

Guideline for Designing Warning Labels for Machine Tools

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Japan Machine Tool Builders' Association

Guideline for Designing Warning Labels for Machine Tools

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Foreword (Explanation)

In 2015, the Electrical and Safety Standards Committee of the Japan Machine Tool Builders' Association raised a concern about Japanese machine manufacturers using warning labels in various formats and suggested a necessity to standardize warning labels. Accordingly, it was decided to establish a working group under the Expert Committee to prepare a guideline.

1. Introduction

This Guideline aims to prevent harm to the human body and damage to properties by standardizing to the extent possible indication (warning labels) about safe use of machine tools to make them easier for users to understand. For that purpose, this Guideline helps obtaining necessary information about the design of warning labels.

Warning labels must be selected in accordance with the laws, regulations, standards, etc. of the country or region where the relevant machine tool is/will be used. However, two types of warning labels following the standards set by ANSI and ISO have already been used for machine tools, and such warning labels are broadly accepted and used around the world. Therefore, in this Guideline, we decided to recommend ANSI-type warning labels widely used in Japan, and to describe special matters to be noted from ISO-type warning labels as supplementary information.

Compatibility between ANSI and ISO standards

While ISO standards have no mention about the content of ANSI standard or differences from them, ANSI standards describe differences from ISO standards where necessary.

Example 1: ANSI Z535.4 describes that labels in a format compliant with ISO 3864-2 Annex C may be used.

Example 2: ANSI Z535.3 and Z535.4 describe that, regarding the triangular marks to be placed in front of the word “Danger”, “Warning”, “Caution”, etc., in addition to those stipulated by the ANSI standards, display methods stipulated by ISO 3864-2 etc. can also be used.

2. Scope

This Guideline applies to the design of warning labels to be used on machine tools and their peripheral equipment used in Japan and overseas. However, this Guideline does not apply to individual devices (e.g., motors) used inside a machine tool or its peripheral equipment.

3. Reference Standards and Related Laws

3.1 International standards

ISO 3864-1	Graphical symbols — Safety colors and safety signs — Part 1: Design principles for safety signs and safety markings
ISO 3864-2	Graphical symbols — Safety colors and safety signs — Part 2: Design principles for product safety labels
ISO 3864-3	Graphical symbols — Safety colors and safety signs — Part 3: Design principles for graphical symbols for use in safety signs
ISO 7010	Graphical symbols — Safety colors and safety signs — Registered safety signs

3.2 Japanese standards and related laws

- JIS Z9101 Safety colors and safety signs -- Design principles for safety signs in workplaces and public areas
- JIS Z9103 Safety colors -- General specifications
- JIS Z9104 Safety signs -- General specification

3.3 American standards and related laws

- ANSI Z535.1 Safety Colors
- ANSI Z535.3 Criteria for Safety Symbols
- ANSI Z535.4 Product Safety Signs and Labels

3.4 Chinese national standards and related laws

- GB 2893 (Safety colors)
- GB/T 2893.1 (equivalent to ISO 3864-1)
- GB/T 2893.2 (equivalent to ISO 3864-2)
- GB/T 2893.3 (equivalent to ISO 3864-3)
- GB 2894 (Safety Signs and Guideline for the Use)
- GB 5296 series (standards related to labeling of products of consumer interest)
- GB/T 9969 (standards related to labeling of industrial products)
- Product Quality Law
- Law on the National Common Language
- Product Labeling Requirements

3.5 South Korean standards and related laws

- KSA 3502 General Rules of the Use of Safety Colors
- KSA 3510 Safety Labeling

4. Basic Concept of Warning labels

4.1 General

A warning label shall be used for a case where risk remains in a product even after taking all possible technical measures to reduce the risk, especially designing the product in accordance with safety standards. Use of a warning label as a substitute for inherently safe design, safeguarding, or complementary protective measures is not permitted under international and Japanese standards. In Western countries, in the USA in particular, if a warning label is used on a product even though safeguarding is possible, it will be regarded as a defect by design and product liability (PL) will be strictly pursued. European countries have high safety awareness and recognize that “A warning label indicates a defect (defect by design)”. Therefore, a decision to attach warning labels shall be carefully made.

In safe design of a product, in order to achieve the safety of the product, risk assessment and the three-step method are to be used.

See 4.2 *Risk assessment* and 4.3 *Three-step method* for details.

Warning labels shall be regarded as the last resort for a manufacturer to relay safety messages to users who are unable to read the user’s manual because the product was sold as a secondhand product or for other reasons.

4.2 Risk assessment

In risk assessment, the following procedures are repeated to reduce risk to the extent possible:

- (1) determination of the limits of the machinery;
- (2) identification of the hazard and associated hazardous situations;
- (3) risk estimation;
- (4) evaluation of the need for risk reduction;
- (5) risk reduction by protective measures;
- (6) reevaluation to check whether the risk has been adequately reduced.

4.3 Three-step method

The protective measures in Section 4.2 (5) are referred to as the three-step method, and the three steps below shall be applied in the following sequence.

Step 1: Inherently safe design measures

Step 2: Safeguarding and complementary protective measures

Step 3: Information for use (warning labels, user's manual, etc.)

Warning label is included in Step 3: Information for use, which is in the lowest priority of measures to apply. This however does not imply that the importance of warning labels is low.

4.4 Objective of warning label

The relationship between risk assessment, the three-step method and risk reduction process is shown in Figure 1.

Reduction of the risk can be expected when the user appropriately implemented measures based on the content of warning labels, warning devices and instruction manuals provided as the information for use.

Risk reduction process

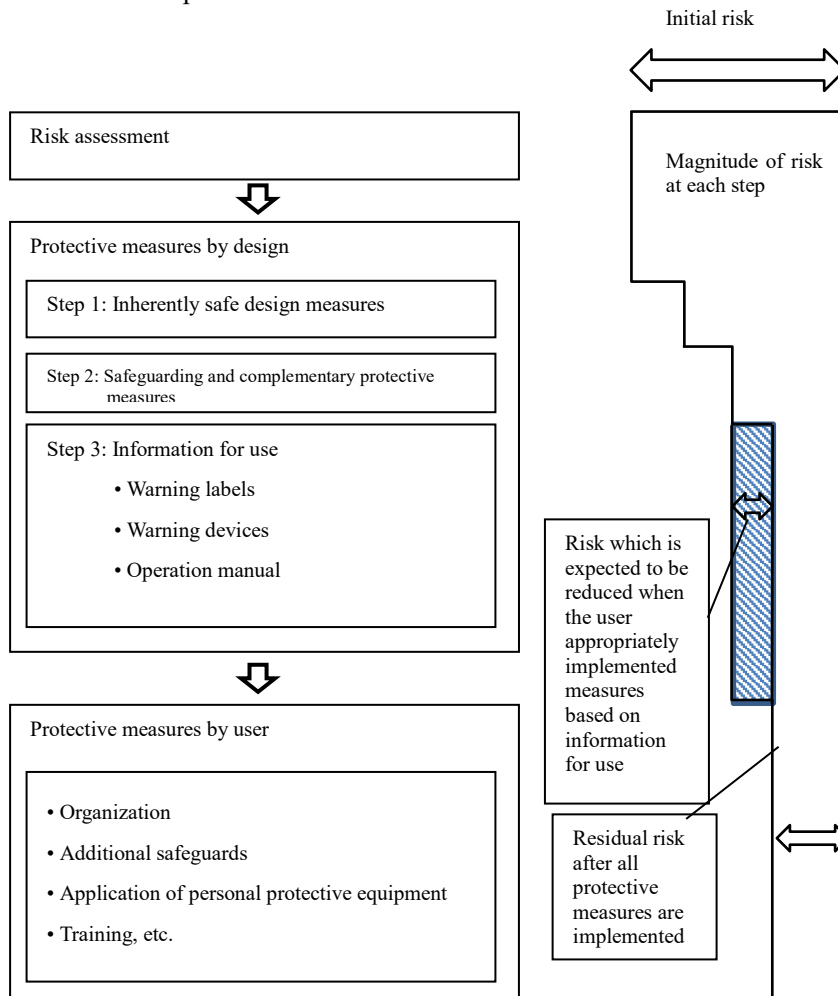


Figure 1 Risk reduction process from point of view of designer

4.5 Matters to be considered for warning labels

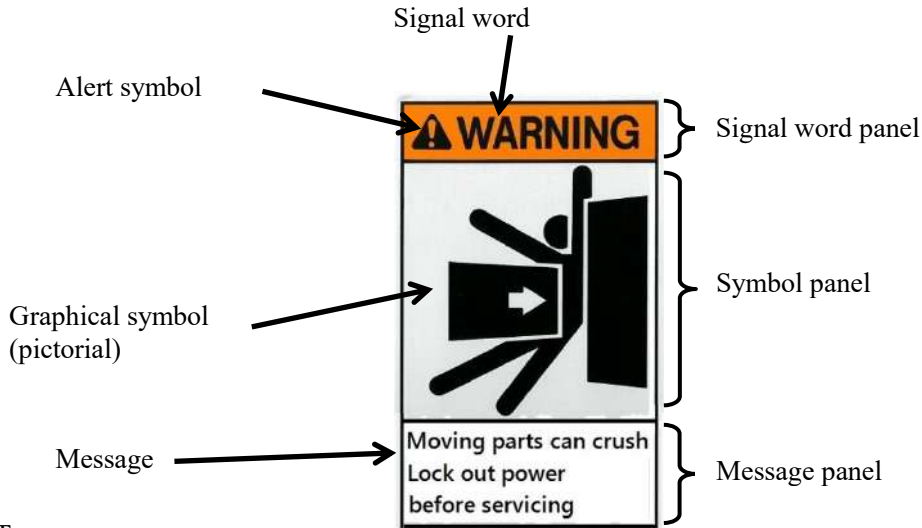
When designing a warning label, considerations shall be given to the following points:

- (1) intended use in all operating modes of the machine;
- (2) the need for personal protective equipment;
- (3) reasonably foreseeable misuse;
- (4) symbols and written warnings shall be readily understandable and unambiguous, in regards to the part of the function(s) of the machine to which they are related; for example, use of standardized wordings and symbols;
- (5) symbols should generally be used in place of written warnings, but only when such symbols are readily understandable by operators;
- (6) written warnings shall be drawn up in the language(s) understood in the country or region in which the machine will be used.

5. Name of Sections of Warning labels

The name of sections of an example warning label is shown below.

(This example is a warning label that shows hazard inside a protective cover at the back of a machine)



6. Layout Types

6.1 General

In Europe, labels with a symbol only without letters are mainly used to avoid the necessity of addressing multiple languages used in the region.

However, labels with a symbol only may cause misunderstandings if they are used in regions where the symbol has not been used in the culture. Taking that into account, in order to make warning labels easy to understand by users and to eliminate the possibility of misunderstandings, this Guideline recommends labels with 3 panels where symbols are shown along with written messages.

If labels with a symbol only are to be used, the meaning of the symbols shall be described in the user's manual.

6.2 Labels with a symbol only

It is recommended to use those specified by ISO, but they should not be used unless they are generic. Some studies indicate that people do not correctly recognize safety symbols in Europe.

For instance, only 24% of subjects correctly recognized the skull and crossbones mark used for indicating a substance is toxic.

Examples of symbol-only warning labels are shown below.

6.2.1 Examples of labels with a symbol only expressing hazards



Electric shock hazard



Laser radiation hazard

6.2.2 Examples of labels with a symbol only expressing prohibited acts



Do not step on



Do not touch

6.2.3 Examples of labels with a symbol only expressing enforcements



Wear gloves

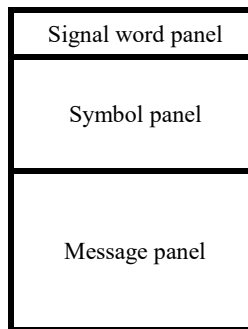


Wear ear protection

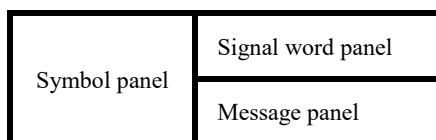
6.3 Labels with 3 panels

6.3.1 In a single language

A case where panels were arranged vertically

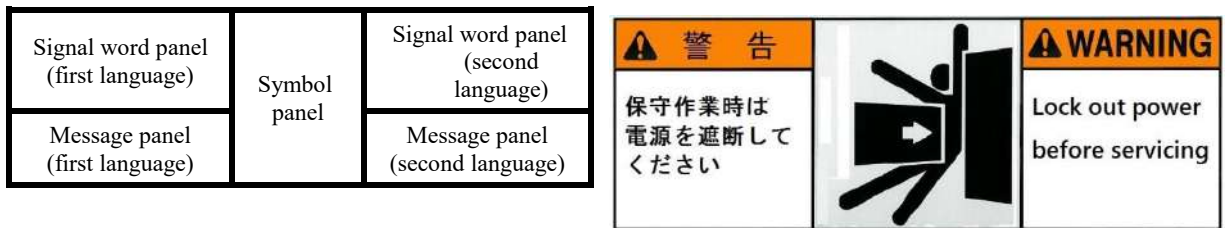


A case where panels were arranged vertically next to a symbol panel

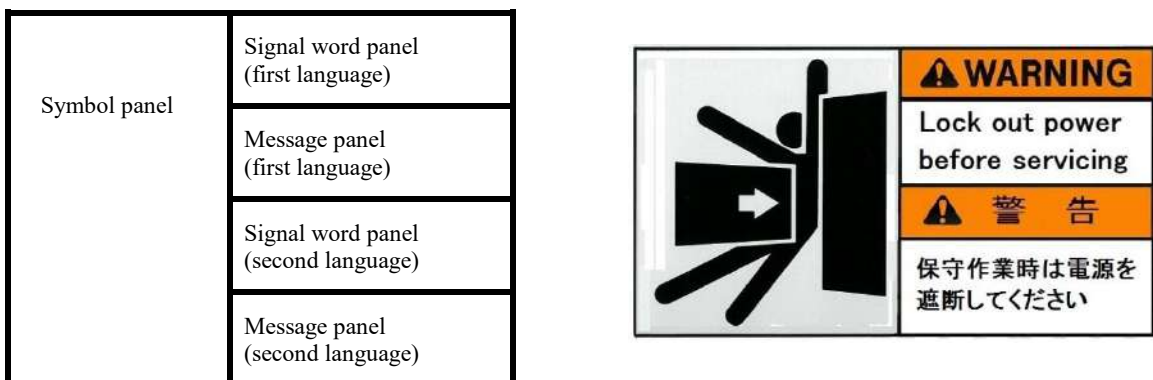


6.3.2 In multiple languages

A case where panels with different languages were arranged vertically on both sides of a symbol panel



A case where panels with different languages were arranged vertically next to a symbol panel



The format of placing two languages in one frame is actually used quite often, but this format is not specified by any standard and if for example a warning written in English is shown alongside a warning written in Japanese, the warning written in Japanese is merely a hindrance to read the written warning for persons who can read English only.

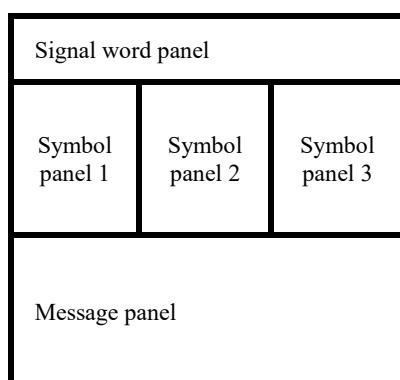
In a certain court case, such warning labels were shown to an American jury and the jury stated that they were “hard to read”.

Therefore, considering the ease of reading, it is preferred to adopt a format which uses different frames for different languages, unless special circumstances indicate otherwise.

6.3.3 Labels with multiple symbol panels

In principle, warning labels are to be individually attached to places near locations with danger. However, in a PL trial case where multiple warning labels were attached to one place, the court learned that the labels caused ignorance of warning by users due to the cluster of information and didn't serve their intended functions as warning labels.

In cases where the use of multiple warning labels can be regarded as a cluster of information, a warning label in which multiple symbols are placed can be used, but the signal word to express the level of risk must be the same.



7. Signal Word Panel

7.1 Determination of the risk

A signal word of a warning label is selected according to the risk of harm presented by the hazardous situation that the label addresses.

The risk is determined based on:

- worst credible severity of harm if an accident occurs;
- probability of an accident if the hazardous situation occurs;
- probability of the worst credible severity of harm occurring if an accident occurs.

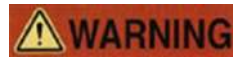
7.2 Selection of signal word and alert symbol

The types of signal words, their meaning and colors used are shown below.

Signal word (Japanese)	Signal word (English)	Description	Coloring
		Indicates a hazardous situation which, if not avoided, will almost certainly result in death or serious injury.	Background: red Triangle and letters: white Exclamation mark: red
		Indicates a hazardous situation which, if not avoided, could result in death or serious injury.	Background: orange Triangle and letters: black Exclamation mark: orange
		Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.	Background: yellow Triangle and letters: black Exclamation mark: yellow

<p style="text-align: center;">通告</p>	<p style="text-align: center;">NOTICE</p>	<p>Addresses practices not related to personal injury</p>	<p>Background: blue Letters: white</p>
<p style="text-align: center;">安全指示</p>	<p style="text-align: center;">SAFETY INSTRUCTIONS</p>	<p>Indicates specific instructions or procedures related to the safety.</p>	<p>Background: green Letters: white</p>

Regarding the colors of an alert symbol (a triangle with an exclamation mark inside) to be placed on the left of letters in the signal word panel, ISO standards (ISO 3864-2) specify the use of an alert symbol colored in yellow and black and background colors as shown below instead of using background colors or white as shown above.



This coloring makes warning labels more complex, and this Guideline recommends coloring as shown in the table above.

7.3 Letter size of signal word

Signal word letter height should be 150% or larger than the height of the majority of letters in the message panel. (See Section 9.3.3)

If space is limited, it can be the same as the height of the majority of letters in the message panel.

7.4 Points to be noted when determining a signal word

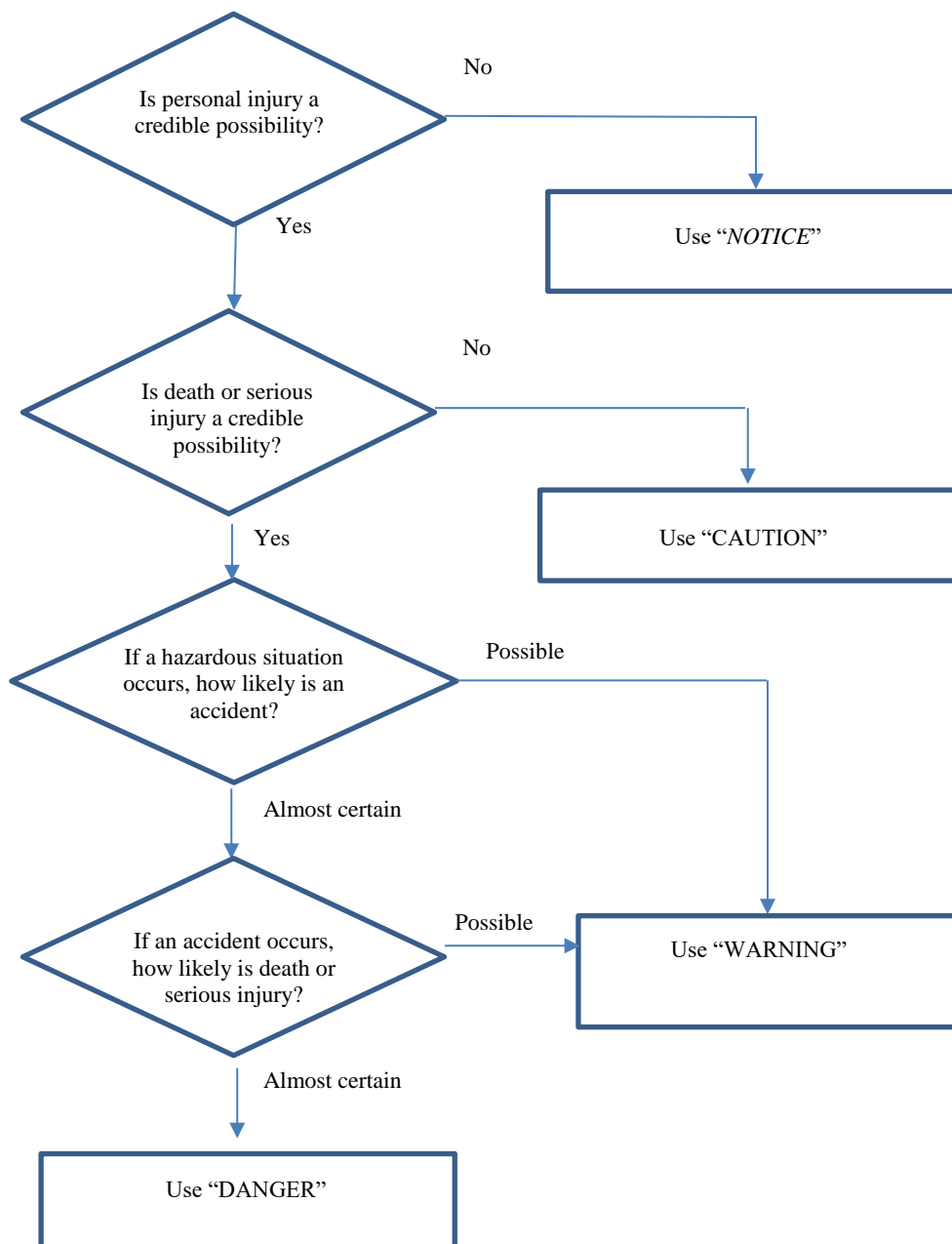
For a machine for which different operating modes can be selected, a signal word shall be selected assuming operation in an operating mode with the highest risk.

If a guard is to be removed for maintenance work, a signal word shall be selected taking into account the risk under such situations.

Note: If a guard is to be opened during normal work or scheduled inspection, considerations shall be given to installation of an interlock.

7.5 Process of signal word selection




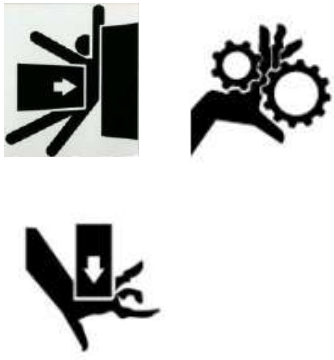






A signal word is selected following the flow shown below.



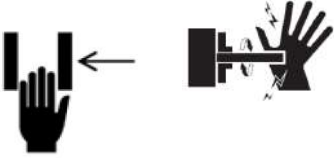



















7.6 Examples of signal word selection



Examples of signal word selection are shown below, but selection may be different or warning labels may become unnecessary depending on the size of machine, processing conditions, protective measures, results of risk assessment, etc.

Examples of signal words common for various machines






No.	Hazardous situation Graphical symbol (example)	Signal word	Remarks
1	<p>Electric shock by touching a live part inside a control board or at a peripheral wiring part</p> 		When work is conducted while exposing a live part of an electrical machine, the user's body may come into contact with the live part.
			If equipment inside the board is protected by a protective cover, and if workers are limited to experts or qualified persons on electrical parts handling, the workers have adequate knowledge of the live part and the possibility of electric shock is low.
2	<p>Colliding, crushing, or cutting by a moving part inside a maintenance cover</p> 		If a large moving part is operating inside a maintenance cover or a door, or if a moving part is traveling at high speed, placing a hand or the body into such a section may cause death or serious injury.
			If cutting etc. does not occur and only minor injury such as rubbing occurs at the moving part inside.
3	<p>A hand getting caught at a chip discharging area of a chip conveyor</p> 		If a hand can reach the moving part from the discharging area, the hand gets caught by the rotating part.
4	<p>Getting crushed by falling or movement of a gravity axis when a part (e.g., ball screw, servo motor, brake) of the gravity axis was removed for disassembling or repair</p> 		Repair, disassembling, etc. may not always be carried out by workers who understand the structure of the machine or hazards, and warning labels need to be designed assuming the skill level of potential workers and associated risks.


5	<p>Falling while disassembling or repairing at a high place</p> 		<p>For work at places with a risk of falling, insist on the use of protective devices for fall prevention.</p>
6	<p>Moving part inside a machine (during setting work)</p> <ul style="list-style-type: none"> • A hand or clothing getting caught in the rotating spindle • A hand getting crushed at the axis moving part • Getting caught at a wiper or moving part of a chip conveyor • Getting caught in the pallet changer    		<p>If work can be performed under a door-opened condition, there is a possibility of injury such as getting caught or crushed.</p>
			<p>If operation under a door-opened condition is limited to workers with adequate knowledge and if additional protective measures (e.g., enabling device) complying with safety standards are taken, the possibility of an accident is low.</p> <p>Regarding workers with adequate knowledge, the machine manufacturer shall specify required knowledge levels in the user's manual.</p>
7	<p>Prohibition of unauthorized modification</p>		<p>Users must not change settings or modify a machine without consulting the manufacturer of the machine.</p>

8	<p>Injury due to breaking of a cover when a person gets on it</p>		<p>Injury due to breaking when a person gets on a part for which getting on is not expected</p> <p>Note: Use “WARNING” for work at a high place.</p>
9	<p>Slipping and falling inside a machine</p> 		<p>A person slips on coolant or oil and falls</p>
10	<p>Injury of hand by coming in contact with a chip</p>		<p>When a hand may directly contact a long or pointed chip</p>
11	<p>Injury of hand by coming in contact with a tool edge</p> 		<p>When a hand may directly come in contact with a pointed edge or sharp part</p> <p>Note: It is considered that a warning is not needed for obvious danger such as the blade of a knife. Therefore, if there is no risk other than tool edges (e.g., dropping of a tool, fingers getting caught at the tool holding area), warning labels are not needed.</p>
12	<p>Getting crushed by a power-operated door</p> 		<p>Warning labels are not needed if the risk is adequately reduced by implementing protective measures (e.g., function to stop the closing movement or initiate reopening when contact is detected while closing the door).</p>
13	<p>Injury by a metal part which is attracted by a magnet of linear motor</p>  		<p>Metals are abruptly attracted to a strong magnet, making it impossible to avoid damage such as fingers getting crushed.</p> <p>Note: In some cases, “WARNING” on personal injury for persons using a pacemaker or “NOTICE” for damage to electronic devices are needed.</p>


14	<p>Instruction to wear personal protective equipment</p> 	<p>SAFETY INSTRUCTIONS</p>	<p>Wearing of ear protection against noise, goggles for protecting eyes, etc.</p>
15	<p>Instruction to carefully read the user's manual</p> 	<p>SAFETY INSTRUCTIONS</p>	<p>Read through the user's manual before using the machine.</p>

Examples of signal words for turning machines



No.	Hazardous situation Graphical symbol (example)	Signal word	Remarks
16	<p>Impact by rotating bar material which protruded from the back of spindle</p> 		<p>Protrusion of bar material is prohibited.</p> <p>While a bent large-diameter bar material is rotating, if the person approaches the bar material without any notice, the person may receive a major impact on the head, etc.</p> <p>Describe the use of a bar feeder or support in the user's manual.</p> <p>Adopt a structure which mechanically prevents protrusion of bar materials. (e.g., use of a cover)</p> <p>Note: In a PL lawsuit case, the court heard that "It is the machine manufacturer who can provide an ideal safety guard at a low price".</p>
			<p>If the bar material is thin, or the rotation speed is low, the chance of a person coming in contact with it becomes low and the impact by the bar material becomes small, making the degree of harm low.</p>
17	<p>Bruising of the face by a deformed vision panel due to an impact of a workpiece which was ejected inside a machine</p> 		<p>Polycarbonate materials absorb energy when they stretch and therefore readily deform outward due to energy of a scattered workpiece or chuck. If someone's face is close to the deformed vision panel, it will receive an impact.</p>

18	Forgetting to attach protective parts 	NOTICE	For sections of driving mechanism parts which may become stained, malfunction or break when the machine is operated without attaching a cover to prevent intrusion of chips or coolant.
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Examples of signal words for machining centers

No.	Hazardous situation Graphical symbol (example)	Signal word	Remarks
19	Getting caught by rotation of the spindle while tightening the milling chuck on the spindle	 WARNING	Work to tighten a cutting tool on the tool holder attached to the spindle while electronically maintaining a fixed position by the machining center. Normally this work is prohibited, and it is considered misuse.
20	Breaking of machine parts by attaching a tool in a wrong direction	NOTICE	In cases where failure or breaking of a mechanical part could occur.



Examples of signal words for grinding machines

No.	Hazardous situation Graphical symbol (example)	Signal word	Remarks
21	Contact with a rotating abrasive product	 WARNING	If work can be performed under a door-opened condition, there is a possibility of coming in contact with or getting caught by the abrasive product.
		 CAUTION	If setting work is limited to experienced workers and if additional protective measures (e.g., enabling device) complying with safety standards are taken, the possibility of an accident is low. (Regarding the conditions for experienced workers, it is the machine manufacturer's responsibility to describe them in the user's manual.)

Examples of signal words for electrical discharge machines

No.	Hazardous situation Graphical symbol (example)	Signal word	Remarks
22			Electric shock by touching a live wire
			Electric shock by touching a waste wire protruding from the collection box.
23			Burning by touching a wire which became hot due to electric current for wire cutting operation.
24	Slipping and falling of a worker due to leaking of oil on the floor around the machine		In cases where oil could leak from the oil tank in which a work piece is installed.

Examples of signal words for other machines

No.	Hazardous situation Graphical symbol (example)	Signal word	Remarks
25	Damage to the eyes by a laser beam entering the eyes		If an invisible laser beam used for processing potentially enters the eyes, it must be addressed by design. It must not be addressed with only a warning label.
			In cases where a weak laser beam for measuring enters the eyes

8. Symbol Panel

8.1 Classification of symbols and how to draw the frame

8.1.1 Symbols expressing hazards

A hazard shall be displayed by showing the hazard in black in a yellow equilateral triangle with a black frame.



(Labels with a symbol only)



(Label with 3 panels)

For the label with 3 panels, there is no need to use a yellow triangle frame. The symbol expressing the hazard shall be directly placed in the symbol panel.

Symbols drawn in the symbol panel of a label without using a special frame are all regarded as hazard.

In this case, the symbol shall be drawn in black on a white background.



8.1.2 Symbols expressing prohibited acts

For prohibited acts, the symbol of the act to be prohibited is drawn in black on a white background, with a red circle with a red 45° diagonal line running from the left top to the right bottom of the circle overlaying it.



(Label with a symbol only)



(Label with 3 panels)



8.1.3 Symbols expressing enforcements

Enforcements are to be shown in a white symbol drawn in a blue-filled circle.



(Label with a symbol only)



(Label with 3 panels)



8.2 How to draw a human figure

Representation of the human form must be simple, consistent, and believable.

Interpretation must be instant and must not require the viewer to study the symbol to determine what part of the body is involved.

The human figure's specific position used in the safety symbol is usually determined by:

- a. The type of the hazard;
- b. The direction or orientation of the hazard;
- c. Movements or positions resulting from involvement with the hazard;
- d. The type of injury caused by the hazard;
- e. Movements or positions involved in the operation of machine.

See Material E in Supplementary Materials for details about how to draw a human body.

8.3 Size of symbols

The symbol should be sufficiently visible and legible at a distance from the warning label.

Generally, the recommended minimum height, h (mm), of a symbol can be calculated from the following equation. (According to ISO 3864-2 2004(previous edition))

$$h = D/40 \quad \text{where } D \text{ is the minimum safe viewing distance (mm)}$$

For the minimum safe viewing distance, see 9.4 Letter size

9. Message Panel

9.1 Content of message

The message must communicate information to the viewer on the type of typical hazard, the consequence of not avoiding the hazard and how to avoid the hazard, and must sufficiently communicate the originally intended content.

The message is required to be written so that it can be understood by the worker. This means choosing words that accurately describe the specific hazard and avoidance information in terms the intended workers can understand.

9.2 Layout order of content of message

If users of the machine need to be notified of a potential hazard, the type of hazard should be placed before the hazard avoidance information. If users of the machine need to immediately follow the avoidance information, the avoidance information should be placed first.

The order of the content is to be determined by the importance of element, and the avoidance information must not be haphazardly placed first.

<p>Danger of crushing and cutting</p> <ul style="list-style-type: none">• Do not enter while in use• Lockout power before entering for maintenance

<p>Danger of ejection</p> <ul style="list-style-type: none">• Do not start while the door is open• Do not open the door while operating• Do not stand in front of a rotating part

Examples of hazard written first

Wear safety belt

Danger of slipping or falling during work

Close door

Danger of slipping on scattered chips and coolant

Examples of action/avoidance information written first

9.3 Structure of message

For the message, active and assertive expressions that directly describe actions should be used. The length of the message depends on the amount of information that needs to be communicated to the workers to allow them to understand and avoid the hazard. Once this information is determined, it should be written and formatted in a manner that is concise and easily understood. The following are several principles that can be applied to the message to achieve this objective.

9.3.1 Separation of message content

To enhance readability, the message should be arranged in an outline format. For separation of a message, the use of bullet points is recommended.

Moving parts can crush and cut.

- Do not enter while operating
- Lockout power before entering

Separation using bullet points
(Recommended)

Moving parts can crush and cut.
Do not enter while operating.
Lockout power before entering.

Arrangement without bullet points
(Can be used)

Moving parts can crush and cut. Do not enter while operating. Lockout power before entering.

Continuous writing
(Not recommended)

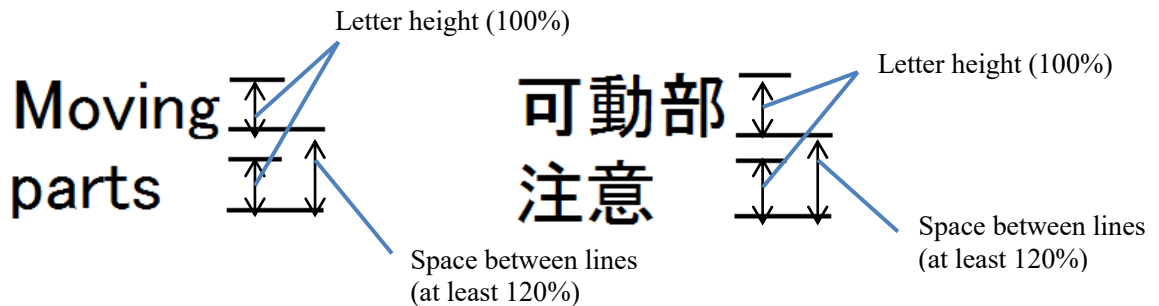
9.3.2 Text justification

Left aligned “ragged right” text should be used for all but one-line messages. Left alignment aids in readability by creating a vertical line that the eye naturally locates when searching for the next line of text. Justified text should be avoided because the added space between words makes it more difficult to read.

9.3.3 Type style

Sans serif styles should be used for text.

Space between lines (height from the bottom of a text to the bottom of a text on the next line) should be at least 120% of the height of the letters.



9.3.4 Coloring of message panel

While ISO and ANSI standards accept both “black type on a white background” and “white type on a black background”, “black type on a white background” is to be used in this Guideline since the Chinese GB standards specify the use of “black type on a white background”.

9.4 Letter size

Legibility at the minimum safe viewing distance determines the proper letter size for the message.

The minimum safe viewing distance refers to the distance a person can be from the warning label and still have time to follow the warning label’s message to avoid the hazard.

The letter sizes shown here indicate the recommended letter size. Letter size may need to be larger for various reasons like:

- to obtain conspicuousness from other information;
- to facilitate legibility under low light, or other unfavorable viewing conditions;
- to warn persons at distances greater than the minimum safe viewing distance;
- to convey special emphasis for portions of the message;
- to facilitate legibility for people who have difficulty reading small text.

A formatted label should be visually examined in the environment expected for actual use (lighting, background, angle, etc.), and tested for legibility in that environment by persons representative of the expected viewers. If the reading condition is unfavorable, the height of letters is to be determined by Equation (4).

Recommended letter height

Minimum safe viewing distance (mm)	Recommended letter height (mm)
300	2
600	4
900	4.8
1500	6.3
3000	10

When the minimum safe viewing distance is no greater than 600 mm:

$$\text{Letter height (mm)} = \text{Minimum safe viewing distance (mm)} / 150 \quad \text{Equation (1)}$$

When the minimum safe viewing distance is greater than 600 mm but not greater than 6000 mm:

$$\text{Letter height (mm)} = (\text{Minimum safe viewing distance (mm)} / 304.8 - 2) \times 0.76 + 4.06 \quad \text{Equation (2)}$$

When the minimum safe viewing distance is greater than 6000 mm:

$$\text{Letter height (mm)} = \text{Minimum safe viewing distance (mm)} / 343.2 \quad \text{Equation (3)}$$

Recommended letter height for unfavorable reading conditions

$$\text{Letter height (mm)} = \text{Minimum safe viewing distance (mm)} \times 0.007 \quad \text{Equation (4)}$$

10. Colors to Be Used in Warning labels

For colors used in warning labels, the color codes described in Material D are recommended.

11. Warning label Attaching Position

Warning labels should be placed to positions that satisfy the conditions below.

(1) Readily visible position

To be within the visual field of users taking into account their work procedures.

To be clearly visible from all potential points of view (work location or within danger zone)

(Warning labels shall be located at the field of vision within 30° downward and 25° to the left and right from workers in the normal posture.)

Not to be obstructed by a moving object or opening/closing of doors.

A warning label shall be attached to such a position that the label automatically comes into visual field of machine users or maintenance personnel to eliminate the possibility of such persons not noticing the label.

(2) Position that comes into visual field and enables taking act to avoid harm before a dangerous situation is created

(3) Do not attach to objects (e.g., safety cover) which are removed during maintenance and may not be returned to the original position. Attach to a position that automatically comes into visual field near a safety cover.

(4) Basically fixed parts are preferred to moving parts

(5) Position that easily identify hazards (e.g., near the hazard)

(6) Protected place

To be at a place protected from damage due to collision/contact with other objects, chips, etc. while taking discoloration due to lubricating oil, cutting oil, UV etc. and degradation due to chemical change into account.

12. Warning label Life Extension and Fixing Methods

In principle, warning labels shall not become illegible or come off in the expected life time the product will be used and expected use environment.

Protective treatment (e.g., coating) should be applied to the label surface.

Labels shall basically be attached by an adhesive, but fixing methods by rivets or screws shall be considered if the label may be subjected to an external force (including friction) or projectiles.

13. User's Manual

Regarding warning labels, the information below shall be included in the user's manual.

(1) Type of signal word and its meaning

(2) Type of symbol and its meaning

(3) Attached position and drawing of the warning label

(4) Procurement information

- Information about procurement of the warning label (e.g., model number of the label, ordering number) shall be included in the user's manual so that users of the machine can obtain and attach an equivalent label or replace the label when, for example, the label comes off or becomes difficult to read due to the use environment of the machine or direct external forces.

Note: The information shall be provided to the user according to the "Guidance related to the residual risk" issued by the Ministry of Health, Labor and Welfare (MHLW) in Japan.

Detailed format of provided information are available at the websites of MHLW.

Meanwhile, in some cases the list of residual risks listed above can be handled as "a defect by design" in a lawsuit on product safety, and a list of residual risks may be regarded by trial lawyers as the perfect material to attack the manufacturer.

Therefore, risk assessment must be thoroughly conducted to sufficiently narrow down residual risks.

Supplementary Materials

Material A Comparative list of terms used in this Guideline and other standards

Term used in this Guideline	Term used in ANSI standard		Term used in ISO standard	
	English expression (original)	Japanese translation	English expression (original)	Japanese translation
Panel	Panel	区画	Panel	パネル
Signal word panel	Signal word panel	シグナル・ワード区画	Hazard severity panel	潜在危険の重大度パネル
Symbol (graphical symbol) panel	Safety symbol panel	安全記号区画		
Message panel	Message panel	メッセージ区画	Supplementary safety information panel	補足安全情報パネル
Graphical symbol	Pictorial	絵図	Graphical symbol	図記号
Alert symbol	Safety alert symbol	安全警告記号	General warning sign	一般警告記号

Material B Expression of signal word in various languages

Examples for main languages are shown below.

Signal word Language	DANGER	WARNING	CAUTION	NOTICE	SAFETY INSTRUCTION
Japanese	危険	警告	注意	通告	安全指示
Chinese (Simplified)	危险	警告	注意	公告	安全提示
Chinese (Taiwanese)	危險	警告	注意	公告	安全提示
Korean	위험	경고	주의	통보	안전 지침
Thai	อันตราย	คำเตือน	ข้อควรระวัง	แจ้งให้ทราบ	คำแนะนำความปลอดภัย

Material C Expressions in English

Expressions in English should be written and formatted in a manner that is concise and easily understood. The following are several principles for that purpose.

C.1 Use of headline style

Eliminate nonessential words to make it concise. Omit pronouns (this, that, they), articles (a, the, an), and forms of the verb “to be” (is, are, were) as much as possible. Avoid the use of hyphens (-).

Moving parts can crush and cut.
Keep guard in place.
Lockout power before servicing

Example text in headline style

This machine has moving parts
that can crush and cut. Keep the
guard in place while operating
this machine. Before servicing is
performed, lockout power.

Example text not in headline style

C.2 Use of active voice

Write sentences in active voice, rather than passive voice. The subject “you” or “your” can be inferred from the sentence and is unnecessary.

Keep hands away from rotating
blade.
Lockout power before servicing
equipment.
Immediately replace guards after
repair or adjustment.

Example of active voice sentences

Your hands must be kept away from
rotating blade.
Power must be locked out before
servicing equipment.
After repair and adjustment,
immediately replace guards.

Example of passive voice sentences

C.3 Omission of prepositional phrases

Use prepositional phrases as little as possible.

Disconnect power to service
equipment.
Turn off power if jam occurs.

Example sentences without prepositional phrases

Disconnect power in order to
service equipment.
Turn off power in the event a jam
occurs.

Example sentences with prepositional phrases

C.4 Upper and lower case letters

Capitalize only the first letter of the first word in a sentence. The use of all upper case letters is discouraged. A single word or phrase may be set in upper case letters to provide emphasis.

Moving parts can crush and cut.
Do not remove guard.
Lockout power before servicing.

Example of sentences with mixed case lettering

Moving parts can crush and cut.
Do NOT remove guard.
LOCKOUT power before servicing.

Example of sentences with selective use of upper case

MOVING PARTS CAN CRUSH AND CUT.
DO NOT REMOVE GUARD.
LOCKOUT POWER BEFORE SERVICING.

Example of all upper case sentences
(Not recommended)

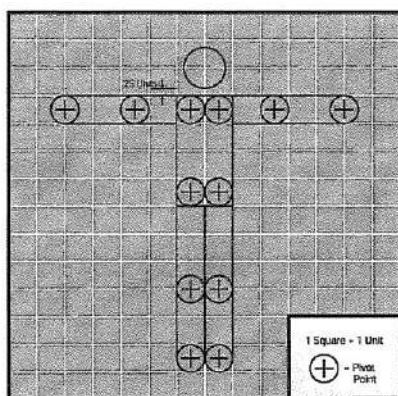
Material D Code of colors used in warning labels (See JIS Z 9103 “Safety colors” Reference 1)

Color	Munsell color code
Red	7.5R 4/15
Yellow	2.5Y 8/14
Black	N1
Orange	2.5YR 6/14
Blue	2.5PB 3.5/10
White	N9.5
Green	10G 4/10

Material E Examples of how to draw a human figure

E.1 Basic human figure

The basic human figure is based on a grid system composed of uniform squares, or units. The full human figure is 12 units tall, 2 units wide at the trunk, and has a circular head 1.75 units in diameter. The precise unit measurements for drawing the figure are shown in the figure below.



This figure shows the basic human figure in ANSI Z 535.3. In the figure in JIS A 8312, the pivot point of the knee is 0.5 units higher. Also, in the figure of ISO 3864-3, the pivot point of the shoulder and the length of the trunk are different by 0.5 units, and the arm width is 7/8 units.

The measurements are modified as shown in the figure below when the person is depicted in a stationary, freestanding position viewed from the front or rear.

Make limb ends semicircular



E.2 Human figures animation

By modifying the basic human figure using the pivot points, action or movement can be depicted.

The unit proportions shall remain the same, except in situations where the overlapping of limbs causes a visual foreshortening of the limbs.

When foreshortening occurs, it is compensated for by adding a 0.5 unit to the limb.

The human figure in various positions is shown in the figure below.

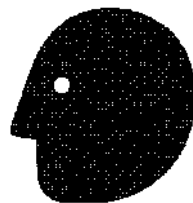


E.3 Head

When the head is involved with the hazard, a profile version of just the head is used instead of the full body figure.

The profile head can be substituted for the circle representation of the head when a side view of the full human figure or upper torso figure appears.

The head can face either left or right.



E.4 Upper body

Some hazards that involve the arms, hand, or head may best be expressed by using the upper half of the body, in either front or profile view, rather than the full body or the head alone.

When depicted in a profile position, the upper body can be effective in conveying the idea of directional movement with respect to the hazard.



E.5 Hands

The complexity of the human hand and the many possible finger movements offer great flexibility in designing symbols to communicate various specific messages.

At the same time, that complexity also makes the human hand one of the most difficult elements to depict in safety symbols.

The figure below shows a simplified shape and form for easy recognition.

In the full palm view (or full back of the hand view), generally the fingers should not be spread.



In the full hand view, the fingers may be spread. For example, two basic hand positions are shown in the figure below.



Position A



Position B

Position A shows the thumb extended along the same axis as the arm.

Position B shows the hand rotated several degrees around the hand pivot position.

Selection of Position A versus Position B should be based on which position is judged to best express the involvement with the hazard. For design consistency, hands are added to both arms when both arms are shown, even when only one arm is involved with the hazard.

Hand profiles are often used to convey a feeling of depth, which can improve understandability of the symbol. Although the hand is not actually drawn in perspective, the positioning of the fingers can create a three-dimensional impression.

Hand profiles are the most difficult elements of the human figure to design. Hand profiles maintain visual consistency. Valuable time can be saved when creating hand profiles by taking existing symbols and modifying or repositioning elements of the hand as necessary. Situations that require various finger movements can be depicted by selecting the hand closest to the desired position and modifying it.

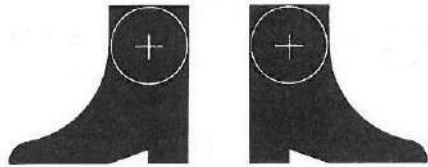
When depicting a hazard, the body should convey a reaction consistent with the hazard's impact or pain

it would likely cause. For example, showing a passive hand near a hazard might convey the message “Put hand here.” Instead, showing the hand as it would look interacting with the hazard, including distortion of the hand to indicate crushing, cutting, etc., would be more likely to communicate the correct message.



E6. Feet

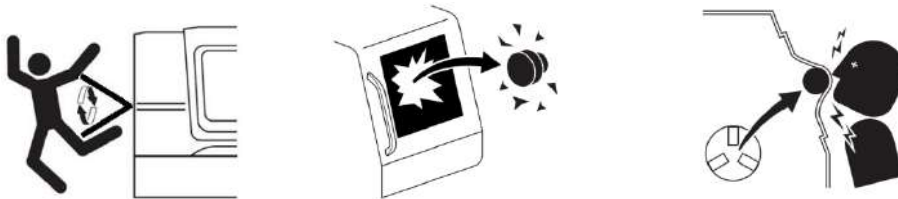
When a symbol illustrates just the lower legs or feet, the foot shown in the figure below may be added to the foot pivot position. It can be used facing either left or right. Some hazards that involve the feet or lower limbs are most effectively expressed by using the full human figure, lower body, or legs. Adding feet to the figure can increase recognition of the limb elements.



Material F Example of symbols and labels

F.1 Examples of symbols expressing a risk

Collision with a work piece:



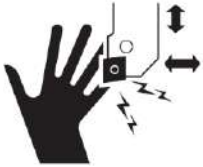
Contact with a rotating work piece:



Puncture by tail stock:



Injury of hand by a cutting tool:



Getting caught in a rotating object (e.g., gear):



(JIS A 8312)



(ISO 3864-3, A 3.6)

Getting caught in a chip conveyor:



(ISO 3864-3, A 3.6)



(JIS A 8312)

Getting caught in a chain or belt:



(JIS A 8312)

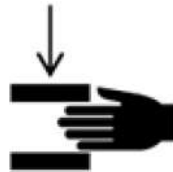


(JIS A 8312)

Body getting crushed at a moving part:



(ISO 7010-W019)



(ISO 7010-W024)

Collision of body with a moving part:



(JIS B 9100 A 6.5)

Tripping:



(ANSI Z535.3)



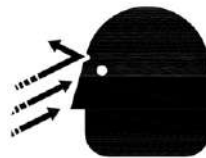
(ISO 7010-W007)

Falling:



(ANSI Z535.3)

Projectiles:



(JIS B 9100 A 9.3)

Burning by hot surface:



(ANSI Z535.3)

Electrocution:



(ANSI Z535.3)



(ANSI Z535.3)

F.2 Examples of labels with a symbol only expressing hazard registered in ISO standard



(ISO 7010 W001)



(ISO 7010 W004)



(ISO 7010 W006)



(ISO 7010 W008)



(ISO 7010 W011)



(ISO 7010 W012)



(ISO 7010 W017)

F.3 Examples of labels with a symbol only expressing prohibited act registered in ISO standard
(Do Not Touch, Do Not Step On, No Fire, etc.)



(ISO 7010 P019)



(ISO 7010 P024)



(ISO 7010 P010)



(ISO 7010 P015)



(ISO 7010 P007)



(ISO 7010 P034)



(ISO 7010 P011)



F.4 Examples of labels with a symbol only expressing enforcements registered in ISO standard
(Wear helmet, Wear safety glasses, etc.)



(ISO 7010 M014)



(ISO 7010 M004)



(ISO 7010 M007)



(ISO 7010 M003)



(ISO 7010 M002)

Material G Examples of warning label attachment

G.1 Moving parts or rotating parts (chip conveyor discharging area)



G.2 Parts operated by opening or releasing the interlock of a guard

Guard closed



Guard opened



Material H Standards to refer to

The number of standard and clause related to the clause of this Guideline

Clause	Content	No. of related standard and clause
4.	Basic Concept of Warning labels	-
4.1	General	ISO 12100:2010 6.1. JIS B 9700:2013 6.1.
4.2	Risk assessment	ISO12100:2010 4 JIS B 9700:2013 4
4.3	Three-step method	ISO 12100:2010 6.1. JIS B 9700:2013 6.1.
4.4	Objective of warning label	ISO 12100:2010 4. JIS B 9700:2013 4.
4.5	Matters to be considered for warning labels	ISO 12100:2010 6.4.1.2, 6.4.4 JIS B 9700:2013 6.4.1.2, 6.4.4
5.	Name of Sections of Warning labels	ANSI Z535.4-2011 4.8
6.	Layout Types	-
6.1	General	-
6.2	Labels with a symbol only	ISO 3864-2:2016, 6.2 ANSI Z535.3-2011 A2
6.3	Labels with 3 panels	ISO 3864-2:2016 6.6 ANSI Z535.4-2011 B5, B6, B7
7.	Signal word panel	-
7.1	Determination of the risk	ANSI Z535.4-2011 E3
7.2	Selection of signal word and alert symbol	ISO 3864-2:2016 A.4 ANSI Z535.4-2011 A1
7.3	Letter size of signal word	ANSI Z535.4-2011 8.2.3
7.4	Points to be noted when determining a signal word	
7.5	Process of signal word selection	ANSI Z535.4-2011 E4.3
7.6	Examples of signal word selection	-
8.	Symbol panel	-

8.1	Classification of symbols and how to draw the frame	-
8.1.1	Symbols expressing hazards	ISO 3864-1:2011 6.4 ISO 3864-2:2016 6.2 ANSI Z535.3-2011 5.2, A2.1 JIS Z 9101:2005 7.4
8.1.2	Symbols expressing prohibited acts	ISO 3864-1:2011 6.2 ISO 3864-2:2016 6.2 ANSI Z535.3-2011 5.4, A2.3 JIS Z 9101:2005 7.2
8.1.3	Symbols expressing enforcements	ISO 3864-1:2011 6.3 ISO 3864-2:2016 6.2 ANSI Z535.3-2011 5.3, A2.2 JIS Z 9101:2005 7.3
8.2	How to draw a human figure	ISO 3864-3:2012 A.3.3 ANSI Z535.3-2011 A6.3
8.3	Size of symbols	ISO 3864-2:2016 D.5 (ISO 3864-2:2004 D.5) ANSI Z535.3-2011 6.2
9.	Message panel	-
9.1	Content of message	ANSI Z535.4-2011 6.5, B3.1, B3.3.12
9.2	Layout order of content of message	ANSI Z535.4-2011 B3.2
9.3	Structure of message	ANSI Z535.4:2011 6.5.2, B3.3
9.3.1	Separation of message content	ANSI Z535.4:2011 B3.3.5
9.3.2	Text justification	ANSI Z535.4:2011 B3.3.6
9.3.3	Type style	ANSI Z535.4:2011 B3.3.8, B3.3.9
9.3.4	Coloring of message panel	ANSI Z535.4:2011 B3.3.11 GB 2894 4.5.2.1
9.4	Letter size	ANSI Z535.4:2011 B3.3.13, B3.3.14
10.	Colors to Be Used in Warning labels	(See Material D)
11.	Warning label Attaching Position	ISO 3864-2:2016 D.6 ANSI Z535.4-2011 9.1 JIS B 9706-1:2009 4.2
12.	Warning label Life Extension and Fixing Methods	ISO 3864-2:2016 D.7 ANSI Z535.4-2011 10.1
13.	User's Manual	ISO 3864-2:2016 D.8 ANSI Z535.4-2011 10.2

Material A	Comparative list of terms used in this Guideline and other standards	ISO 3864-2:2016 3.4, 3.7, 3.15 ANSI Z535.4-2011 4.8, 4.9, 4.11
Material B	Expression of signal word in various languages	ISO 3864-2:2016 B.1 ANSI Z535.4-2011 D1
Material C	Expressions in English	ANSI Z535.4-2011 B3.3
Material D	Code of colors used in warning labels	ANSI Z535.1-2017 JIS Z 9103:2005
Material E	Examples of how to draw a human figure	-
Material E.1	Basic human figure	ISO 3864-3:2012 A.3.2 ANSI Z 535.3-2011 A6.3 JIS A 8312:2016 D.3.2
Material E.2	Human figures with movement	ISO 3864-3:2012 A.3.3 ANSI Z 535.3-2011, 6.3.2 JIS A 8312:2016 D.3.3
Material E.3	Head	ISO 3864-3:2012 A.3.4 ANSI Z535.3-2011 A6.3.3 JIS A 8312:2016 D.3.6
Material E.4	Upper body	ANSI Z535.3-2011 A6.3.4 JIS A 8312:2016 D.4
Material E.5	Hands	ISO 3864-3:2012 A.3.5, A.3.6 ANSI Z535.3-2011 A6.3.5 JIS A 8312:2016 D.5
Material E.6	Feet	ISO 3864-3:2012 A.3.7 ANSI Z535.3-2011 A6.3.6 JIS A 8312:2016 D.6
Material F	Example of symbols and labels	(Refer to the standard number shown beneath the drawing)
Material G	Examples of warning label attachment	-