear speed, appearing at the end of Clause 4.2, deemed to be too low.

CONTROL SWITCHES (LOW-VOLTAGE SWITCHING DEVICES FOR CONTROL AND AUXILIARY CIRCUITS, INCLUDING CONTACTOR RELAYS)

Part 2 : Special requirements for specific types of control switches

SECTION ONE: PUSH-BUTTONS AND RELATED CONTROL SWITCHES

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1. General

1.1 *Scope*

This Recommendation applies to push-buttons and related control switches such as foot-switches, rotary switches, etc., using contact elements similar to those of push-buttons.

1.2 *Object*

This Recommendation gives additional requirements, not found in IEC Publication 337-1, Control Switches, Part 1: General Requirements, applicable to push-buttons and related control switches, together with definitions and terms useful in stating desired properties of design or performance.

2. Definitions

For the purpose of this Recommendation, the following definitions shall apply. The most important terms have been explicitly defined, while for the more obvious terms, the definition has been implied through the wording of the text in which they appear.

2.1 *Basic definitions and classification*

2.1.1 *Push-button*

A control switch having an actuator intended to be operated by force exerted by a part of the human body, usually the finger or palm of the hand, and having stored energy (spring) return.

2.1.2 *Pull-button*

A control switch having an actuator intended to be operated by manual pull, and having stored energy (spring) return.

2.1.3 *Push-pull button*

A control switch having an actuator intended to be operated by manual push and returned to its initial position by manual pull, or vice versa.

Note. — There are also "push-push" or "push-turn" buttons.

2.1.4 *Rotary switch (e.g. selector switch)*

A control switch having an actuator intended to be operated by manual rotation.

Notes 1. — A rotary switch may have more than two positions; it may or may not have a spring return.

2. — The rotary switches referred to above are those forming an integral part of a range of push-buttons.

2.1.5 *Joy-stick*

A control switch having an actuator consisting of a pin or stick projecting essentially at a right angle from the panel or enclosure when in one of its positions and intended to be operated by angular displacement.

Notes 1. — A joy-stick may have more than two positions associated with different directions of the displacement of the stick and operating the contact elements differently; such a joy-stick is referred to as a *joy-stick selector*. A joy-stick which operates all contact elements alike for whatever the direction of the displacement is referred to as a *wobble-stick*.

2. — The pin or stick may or may not have a spring return.

2.1.6 *Foot-switch (pedal)*

A control switch having an actuator intended to be operated by force exerted by a foot.

2.2 *Definitions concerning operation*

2.2.1 *Latched push-button*

A push-button with spring return, but which remains in the actuated position until a latch is released by a separate action.

Notes 1. — The latching may be released by subsequent actuation (such as pushing, turning, etc.) of the same or of an adjacent push-button or by the action of an electro-magnet, etc.

2. — A push-button, the release of which is obtained by actuation of an adjacent button, is referred to as a *maintained contact push-button*.

2.2.2 *Locked push-button*

A push-button which may be secured in one or more of its positions by a separate action.

Note. — The locking may be obtained by turning the button, by turning a key, by operating a lever, etc.

2.2.3 *Key-operated push-button*

A push-button which can only be operated as long as a key remains inserted.

Note. — Key withdrawal may be provided at any position.

2.2.4 *Time-delay push-button*

A push-button the contacts of which return to the initial position only after a pre-determined interval of time following the release of the actuating force.

2.2.5 *Delayed action push-button*

A push-button in which the switching operation does not occur until after the force on the button has been maintained for a pre-determined interval of time.

2.2.6 *Illuminated push-button*

A push-button incorporating a signalling lamp in the button.

2.3 *Definitions concerning the appearance of actuators*

2.3.1 *Button*

The external end of the actuator of a push-button, to which the actuating force is applied.

2.3.2 *Long button*

A button which protrudes in both its initial and operated positions.

2.3.3 *Short button*

A button which protrudes when in its initial position but does not protrude significantly when in the operated position.

2.3.4 *Flush-button*

A button which is substantially level with the adjacent fixed surrounding surface when in its initial position and is below this surface when it is operated.

2.3.5 *Recessed button*

A button which is below the adjacent fixed surrounding surface in both its initial and operated positions.

2.3.6 *Mushroom button*

A long button the protruding end of which has an enlarged diameter.

2.4 *Definitions concerning the degree of protection against ingress of liquids*

A long or short button may be covered by *bellows*; a flush or recessed button may be covered by a *diaphragm*. A gasket may be inserted between the actuator and the contact element; the bellows, the diaphragm or the gasket provide a specified degree of protection for the contact element.

Note. — This specified degree may be either one of those standardized in IEC Publication 144, Degrees of protection of enclosures for low-voltage switchgear and controlgear, or one of those defined below.

2.4.1 *Oil-tight push-button*

A push-button so designed that, under stated service conditions and for a determined minimum number of operations, oil cannot enter the enclosure.

Notes 1. — Unless otherwise specified, the stated service conditions are the standard service conditions specified in Clause 6 of IEC Publication 337-1, and the stated minimum number of operations is equal to the mechanical endurance of the push-button.

2. — If a push-button satisfies the conditions required when the oil used is of a determined type, it will be assumed to be also tight to any other similar oil.

2.4.2 *Cutting-fluid-tight push-button*

A push-button so designed that, under stated service conditions and for a determined minimum number of operations, cutting-fluids cannot enter the enclosure.

Notes 1. — Unless otherwise specified, the stated service conditions are the standard service conditions specified in Clause 6 of IEC Publication 337-1, and the stated minimum number of operations is equal to the mechanical endurance of the push-button.

2. — If a push-button satisfies the conditions required when the cutting-fluid used is of a determined type, it will be assumed to be also tight to any other similar cutting-fluid.

2.4.3 *Oil- and cutting-fluid-tight push-button*

A push-button which is simultaneously oil-tight and cutting-fluid-tight.

2.5 *Definitions concerning the operation of push-buttons*

2.5.1 *Covered push-button*

A push-button in which the button is protected against inadvertent operation by a lid or a cover.

2.5.2 *Shrouded push-button*

A push-button in which the button is protected against inadvertent operation in certain directions.

2.5.3 *Free push-button*

A push-button in which the rotation of the actuator around its axis is not limited.

2.5.4 *Guided push-button*

A push-button in which the rotation of the actuator around its axis is prevented.

Note. — Examples of guided push-buttons: push-buttons, the actuators of which are keyed, square or rectangular, etc.

2.5.5 *Definitions concerning the travel of the actuator (namely of the button)*

2.5.5.1 *Pre-travel of the actuator* (dimension "a" on figure 1, page 18)

The maximum travel of the actuator which causes no travel of the contact elements.

2.5.5.2 *Over-travel of the actuator*

The travel of the actuator after all the contacts have reached their closed (open) position.

2.5.5.3 *Direct drive*

A connection between actuator and contact element that excludes any pre-travel of the actuator.

2.5.5.4 *Positive drive*

A connection between actuator and contact element such that the force applied to the actuator is transmitted without any limitation to the contact element.

2.5.5.5 *Limited drive*

A connection between actuator and contact element that limits the force transmitted to the contact element.

2.5.5.6 *Minimum starting force (or moment)*

The smallest value of force (or moment) initiating the pre-travel of the actuator.

2.5.5.7 *Minimum actuating force (or moment)*

The minimum value of the force (or moment) to be applied to the actuator that will cause all contacts to reach their closed (open) position.

2.5.6 *Definitions concerning the travel of the contact element*

2.5.6.1 *Pre-travel of the contact element* (dimension "b" on figure 1)

The maximum travel of the contact element which causes no relative motion of the contacts.

2.5.6.2 *Over-travel of the contact element* (dimension "d" on figure 1)

The travel of the contact element after the contacts have reached their closed (open) position.

2.5.7 *Common definitions concerning the travels of the actuator and of the contact element*

2.5.7.1 *End stop*

A device that limits the travel of a moving part.

Note. — An end stop may relate either to the actuator or to the contact element.

3. Conditions for construction and application

3.1 *Mechanical*

Push-buttons and related control switches shall be selected with regard to their intended environment.

Actuators intended to be water-tight, dust-tight, etc., shall satisfy the conditions laid down in IEC Publication 144 when those actuators are installed to operate through the covers of enclosures themselves satisfying these conditions.

3.2 *Colours*

Push-buttons may be distinguished by the colour of the button. This colour shall then be selected according to the function of the push-button.

Colours used for identification shall be bright and easily distinguishable.

Particular attention shall be given to ensure that coloured push-buttons will retain their colours essentially unchanged under the adverse influence of the environment, including the effect of ultra-violet light.

3.3 *Illuminated push-buttons*

When illuminated push-buttons are coloured, this colour shall be bright. If they are coloured when viewed in reflected light with the lamp extinguished, they shall be of approximately the same colour when viewed in the dark with the lamp illuminated.

The materials used shall be suitable for the increased temperature caused by the lamp. Parts liable to be touched in service shall not reach a temperature exceeding the ambient air temperature by more than 15 °C for metallic parts or 25 °C for parts of insulating material.

3.4 *Functional markings*

Push-buttons and related control switches may be identified by symbols in the form of engravings or coloured designs on the end of the button. If a stop-button carries any symbol engraved or marked on the button, then this symbol shall be a circle or an oval (signifying the value zero). A circle or an oval shall not be engraved or marked on a control switch which is not a stop-button.

Letters or words may be used where the space available is sufficient to ensure an unambiguous identification. In all other cases, identification markings shall be placed on permanent labels surrounding each button or closely adjacent to it.

3.5 *Actuating force (or moment)*

The force (or moment) required to operate the actuator shall be compatible with the intended application, taking into account the size of the button, the type of enclosure or panel, the environment of the installation and the use for which it is intended.

The minimum starting force (or moment) shall be sufficiently large to prevent inadvertent operation; e.g. push-buttons to be used on hose-proof enclosures (see IEC Publication 144) shall not become actuated when hit by the jet of water applied during the test of the enclosure.

To avoid operator fatigue, it is recommended that the maximum actuating force (or moment) should not exceed the following values:

TABLE I

Maximum values for actuating forces and moments

Frequency of operation	Maximum actuating force (newtons)			Maximum actuating moment (newtons metres)	
	Push-button		Foot-switch	Rotary switch	
	Operation by finger	Operation by palm		Operation by finger only	Operation by whole hand
Less than or equal to 30 an hour	(Figures under consideration)				
More than 30 an hour					

Push-buttons and related control switches, particularly foot-switches, shall be fitted with strong end stops, capable of withstanding occasional severe mechanical stresses.

3.6 *Location of push-buttons in control stations*

It is recommended that push-buttons related to the same equipment or to complementary operations (e.g. the push-buttons initiating start and stop of a motor) be located adjacent to one another.

When push-buttons for "start" and "stop" are installed together, it is recommended that the "stop" button be located where its operation is easier.

4. Tests

Push-buttons and related control switches shall be subjected to the tests specified in IEC Publication 337-1 with the following modifications:

4.1 *Type tests (making and breaking capacities)*

The tests for making capacity and breaking capacity shall be performed with the actuator operated by a machine complying with the requirements of Clause 4.2.

4.2 *Operating machine for making and breaking capacity test*

The operating machine shall apply the actuating force (or moment) to the actuator in the direction of its motion.

The force (or moment) or the travel of the operating machine shall comply with one of the following conditions:

a) The maximum force (or moment) exerted on the actuator shall not exceed 1.5 times the force (or moment) required for maximum over-travel of the contact element(s), with a minimum of 20 N (or 4 N.m).

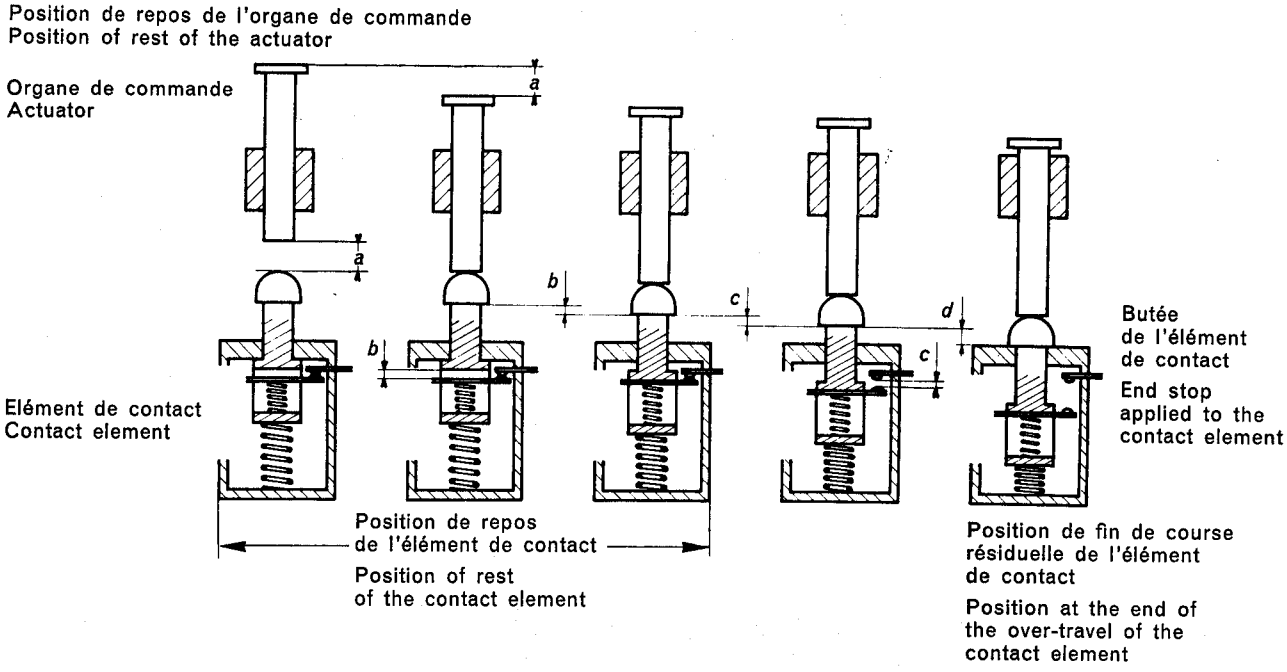
b) The over-travel of the contact elements shall be between 50% and 80% of the over-travel inherent in the design of the contact elements.

During the whole part of the operating cycle where the contacts move from open to closed position (or vice versa), or at least at the moment when the switching operation occurs, the velocity of the operating machine, measured where it touches the button, shall be between 0.05 and 0.15 metre per second; for rotary switches, the angular velocity shall be between 2 and 4 revolutions per second.

4.3 *Special tests*

Special tests may be: mechanical endurance test and electrical endurance test.

It is recommended that, if tests for mechanical endurance (see Clause 8.3.1 of IEC Publication 337-1) or of electrical endurance (see Clause 8.3.2 of IEC Publication 337-1) are to be performed, the test operating machine described in Clause 4.2 should be used.



a { Course d'approche de l'organe de commande (article 2.5.5.1)
Pre-travel of the actuator (Clause 2.5.5.1)

b { Course d'approche de l'élément de contact (article 2.5.6.1)
Pre-travel of the contact element (Clause 2.5.6.1)

c { Valeur minimale requise pour la distance entre contacts ouverts
Minimum value required to give adequate contact gap

d { Course résiduelle de l'élément de contact (article 2.5.6.2)
Over-travel of the contact element (Clause 2.5.6.2)

$b + c + d$ { Course totale de l'élément de contact
Total travel of the contact element

$a + b + c + d$ $(+ e)$ * { Course totale de l'organe de commande
Total travel of the actuator

FIG. 1. — Manœuvre des boutons-poussoirs.
Operation of push-buttons.

* *Note.* — En raison de la possibilité d'une liaison élastique entre l'organe de commande et l'élément de contact (un exemple est donné par la figure 2), la course résiduelle de l'organe de commande (article 2.5.5.2) peut être supérieure à la course résiduelle de l'élément de contact (article 2.5.6.2) d'une quantité *e*.

Because of a possible resilient connection between the actuator and the contact element (for example, see figure 2), the over-travel of the actuator (Clause 2.5.5.2) may exceed the over-travel of the contact element (Clause 2.5.6.2) by a length *e*.

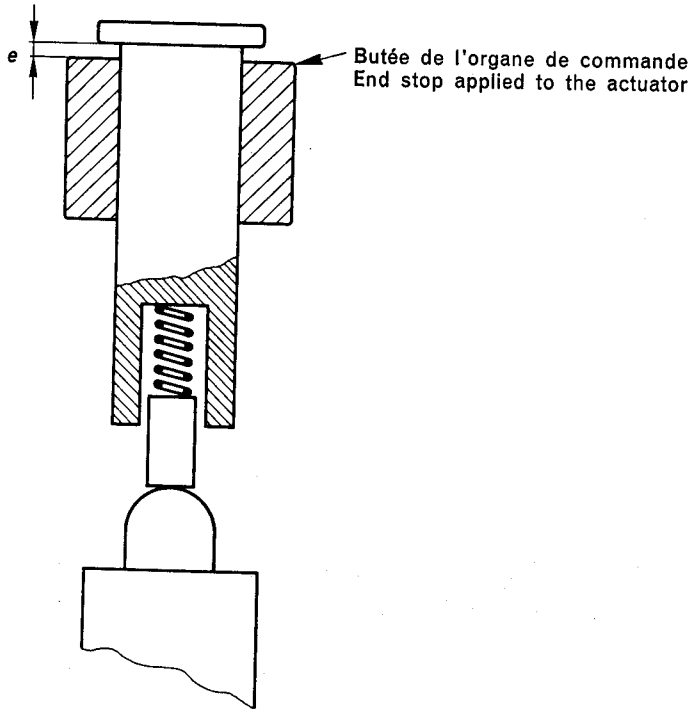

e
Butée de l'organe de commande
End stop applied to the actuator

FIGURE 2