



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS B 9700-1 : 2004

(ISO 12100-1 : 2003)

(JMF)

**Safety of machinery — Basic
concepts, general principles for
design — Part 1: Basic terminology,
methodology**

ICS 01.040.13; 13.110

Reference number : JIS B 9700-1 : 2004 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Health, Labour and Welfare, and the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from the Japan Machinery Federation (JMF) with a draft of Industrial Standard based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

This Standard has been made based on **ISO 12100-1:2003** *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

JIS B 9700 consists of the following 2 parts under the general title “*Safety of machinery — Basic concepts, general principles for design*” :

Part 1: Basic terminology, methodology

Part 2: Technical principles.

A set of standards for safety of machinery has the following structure:

- type-A standards (basic safety standard) giving basic concepts, principles for design, and general aspects that can be applied to all machinery;
- type-B standards (generic safety standards) dealing with one safety aspect or one type of safeguard that can be used across a wide range of machinery:
 - type-B1 standards on particular safety aspects (e.g. safety distances, surface temperature, noise);
 - type-B2 standards on safeguards (e.g. two-hand controls, interlocking devices, pressure sensitive devices, guards);
- type-C standards (machine safety standards) dealing with detailed safety requirements for a particular machine or group of machines.

This Standard is a type-A standard.

Date of Establishment: 2004-11-25

Date of Public Notice in Official Gazette: 2004-11-25

Investigated by: Japanese Industrial Standards Committee

Standards Board

Technical Committee on Industrial
Machinery

JIS B 9700-1 :2004, First English edition published in 2005-01

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

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the original JIS is to be the final authority.

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Printed in Japan

Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Hazards to be taken into account when designing machinery	9
4.1 General	9
4.2 Mechanical hazard	9
4.3 Electrical hazard	10
4.4 Thermal hazard	10
4.5 Hazard generated by noise	10
4.6 Hazards generated by vibration	10
4.7 Hazards generated by radiation	10
4.8 Hazards generated by materials and substances	11
4.9 Hazards generated by neglecting ergonomic principles in machine design	11
4.10 Slipping, tripping and falling hazards	11
4.11 Hazard combinations	11
4.12 Hazards associated with the environment in which the machine is used	11
5 Strategy for risk reduction	11
5.1 General provisions	11
5.2 Specification of the limits of the machine	13
5.3 Hazard identification, risk estimation and risk evaluation	13
5.4 Elimination of hazards or reduction of risk by protective measures	14
5.5 Achievement of risk reduction objectives	15
Annex A (informative) Schematic representation of a machine	18
Index	19
Bibliography	28

Safety of machinery — Basic concepts, general principles for design — Part 1 : Basic terminology, methodology

Introduction This Japanese Industrial Standard has been prepared based on the first edition of **ISO 12100-1** *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology* published in 2003 without modifying the technical contents.

Portions underlined with dots are the matters not stated in the original International Standard.

The primary purpose of **JIS B 9700** is to provide designers with an overall framework and guidance to enable them to produce machines that are safe for their intended use. It also provides a strategy for standard makers.

The concept of safety of machinery considers the ability of a machine to perform its intended function(s) during its lifecycle where risk has been adequately reduced.

The subject of numerous clauses or subclauses of this Standard is also dealt with, in a more detailed manner, in other type-A or B standards.

When a type-C standard deviates from one or more provisions dealt with by Part 2 of this Standard or by a type-B standard, the type-C standard takes precedence.

1 Scope This Standard defines basic terminology and methodology used in achieving safety of machinery.

The provisions stated in this Standard are intended to be used by the designer.

This Standard does not deal with damage to domestic animals, property or the environment.

NOTE : This International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology methodology* (IDT)

2 Normative references The following standards contain provision which, through reference in this Standard, constitute provisions of this Standard. If the indication of the year of publication or the year of coming into effect is given to these referred standards, only the edition of the indicated year constitutes the provision of this Standard but the revision and amendment made thereafter do not apply. The normative references without the indication of the year of publication or the year of coming into effect apply only to the most recent edition (including amendments).

JIS B 9700-2:2004 *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles*

NOTE : **ISO 12100-2:2003** *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles* is identical with the said standard.

JIS B 9702:2000 *Safety of machinery — Principles for risk assessment*

NOTE : **ISO 14121:1999** *Safety of machinery — Principles for risk assessment* is identical with the said standard.

JIS B 9703 *Safety of machinery — Emergency stop — Principles for design*

NOTE : **ISO 13850** *Safety of machinery — Emergency stop — Principles for design* is identical with the said standard.

JIS B 9704-2 *Safety of machinery — Electro sensitive protective equipment — Part 2: Particular requirements for equipment using active opto electronic protective devices (AOPDs)*

NOTE : **ISO 61496-2** *Safety of machinery — Electro-sensitive protective equipment (ESPE) — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)* is identical with the said standard.

JIS B 9960-1:1999 *Safety of machinery — Electrical equipments of machines — Part 1: General requirements*

NOTE : **ISO 60204-1:1997** *Safety of machinery — Electrical equipments of machines — Part 1: General requirements* is equivalent to the said standard.

ISO 13851 *Safety of machinery 'Two-hand control devices' functional aspects and design principles*

ISO 14118:2000 *Safety of machinery — Prevention of unexpected start-up*

ISO 14119 *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

ISO 14120 *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 11689 *Acoustics — Procedure for the comparison of noise-emission data for machinery and equipment*

3 Terms and definitions For the purposes of **JIS B 9700-1** and **-2**, the following terms and definitions apply.

3.1 machinery, machine assembly of linked parts or components, at least one of which moves, with the appropriate machine actuators, control and power circuits, joined together for a specific application, in particular for the processing, treatment, moving or packaging of a material. The terms “machinery” and “machine” also cover an assembly of machines which, in order to achieve the same end, are arranged and controlled so that they function as an integral whole.

NOTE : Annex A provides a general schematic representation of a machine.

3.2 reliability (of a machine) ability of a machine or its components or equipment, to perform a required function under specified conditions and for a given period of time without failing

3.3 maintainability (of a machine) ability of a machine to be maintained in a state which enables it to fulfil its function under conditions of “intended use”, or restored into such a state, the necessary actions (maintenance) being carried out according to specified practices and using specified means

3.4 usability (of a machine) ability of a machine to be easily used thanks to, among others, properties or characteristics that enable its function(s) to be easily understood.

3.5 harm physical injury or damage to health

3.6 hazard potential source of harm

NOTES 1 The term “hazard” can be qualified in order to define its origin (e.g. mechanical hazard, electrical hazard) or the nature of the potential harm (e.g. electric shock hazard, cutting hazard, toxic hazard, fire hazard).

2 The hazard envisaged in this definition:

- either is permanently present during the “intended use” of the machine (e.g. motion of hazardous moving elements, electric arc during a welding phase, unhealthy posture, noise emission, high temperature);
- or may appear unexpectedly (e.g. explosion, crushing hazard as a consequence of an unintended / unexpected start-up, ejection as a consequence of a breakage, fall as a consequence of acceleration / deceleration).

3.7 relevant hazard hazard which is identified as being present as or associated with the machine

NOTE : A relevant hazard is identified as the result of one step of the process described in **JIS B 9702**.

3.8 significant hazard hazard which has been identified as relevant and which requires specific action by the designer to eliminate or to reduce the risk according to the risk assessment

3.9 hazardous situation circumstance in which a person is exposed to at least one hazard. The exposure can immediately or over a period of time result in harm

3.10 hazard zone, danger zone any space within and/or around machinery in which a person can be exposed to a hazard

3.11 risk combination of the probability of occurrence of harm and the severity of that harm

3.12 residual risk risk remaining after protective measures have been taken (see also figure 1)

NOTE : This standard distinguishes:

- the residual risk after protective measures have been taken by the designer;
- the residual risk after all protective measures have been implemented

3.13 risk assessment overall process comprising a risk analysis and a risk evaluation

3.14 risk analysis combination of the specification of the limits of the machine, hazard identification and risk estimation

3.15 risk estimation defining likely severity of harm and probability of its occurrence

3.16 risk evaluation judgement, on the basis of risk analysis, of whether the risk reduction objectives have been achieved

3.17 adequate risk reduction risk reduction at least in accordance with the legal requirements under consideration of the current state of the art

NOTE : Criteria for determining when adequate risk reduction is achieved are given in 5.5.

3.18 protective measure measure intended to achieve risk reduction, implemented (see figure 1.) :

- by the designer (inherently safe design, safeguarding and complementary protective measures, information for use) and
- by the user (organization: safe working procedures, supervision, permit-to-work systems; provision and use of additional safeguards; use of personal protective equipment; training).

3.19 inherently safe design measure protective measure which either eliminates hazards or reduces the risks associated with hazards by changing the design or operating characteristics of the machine without the use of guards or protective devices

NOTE : JIS B 9700-2:2004, clause 4, deals with risk reduction by inherently safe design measures.

3.20 safeguarding protective measure using safeguards to protect persons from the hazards which cannot reasonably be eliminated or from the risks which cannot be sufficiently reduced by inherently safe design measures

NOTE : JIS B 9700-2:2004, clause 5, deals with safeguarding.

3.21 information for use protective measure consisting of communication links (e.g. texts, words, signs, signals, symbols, diagrams) used separately or in combination, to convey information to the user

NOTE : JIS B 9700-2:2004, clause 6, deals with information for use.

3.22 “intended use” of a machine use of a machine in accordance with the information provided in the instructions for use

3.23 reasonably foreseeable misuse use of a machine in a way not intended by the designer, but which may result from readily predictable human behaviour

3.24 safeguard guard or protective device

3.25 guard physical barrier, designed as part of the machine, to provide protection

NOTES 1 A guard may act:

- alone; it is then only effective when it is “closed” for a movable guard or “securely held in place” for a fixed guard;
 - in conjunction with an interlocking device with or without guard locking; in this case, protection is ensured whatever the position of the guard
- 2 Depending on its design, a guard may be called e.g. casing, shield, cover, screen, door, enclosing guard.
- 3 See **JIS B 9700-2:2004, 5.3.2**, and **ISO 14120** for types of guards and their requirements.

3.25.1 fixed guard guard affixed in such a manner (e.g. by screws, nuts, welding) that it can only be opened or removed by the use of tools or destruction of the affixing means

3.25.2 movable guard guard which can be opened without the use of tools

3.25.3 adjustable guard fixed or movable guard which is adjustable as a whole or which incorporates adjustable part(s). The adjustment remains fixed during a particular operation

3.25.4 interlocking guard guard associated with an interlocking device so that, together with the control system of the machine, the following functions are performed:

- the hazardous machine functions “covered” by the guard cannot operate until the guard is closed;
- if the guard is opened while hazardous machine functions are operating, a stop command is given;
- when the guard is closed, the hazardous machine functions “covered” by the guard can operate. The closure of the guard does not by itself start the hazardous machine functions

NOTE : **ISO 14119** gives detailed provisions.

3.25.5 interlocking guard with guard locking guard associated with an interlocking device and a guard locking device so that, together with the control system of the machine, the following functions are performed:

- the hazardous machine functions “covered” by the guard cannot operate until the guard is closed and locked;

- the guard remains closed and locked until the risk due to the hazardous machine functions “covered” by the guard has disappeared;
- when the guard is closed and locked, the hazardous machine functions “covered” by the guard can operate. The closure and locking of the guard do not by themselves start the hazardous machine functions

NOTE : ISO 14119 gives detailed provisions.

3.25.6 interlocking guard with a start function, control guard special form of an interlocking guard which, once it has reached its closed position, gives a command to initiate the hazardous machine function(s) without the use of a separate start control

NOTE : JIS B 9700-2:2004, 5.3.2.5, gives detailed provisions regarding the conditions of use.

3.26 protective device safeguard other than a guard

NOTE : Examples of protective devices are given in 3.26.1 to 3.26.9.

3.26.1 interlocking device, interlock mechanical, electrical or other type of device, the purpose of which is to prevent the operation of hazardous machine functions under specified conditions (generally as long as a guard is not closed)

3.26.2 enabling device additional manually operated device used in conjunction with a start control and which, when continuously actuated, allows a machine to function

NOTE : JIS B 9960-1:1999, 9.2.5.8, gives detailed provisions on enabling devices.

3.26.3 hold-to-run control device control device which initiates and maintains hazardous machine functions only as long as the manual control (actuator) is actuated

3.26.4 two-hand control device control device which requires at least simultaneous actuation by both hands in order to initiate and to maintain hazardous machine functions, thus providing a protective measure only for the person who actuates it

NOTE : ISO 13851 gives detailed provisions.

3.26.5 sensitive protective equipment (SPE) equipment for detecting persons or parts of persons which generates an appropriate signal to the control system to reduce risk to the persons detected. The signal may be generated when a person or part of a person goes beyond a predetermined limit — e.g. enters a hazard zone — (tripping) or while a person is detected in a predetermined zone (presence sensing), or in both cases

3.26.6 active opto-electronic protective device (AOPD) device whose sensing function is performed by opto-electronic emitting and receiving elements detecting the interruption of optical radiation, generated within the device, by an opaque object present in the specified detection zone

NOTE : JIS B 9704-2 gives detailed provisions.

3.26.7 mechanical restraint device device which introduces into a mechanism a mechanical obstacle (e.g. wedge, spindle, strut, scotch) which, by virtue of its own strength, can prevent any hazardous movement

3.26.8 limiting device device which prevents a machine or hazardous machine condition(s) from exceeding a designed limit (e.g. space limit, pressure limit, load moment limit)

3.26.9 limited movement control device control device, a single actuation of which, together with the control system of the machine, permits only a limited amount of travel of a machine element

3.27 impeding device any physical obstacle — e.g. low barrier, rail — which, without totally preventing access to a hazard zone, reduces the probability of access to this zone by offering an obstruction to free access

3.28 safety function function of a machine whose failure can result in an immediate increase of the risk(s)

3.29 unexpected start-up, unintended start-up any start-up which, because of its unexpected nature, generates a hazard. This can be caused by, e.g.:

- a start command which is the result of a failure in, or an external influence on, the control system;
- a start command generated by inopportune action on a start control or other parts of the machine as, e.g., a sensor or a power control element;
- restoration of the power supply after an interruption;
- external / internal influences (e.g. gravity, wind, self-ignition in internal combustion engines) on parts of the machine

NOTE : Machine start-up during normal sequence of an automatic cycle is not “unintended”, but can be considered to be “unexpected” from the point of view of the operator. Prevention of accidents in this case involves the use of safeguarding measures (see **JIS B 9700-2:2004**, clause 5).

[from **ISO 14118:2000**, 3.2]

3.30 failure to danger any malfunction in the machinery, or in its power supply, that increases the risk

3.31 fault the state of an item characterized by inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources

NOTES 1 A fault is often the result of a failure of the item itself, but may exist without prior failure (see **IEV 191-15-01** of **IEC 60050**).

2 In practice, the terms “fault” and “failure” are often used synonymously.

3.32 failure the termination of the ability of an item to perform a required function