



Think Automation and beyond...

Safety Components

IDEC helps you create safe Human Machine Interface environments



IDEC CORPORATION

Safety Components

IDEC provides solutions to help you meet the international requirements of the safety standard ISO 12100.

Automated Assembly Line using Robots

Teaching Pendant

Equipped with 3-position enabling switch and emergency stop switch.
Complies with the international safety standard on robots.



Enabling Switch / Grip-style Enabling Switch

Used by operators working in a guarded hazardous area, to disable machine operation in emergency.

Complies with IEC/EN60947-5-8.



Safety Products Accessory

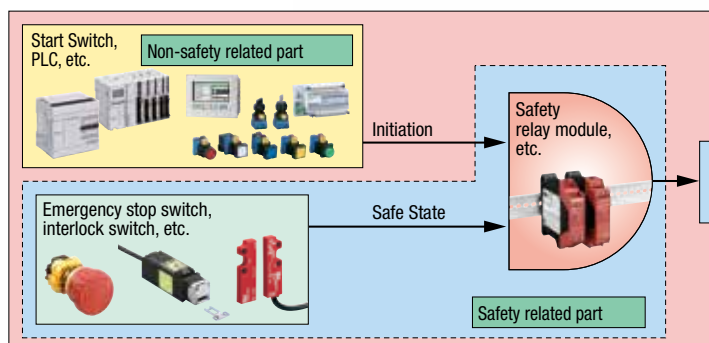
Door Handle Actuator



Emergency Stop Switch (padlockable)



[Safety System Overview]



Safety Controller

Integrates and monitors safety signals from the safety I/O components and safety-related parts.



Interlock Switch with Solenoid

Serves as an interlock that enables the machine to start only when the guard is closed and locked. The guard is unlocked by the solenoid.



Interlock Switch

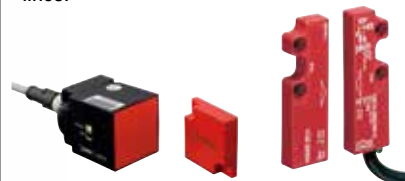
Serves as an interlock that enables the machine to start only when the guard is closed.

Once the guard is opened, the machine stops or cannot be started. This interlock switch is suitable for applications in limited mounting spaces.



Non-contact Interlock Switch

Detects the open/close status of the door without mechanical contact. Taking advantage of dustproof and water-proof construction as well as miniature size, the non-contact interlock switch is suitable for semiconductor manufacturing systems, food processing systems, and assembly lines.



Safety Product Accessory



Emergency Stop Switch

Used to stop machine to avoid accidents in emergency. Provides a safety lock mechanism to prevent accidental startup of the machine.



Surface Mount Indicator

Used to notify operators of the power supply status to robots (yellow or amber illumination is required by UL standard).



Safety Relay Module

Starts the machine only when the safety control system is functioning normally and safety information from safety devices (interlock switch, emergency stop switch, etc.) is relayed to the machine.



LED SignalLight Tower

Steady/flashing/alarm can be selected.



Emergency Stop Switch (Plastic Enclosure)

Can be mounted separate from the control panel wherever required to ensure safety.



Safety Components

Semiconductor Manufacturing System

Interlock Switch

Integral cable design minimizes wiring, preventing wiring mistakes.

LED indicator shows solenoid operation. Five-pole small interlock switch and four-pole interlock switches with a variety of circuits are perfect for installing in narrow areas.



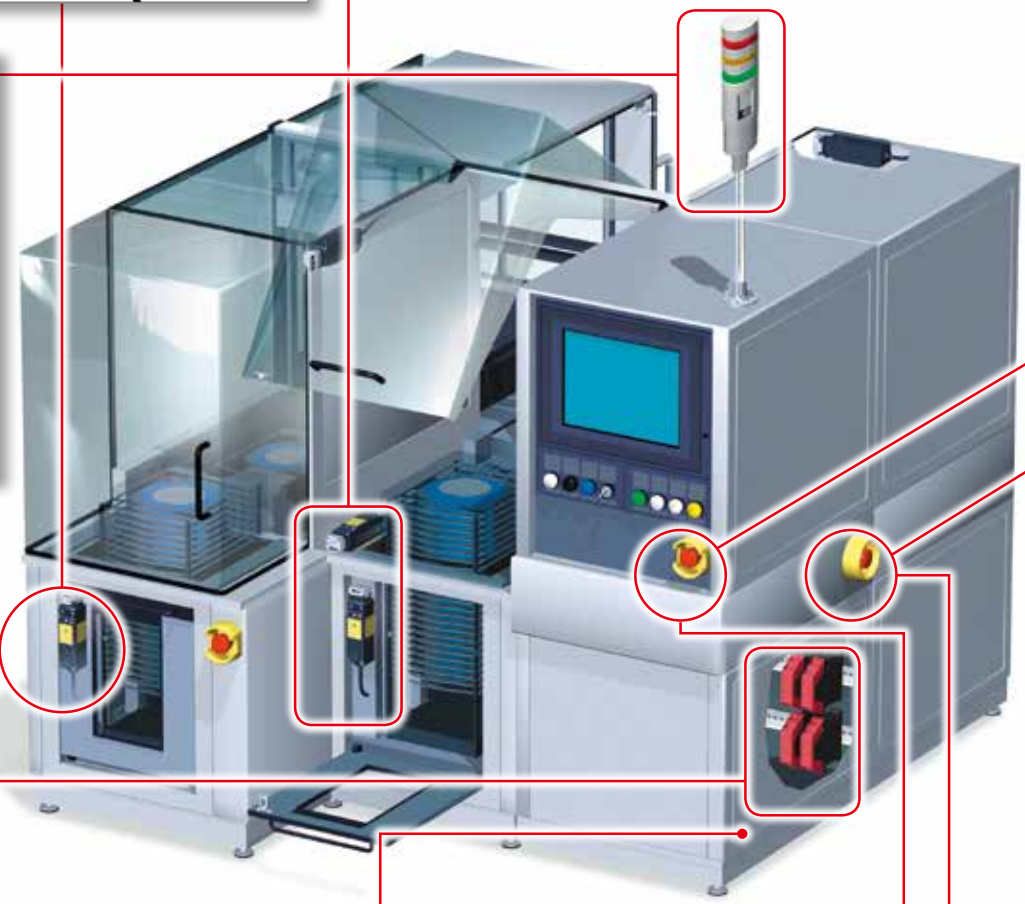
SEMI S2 Compliant Switch Guard

The combination of IDEC's EMO switch guards and emergency stop switches are approved by TÜV Rheinland for compliance with SEMI S2 standards.



LED SignalLight Tower

Ergonomically designed for visual and audible recognition. Flashing cycle complies with IEC standard.



Safety Relay Module

Starts the machine only when the safety control system is functioning normally and safety information from safety devices (interlock switch, emergency stop switch, etc.) is relayed to the machine.



Safety Controller

Integrates and monitors safety signals from the safety I/O components and safety-related parts.



SEMI S2 Compliant Switch

Combination with switch guard complies with SEMI S2. Direct opening action and safety lock mechanism.



Machine Tool

LED Illumination Unit

The bright, clear white illumination color lights up a target object clearly. A wide selection of illumination units to choose from according to the application. IP67f degree of protection.



Interlock Switch

Basic unit and solenoid unit in one housing. Actuation retention force 3000N. Manual unlocking is possible in the event of power failure or maintenance.



LED SignalLight Tower

Ergonomically designed for visual and audible recognition. Flashing cycle complies with IEC standard.



Safety Relay Module

Spring terminals enable easy wiring. Compact and can be installed in narrow areas.



Safety Controller

No programming needed. Safety system can be established easily just by selecting a logic.



Teaching Pendant

Equipped with 3-position enabling switch and emergency stop switch. Complies with the international safety standard on robots.



Emergency Stop Switch

Used to stop machine in order to avoid accidents in emergency. Designed with safety lock mechanism to prevent unauthorized startup.



Safety Components

Emergency Stop Switches

ø16 mm X6 Series



- Third-generation emergency stop switch with Reverse Energy Structure.
- Smallest in its class. 19.5 mm behind the panel.
- Two ways of resetting—pulling and turning.
- Safety lock mechanism (IEC 60947-5-5; 6.2)
- Direct opening action (IEC 60947-5-5; 5.2, IEC 60947-5-1, Annex K)
- IP65 (IEC 60529)



ø16 mm XA Series

ø22 mm XW Series

ø30 mm XN Series



Contact IDEC for certification details.

- Safe Break Action on removable contact block models.
- 1NC, 2NC, 3NC, 4NC
- Push-to-lock, Pull or Turn-to-reset operator.
- Safety lock mechanism and direct opening action.
- XA series unibody: 19.5 mm deep behind the panel, smallest in its class.
- XW series: Screw terminal style is finger-safe (IP20).
- XW1E: mechanical indicator model
- XN series: Padlockable, flush bezel, 60 mm jumbo mushroom, illuminated, and LED push-on are available.
- IP65/IP40 (IEC 60529)

SEMI Emergency Off (EMO) Switch



- SEMI S2 compliant Emergency Off (EMO) switches.
- Direct opening action
- Safety lock mechanism
- Safe Break Action (XA/XW series)
- Reverse Energy Structure (XA/XW series)
- IP65 (IEC 60529)



Contact IDEC for certification details.

Force Guided Relays & Sockets

RF2



- 2-pole force guided relay to save cost and reduce installation space.
- Force guided contact mechanism (EN50205 Type A TÜV approved).
- Reinforced insulation between coil and contact and contacts of different pole.
- Mechanical indicator shows contact status.
- Two terminal types - socket mounting and PC board mounting.
- RT III degree of protection /with LED/counter-electromotive force models.

RF1V / SF1V



- Force guided contact mechanism (EN50205 Type A TÜV approved).
- Contact configuration: 4-pole (2NO-2NC, 3NO-1NC), 6-pole (4NO-2NC, 5NO-1NC, 3NO-3NC).
- Built-in LED indicator available.
- Fast response time (8 ms maximum).
- High shock resistance (200 m/s² minimum).
- Finger-safe DIN rail mount socket and PC board mount socket.
- IP40 (RF1V), IP20 (SF1V, finger-safe screw terminal)

SignalLight Towers

LD6A



- Striped design with non-illuminating area between the lenses.
- Built-in super bright LEDs reduce light disturbance to make the illuminating color stand out.
- IDEC's unique lens shape enables high-visibility from different directions.
- Five different mounting styles available. Easy mounting to aluminum frames, wall mounting, direct mounting, and pole mounting.
- IP65/IP54 (IEC 60529)



Safety Light Curtains

SE4D



- Beam axis adjustment is easy with a visible incident light.
- Zero dead space structure provides efficiency and higher safety.
- Safety and productivity ensured with a built-in muting control function.
- Override function enables safe and smooth restart of the line operation during muting.
- IP65/67 (IEC 60529)

Safety Laser Scanner

SE2L

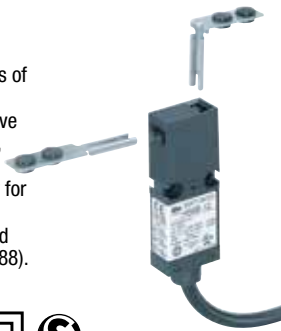


- Distance 5m, sensing angle 270°
- A maximum of four SE2Ls can be interconnected using RS-485 for master/slave operation.
- Dual protection function enables monitoring two separate hazardous areas to stop machines when detecting the access of humans.
- A maximum of 32 area patterns can be configured/switched according to the applications
- Degree of protection: IP65 (IEC 60529)

Interlock Switches

HS6B

- World-class compactness with three poles of contacts (30 × 15 × 78 mm).
- Dual contacts and monitor contacts achieve the highest safety category (ISO 13849-1, EN 954-1).
- Two actuator entry slots provide flexibility for installation options.
- Proprietary actuators prevent unauthorized opening of the contacts (ISO14119, EN1088).
- IP67 (IEC 60529)



HS6E

- Small interlock switch with five poles and solenoid.
- Compact body: 75 × 15 × 75 mm 15 mm wide, thinnest solenoid interlock switch in the world.
- Reversible mounting and angled cable allow four actuator insertion directions.
- Manual unlocking possible on three sides.
- IP67 (IEC 60529)



HS5L

- Compact body: 35 × 40 × 127mm
- The locking strength is 1400N minimum.
- Spring clamp terminal block prevents loosening of wires due to vibration.
- Gold-plated contacts suitable for small loads.
- Spring lock models (unlocks when the solenoid is energized) and solenoid lock models (locks when solenoid is energized) are available.
- The head orientation can be rotated, allowing 8 different actuator entries.
- Spring loaded actuator exclusive for HS5L available.
- LED indicator shows solenoid operation.



HS5D

- Head removal detection function turns OFF the main circuit (11-12) when the head of the HS5D is removed.
- The same size as 2 contact interlock switches (HS5B). 3 contact with dual enabling contacts and a monitor contact are available.
- The actuator is interchangeable with HS5B and HS5E.
- IP67 (IEC 60529)



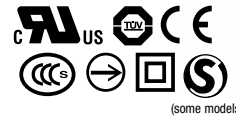
HS5B

- Available with a robust and durable metal head.
- Choice of three conduit port sizes: G1/2, PG13.5, and M20.
- The head orientation can be changed, allowing 8 different actuator entries.
- Compact body (30 × 30 × 91 mm)
- IP67 (IEC 60529)



HS5E

- Small interlock switch with four poles and solenoid (35 × 40 × 146 mm).
- Rear unlocking button for emergency escape available. Also available is the rear unlocking button kit.
- The head orientation can be rotated, allowing 8 different actuator entries.
- IP67 (IEC 60529)



HS5E-K

- Head removal detection circuitry.
- High-security pin tumbler key is used. Sixteen types of key numbers are available.
- The head orientation can be rotated, allowing 8 different actuator entries.
- Available with rear unlocking button for emergency escape.
- IP65 (IEC 60529)



HS5 Series

Door Handle Actuator

- Rattling doors can be locked smoothly and securely.
- A door can be locked with an actuator by pushing and turning the handle.
- Padlock tab is provided to ensure operator safety.
- LED shows solenoid status (when using HS5E-*44L**G).



HS5 Series Slide Handle Actuator

- Shock-resistant metal slide handle actuators ensure safety.
- 2-action operation prevents operation errors.
- An operator trapped inside the hazardous zone can unlock the safe guard using the rear handle.
- Padlock prevents unauthorized resetting.



HS1E/1C

- Basic unit and solenoid unit in one housing.
- Spring lock and solenoid lock.
- Manual unlocking is possible in the event of power failure or maintenance.
- IP67 (IEC 60529)



Contact IDEC for certification details.

HS1L

- Six contacts in a compact housing (same size as HS1E). 3000N locking strength.
- Energy efficient new solenoid unit.
- Manual unlock key and LED indicator are standard.
- Two locking mechanisms to choose from—spring lock or solenoid lock.
- IP67 (IEC 60529)

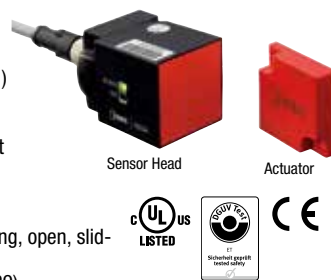


Safety Components

Non-contact Interlock Switches

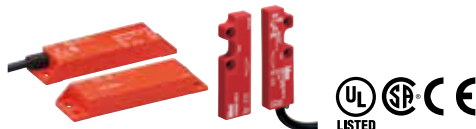
HS3A

- RFID non-contact interlock switch, Category 4 and PLe (EN/ISO 13849-1) compliant.
- The sensor head with built-in safety function (redundant solid state output with internal monitoring) eliminates the need for a designated safety module.
- RFID ensures detection of slow-moving, open, sliding, and rattling doors.
- IP67 (actuator: IP67/IP69K) (IEC 60529)



HS7A

- Compact size and easy positioning (HS7A-DMC).
- Operation signals from auxiliary contacts can be read directly by controllers such as PLCs, allowing for monitoring HS7A-DMP non-contact interlock switches.
- Conformable up to safety category 4 (EN ISO 13849-1) (Combining with proprietary safety relay module achieves safety category 4.)
- Up to 36 sets can be connected (safety relay module: HR1S-DME)
- IP67 (IEC 60529)



Safety Relay Modules

HR1S

- Fault diagnosis function with dual safety circuits.
- Internal relay operations can be monitored with LED indicator.
- Finger-safe protection
- 35 mm wide DIN rail mounting
- Standard and time-delay modules available.
- Safety circuit expansion unit is available.
- IP20 (terminal)/IP40 (housing) (IEC 60529)



HR2S

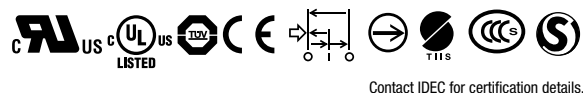
- Compliant with EN ISO 13849-1 Performance level (PL) e, Category 4.
- Spring terminals enable easy wiring.
- The terminal cover does not close if the terminal is not fully inserted into the module.
- IP20 (terminal)/IP40 (housing) (IEC 60529)



Enabling Switches/Grip Style Enabling Switches

HE Series

- 3-position enabling switch to avoid hazards (OFF-ON-OFF).
- Direct opening action mechanism for shifting from position 2 (ON) to position 3 (OFF).
- The switch does not turn ON while being released from position 3 (OFF when pressed) to position 1 (OFF when released).
- Can be used for applications required by the ANSI robot standard (grip style).
- Emergency stop switch and momentary pushbutton versions are available (grip style).
- IP67/IP66/IP65/IP40 (IEC 60529)



Safety Controllers

FS1A SafetyOne

- 24 pre-programmed safety circuit logics.
- No programming required. Configuration complete by turning on a logic switch.
- A safety circuit can be configured easily just by selecting a logic from pre-programmed logics.
- Mode selection, partial/entire stop can be achieved just by selecting a logic.
- One SafetyOne module can connect with various safety inputs such as emergency stop switches and light curtains.
- The status of safety I/Os and the SafetyOne errors can be monitored.
- Solenoid drive output is provided, eliminating the need for a PLC.
- IEC 61508 safety integrity level 3, ISO 13849-1 performance level e, and EN954-1 control category 4 compliant.
- IP20 (IEC 60529)



Relay/Lamp Barriers

EB3C Relay Barrier



- Explosion protection: [Exia] II C
- Input contacts can be used in any explosive gas and Zone 0/Class I Div. 1 areas.
- No ground required.
- IP20 (IEC 60529)



EB3L Lamp Barrier



- Explosion protection: [Exia] II C
- 126 types of pilot lights and buzzers can be connected.
- Illuminated pushbuttons and illuminated selector switches can be connected by combining with the EB3C relay barrier.
- No grounding required.
- IP20 (IEC 60529)



EB3N Safety Relay Barrier



- Explosion protection: [Exia] II C
- Machine safety system can be built in compliance with ISO 13849-1 Category 4, Performance level e.
- IP20 (IEC 60529)



Flameproof & Increased Safety Control Boxes

EC2A

- Applicable for any explosive gas in Zone 1 and 2 areas
- Stainless steel plate enclosure with high corrosion resistance
- Explosion protection: Ex de IIC T6
- IP65 (IEC 60529)



EC2B

Explosion Protection	Ex II2G Ex de IIC T6 (PTB)
	Ex II2D Ex td A21 IP65
	T80°C (PTB)
	Ex de II2C T6 (TIS)

- ATEX directive compliant control boxes ideal for use in Europe and south-east Asia.
- Corrosion resistant stainless steel enclosure.
- Applicable in areas where explosive gases exist including hydrogen and acetylene.
- IP65 (IEC 60529)



EC2C

Explosion Protection	Ex II2G Ex de C T6 Gb
	Ex II2D Ex tb C T80°C Db IP65

- SUS316L Large Size Control Boxes
- Complies with safety standards (IEC60947-5-5)
- For use in explosive gas atmosphere (zone 1, zone 2) and explosive dust atmosphere (zone 21, zone 22)
- Various control units available including meters, pilot lights, pushbuttons, emergency stop switches, selector switches and key selector switches.



Increased Safety Terminal Boxes

EJ2C

Explosion Protection	Ex II2G Ex e C T6 Gb
	Ex II2D Ex tb C T80°C Db IP65

- Corrosion resistant SUS316L
- For use in explosive gas atmosphere (zone 1, zone 2) and explosive dust atmosphere (zone 21, zone 22)

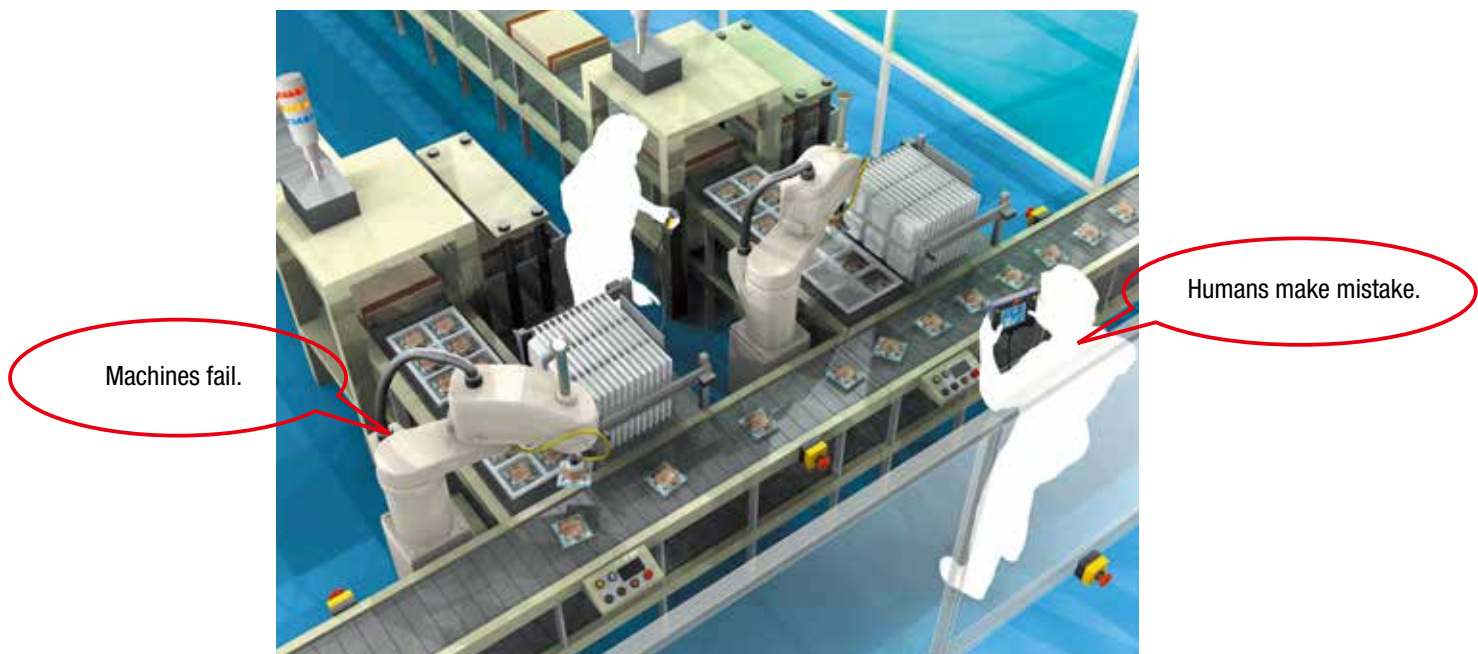


International Safety Concept for Automation and Beyond...

No matter how systems and machines are advanced and highly automated, there are occasions where operators interact with machines directly. FA (factory automation) has long relied on operators to ensure safety when operating machines. However, as witnessed in frequent industrial accidents in recent years, we cannot expect operators to achieve safety. An aging population, a decrease in skilled workers, an increase of part time workers and foreign workers with different languages and culture— society is changing rapidly, and the conventional safety concept is no longer applicable. What is needed is to understand the fact that “humans make mistakes, and machines fail.” We must provide inherent safety design to manufacturing systems to ensure safety.

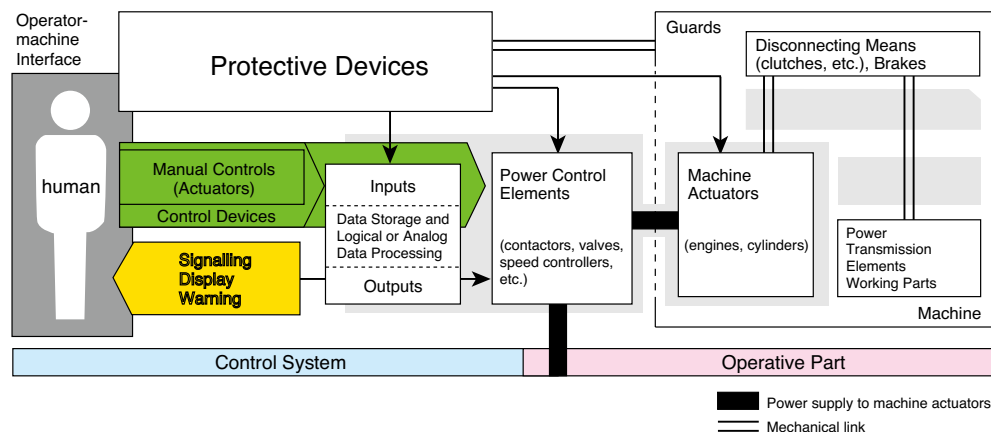
Safety Concept

- ✓ Corporate responsibility
- ✓ Inherent safety
- ✓ Safety-controlled machinery



Schematic of the machinery subject to the ISO 12100 machine safety standard

The ISO12100-1 machine safety standard for the safety of machinery defines various forms of machinery. As a supplement to this standard, Annex A provides the following schematic to illustrate the general concept of machinery.



IDEC's corporate social responsibility (CSR) is to reduce industrial accidents by developing and providing safety technologies. We will continue contributing to the safety of an ever-globalizing society.

EC machinery directive made the CE Mark mandatory effective January 1st, 1995 for all machinery, resulting in higher public concern about the safety of machinery throughout the world.

To reduce the risk of machinery for achieving safety:

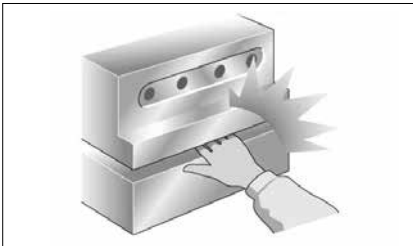
It is necessary for manufacturers to manufacture products and systems based on the technical guidelines which anyone can obtain and understand—ISO, IEC, and EN. By making the most of the standards, manufacturers can explain the safety and safety measures of their products and systems to users and authorities. As shown below, ISO 12100 (Safety of machinery—Basic concepts, general principles for design —Part 1: Basic terminology, methodology) lists the types of hazards which can cause injury or death, or cause damage to properties. By conforming the products or systems to relevant standards, risk can be reduced and safety can be ensured.

Hazards to be taken into account when designing machinery:

Mechanical hazard

Mechanical hazards associated with machine, machine parts or surfaces, tools, work pieces, loads, or projected solid or fluid materials.

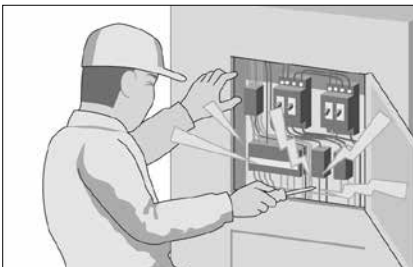
- Crushing
- Shearing
- Cutting or severing
- Entanglement
- Impact
- High pressure fluid injection
- Shape (sharp edges, angular parts)
- Acceleration/deceleration
- Inadequate mechanical strengths
- Mass and velocity
- Potential elements or elastic elements



Electrical hazard

Injury or death from electric shock or burn that can be caused by:

- Contacts of persons with live parts
- Breakdown
- Leakage current
- Electrostatic phenomena
- Thermal radiation



Thermal hazard

Thermal hazard can cause:

- Burns and scalds (extreme temperature, flames or explosions and radiation from heat sources)
- Health-damaging effects generated by hot or cold work environment.



Hazard generated by noise

Noise can cause:

- Permanent hearing loss
- Tinnitus
- Tiredness
- Stress
- Loss of balance
- Loss of awareness
- Impairment of speech communication or of the perception of acoustic signals.

Hazard generated by vibration

Vibration can be transmitted to the whole body and particularly to hands and arms.

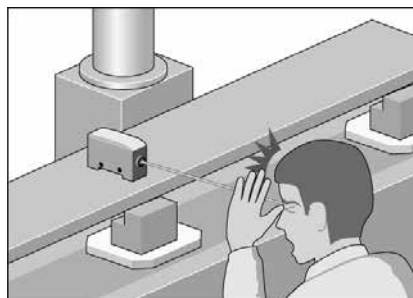
- Low-back morbidity and trauma of the spine
- White-finger disease
- Neurological, osteo-articular disorders



Hazards generated by radiation

These hazards can have immediate effects or long-term effects.

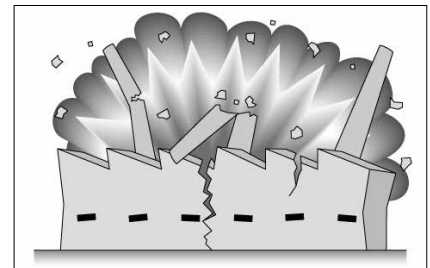
- Electromagnetic fields (low frequency, radio frequency, micro-wave ranges)
- Infra-red light
- Visible light and ultra-violet light
- Laser radiation
- X and γ rays
- α , β rays
- Electron or ion beams, neutrons.



Hazards generated by materials and substances

Materials and substances processed, used, produced or exhausted by machinery, and materials used to construct machinery can cause:

- Hazards resulting from ingestion
- Contact with the skin, eyes and mucous membranes or inhalation of fluids, gases, mists, fumes, fibres, dusts or aerosols (harmful, toxic, corrosive, teratogenic, carcinogenic, mutagenic, irritant or sensitizing effect)
- Fire and explosion hazards
- Biological hazards



Hazards generated by neglecting ergonomic principles in machine

Mismatch of machinery with human characteristics and abilities:

- Physiological effects resulting from unhealthy postures, excessive or repetitive efforts
- Psycho-physiological effects generated by mental overload or underload, or stress, arising from the operation, supervision or maintenance of a machine within the limits of its intended use
- Human errors.

Slipping, tripping and falling hazards

Neglecting the surface of the floorings and access means may cause injuries from:

- Slips
- Trips
- Falls

Hazard combinations

When combined, some individual hazards which seem to be minor can be equivalent to a significant hazard.

Hazards associated with the environment in which the machine is used

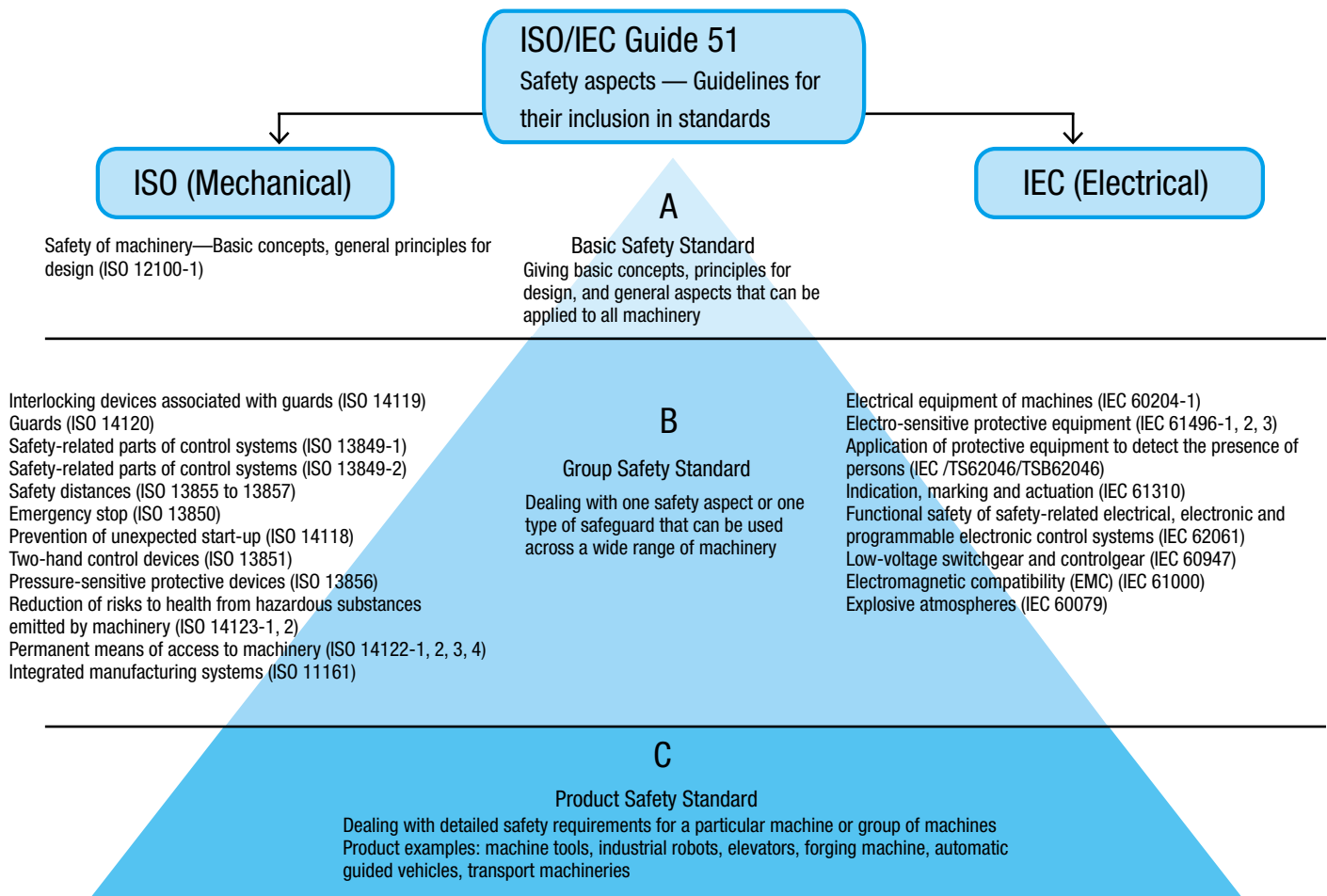
Where a machine is designed to operate under environmental conditions such as follows which can result in hazards, take these hazards into consideration.

- Temperature
- Wind
- Snow
- Lightning

Hierarchy Structure of Safety Standards

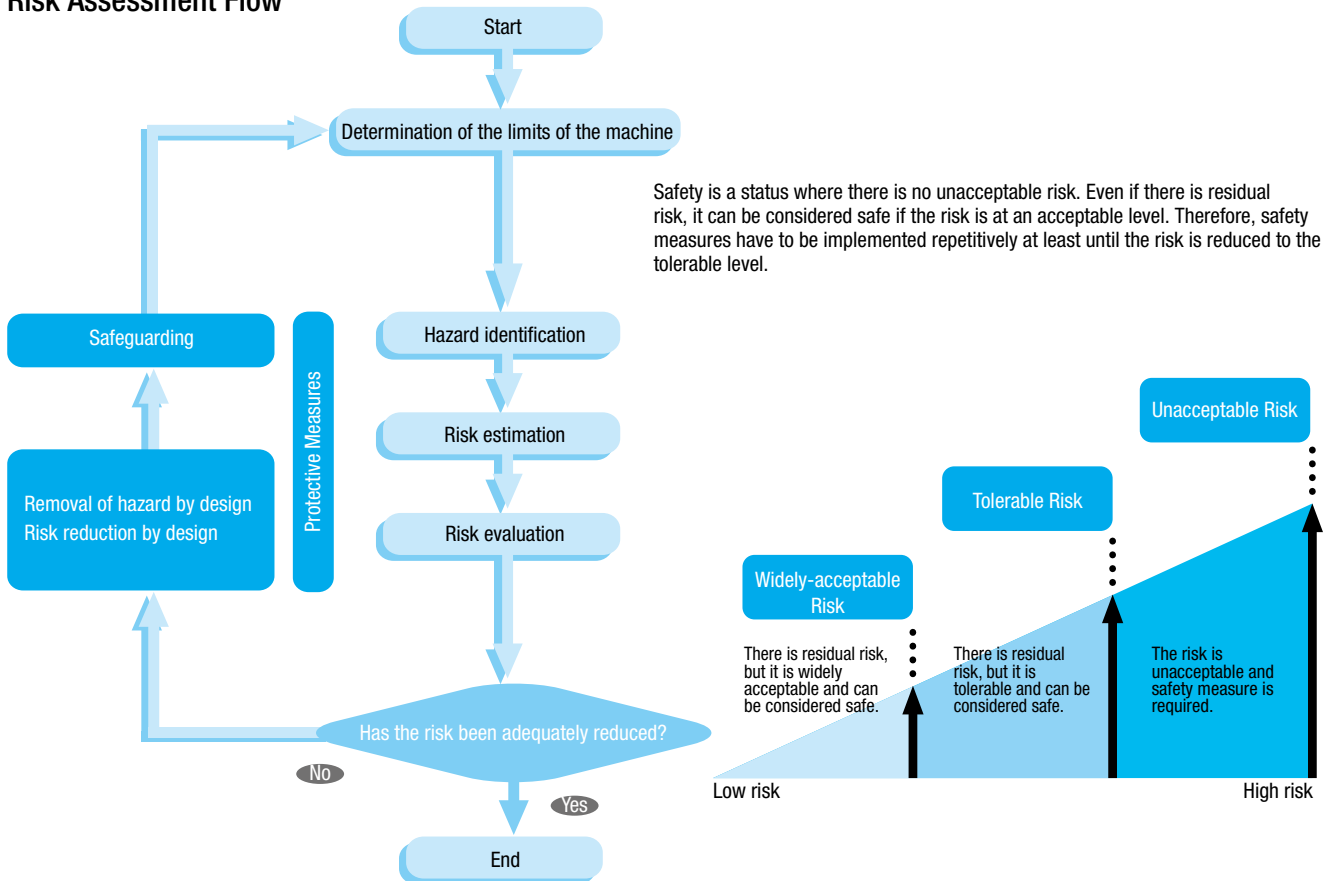
Machines and components never cease to evolve. Although there is a great number of standards in ISO and IEC, not all standards are written for individual machines or components, and it is virtually impossible to update technical requirements of the standards on a daily basis. ISO and IEC standards are divided into basic, group, and product safety standards (ISO/IEC Guide 51). By combining and utilizing relevant standards, even the most up-to-date machinery or component can be manufactured properly.

International functional safety standards—ISO/IEC standards

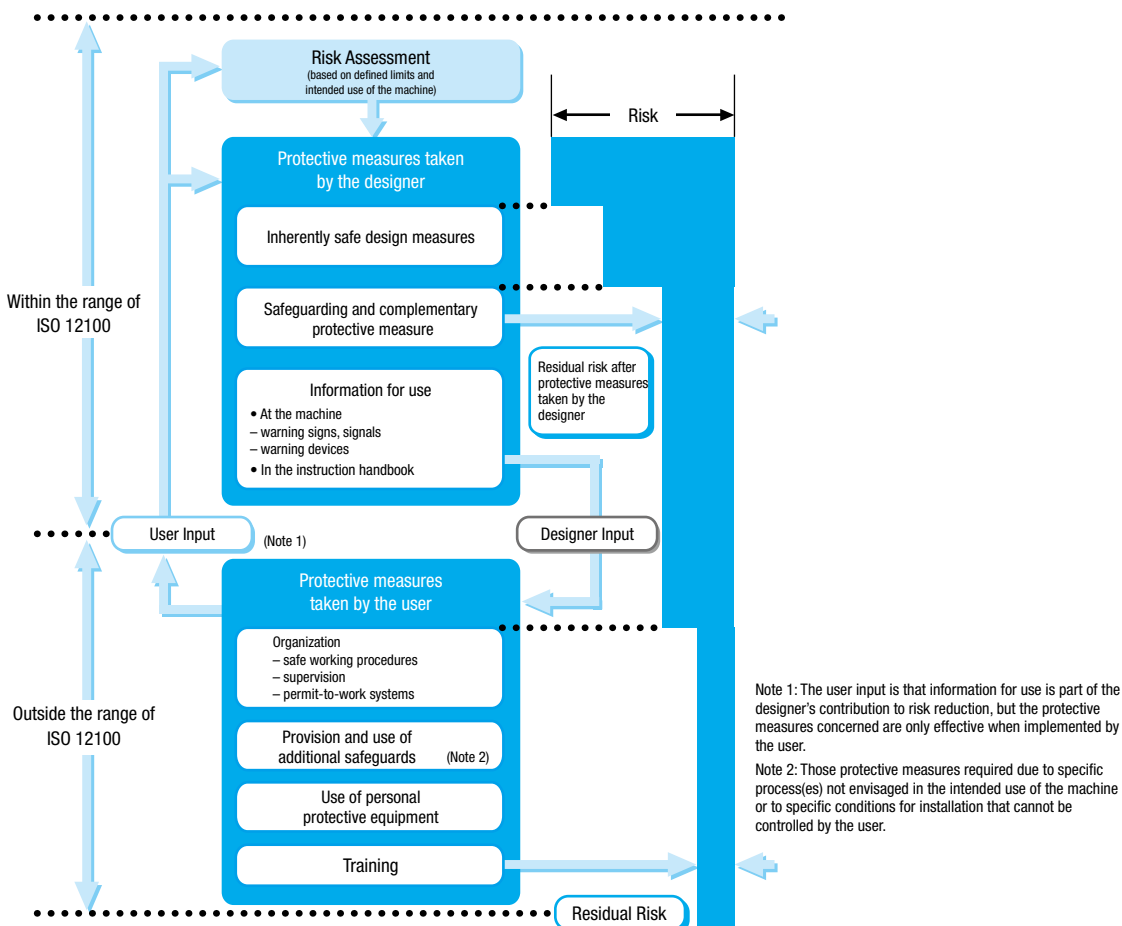


Risk Assessment and Repetitive Risk Reduction Process

Risk Assessment Flow

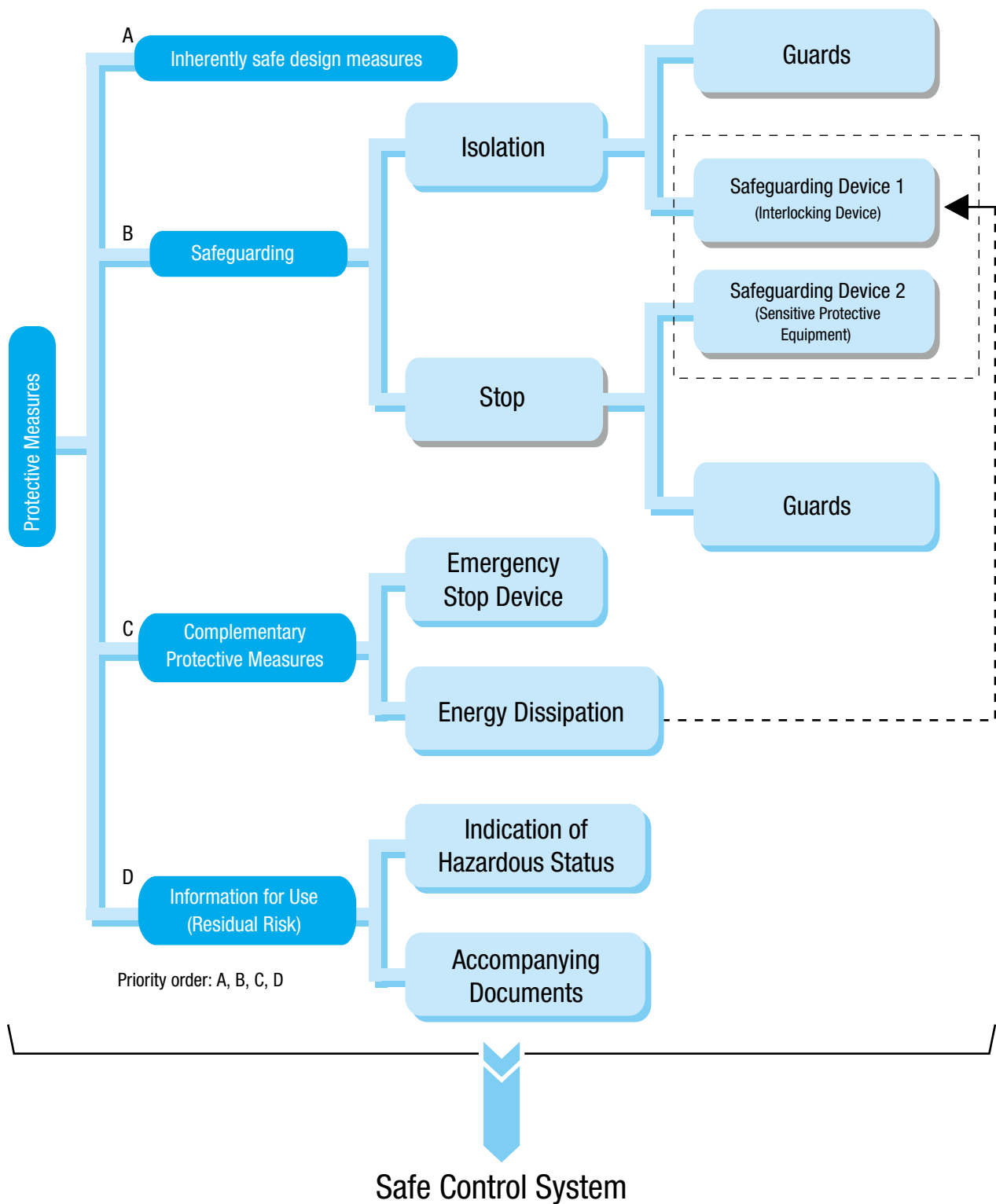


ISO 12100 Coverage



Protective Measures

Protective Measures

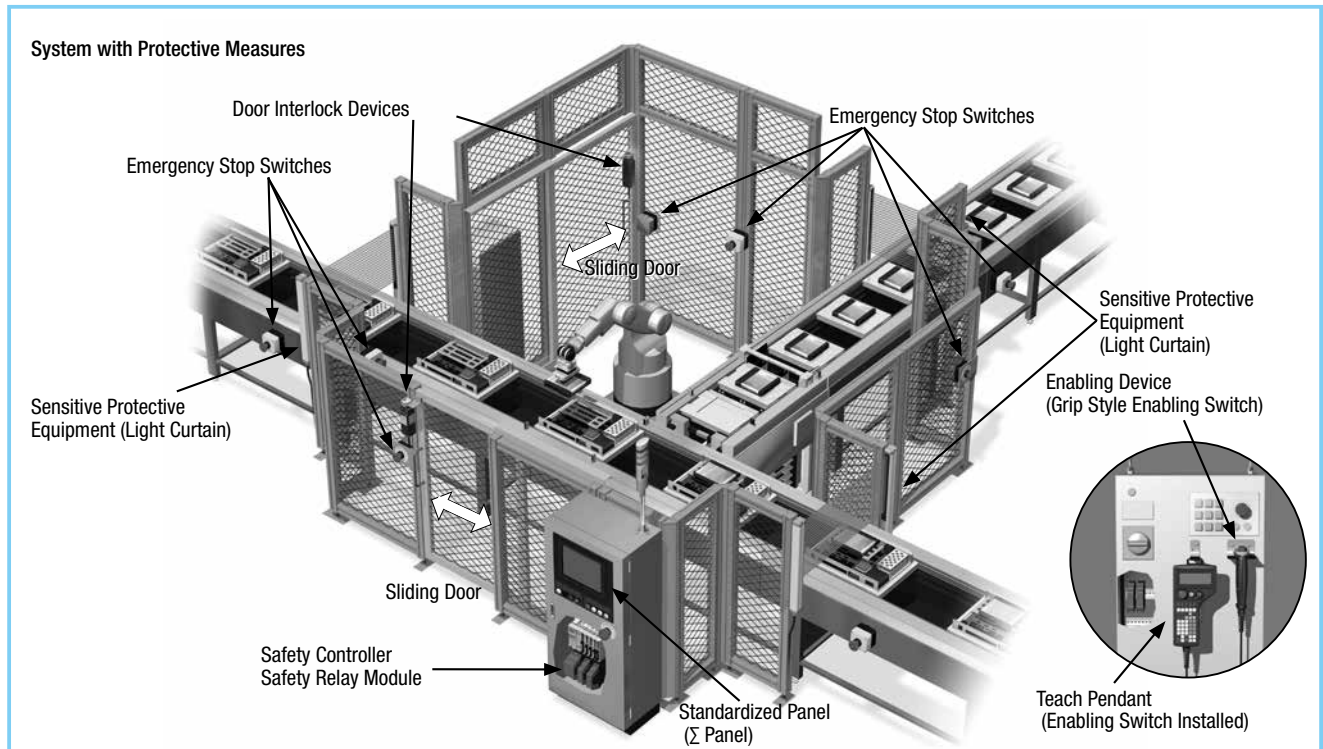


Safety Measure Examples Based on ISO 12100

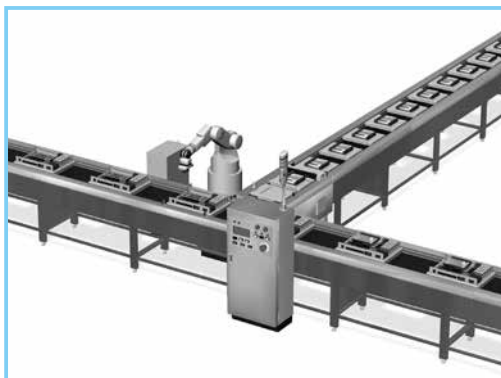
According to ISO 12100, risk assessment starts by identifying hazards. Risk assessment continues until the risks from hazards have been reduced to their lowest practical level. The following example illustrates how a safe system has been achieved by taking safety measures to the hazard; robot.

Note: Basic safety standard ISO 12100 has been applied to the following example, however, in actual applications, product safety standards such as ISO 10218 (Robots) may have to be referred to as well. In this case, apply relevant product safety standards before performing risk assessment.

Risk Assessment in Automatic Mode



System Without Protective Measures



Before performing protective measures:
Control panel was installed within the robot's moving range.
Control panel was located low, requiring operators to squat.
Robot's hand had a sharp edge.
Layout and color of control units (switches and pilot lights) were not standardized.

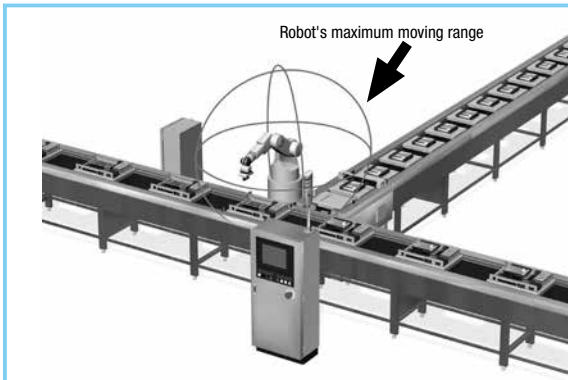
Hazard:
High-power robot operated on a program at high speed.
Hazardous event:
Collision of the robot and operators

(The above example is an example in which the robot is assumed as a hazard. Actual systems have many hazards including robots, and risk assessment must be performed on all hazards.)

Based on the risk assessment concept, protective measures are performed on the above system in order to reduce risks.

Safety Measure Examples Based on ISO 12100

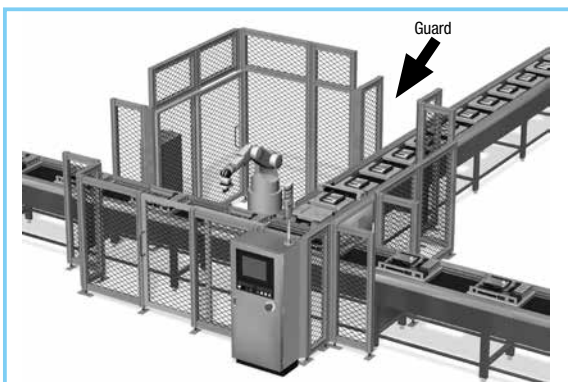
1. Inherently Safe Design Measure



- Remove sharp edges from the robot (for the convenience of production, changing to low-speed and low-power is impossible). (ISO 12100-2, 4.2.1)
- Standardize the layout of control units on the control panel. (ISO 12100-2, 4.8.7)
- Standardize the colors of switches and pilot lights. (IEC 60204-1, 10.3.2)
- Install the control panel outside the robot's moving range. (ISO 12100-2, 4.2.1)
- Install the control panel at a readily accessible location. (IEC 60204-1, 10.1.2)

Measures were taken to the hazard itself, however, the hazardous area can be accessed easily.

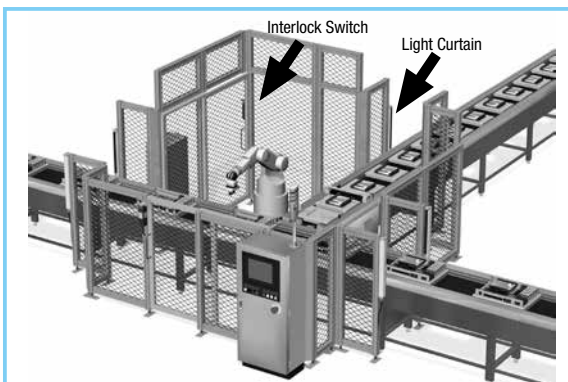
2-1. Safeguarding (Isolation)



- Install the guard outside the robot's moving range.
The guard's height and mesh openings are determined based on the following standards.
 - ISO 14120: Safety of machinery—Guards—General requirements for the design and construction of fixed and movable guards
 - ISO 13852: Safety of machinery—Safety distances to prevent danger zones being reached by the upper limbs
 - ISO 13853: Safety of machinery—Safety distances to prevent danger zones being reached by the lower limbs
 - ISO 13854: Safety of machinery—Minimum gaps to avoid crushing of parts of the human body
- Install a sliding door for maintenance.
- Use the open part as an entrance.

Hazardous area has been isolated, however, the hazard is accessible when the guard or sliding door is open.

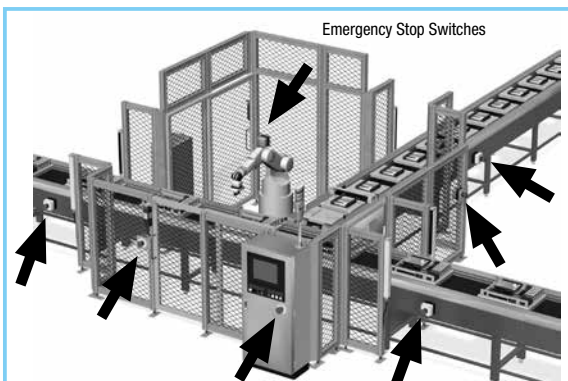
2-2. Safeguarding (Stop)



- Install door interlock devices on the sliding door according to the standards shown below.
- Install sensitive protective equipment (light curtain) to the open part of the guard.
 - ISO 14119: Safety of machinery—Interlocking devices associated with guards — Principles for design and selection
 - IEC 61496-1: Safety of machinery—Electro-sensitive protective equipment (ESPE) - Part 1: General requirements and tests

Interlock device (to isolate hazardous area) and sensitive protective equipment (to stop robots when operator(s) enters the hazardous area) have been installed, however, there is no means for operators to stop the robot consciously in an emergency.

3. Complementary Protective Measure



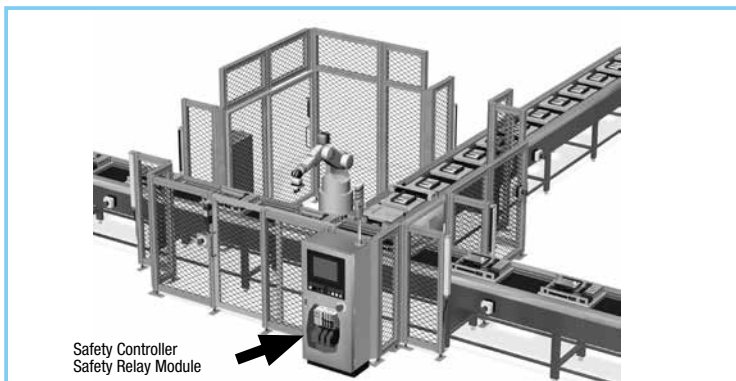
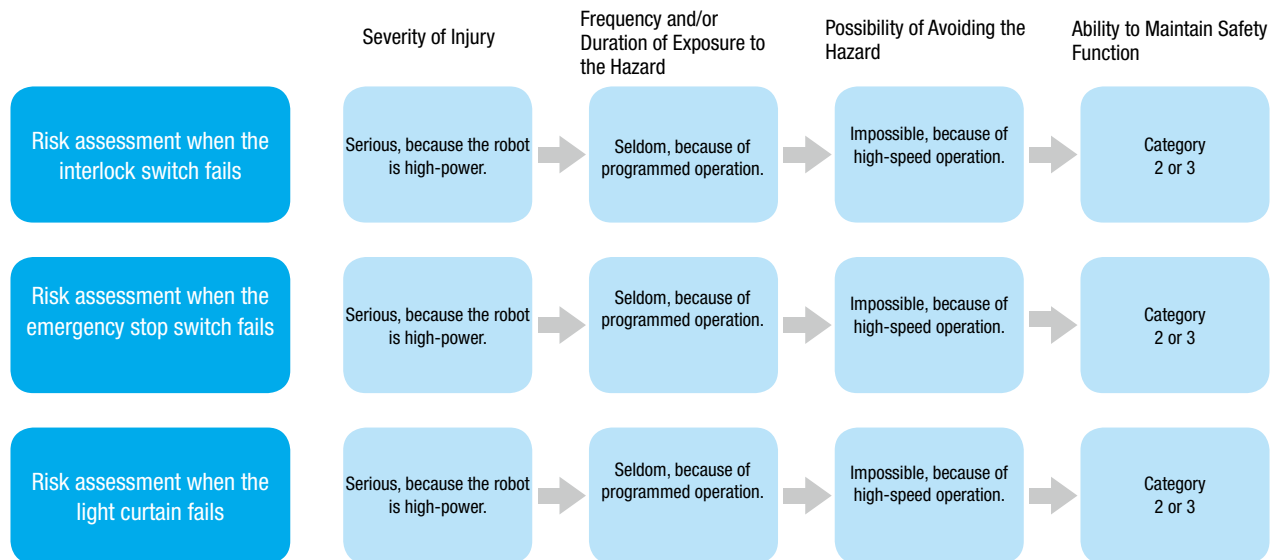
- Install emergency stop switches on the guards.
IEC 60204-1, 10.7.1 "Devices for emergency stop shall be readily accessible."

If the safety components fail, the system might shift into a hazardous situation. A safe system must be established by selecting the ability to maintain the safety function based on the risk assessment result.

Safety Measure Examples Based on ISO 12100

4. Evaluating the Ability to Maintain Safety Function and Establishing the Safety System

Evaluate the risk in the case when safety components fail, select the category (the level of ability to maintain safety function), and establish the safety system.



Establish a safety system of category 2 or 3 using safety controller, safety relay modules and other safety components.

Although risk has been reduced to a tolerable level, there is still residual risk.

5. Information for Use

Provide information about residual risk in an instruction manual, hazard sign, and warning device.

Safety Measure Examples Based on ISO 12100

Risk Assessment in Teaching Mode

System with Safety Measures



Before performing protective measures:

Safety measures are taken for the auto mode.
The robot runs at low speed in teaching mode.

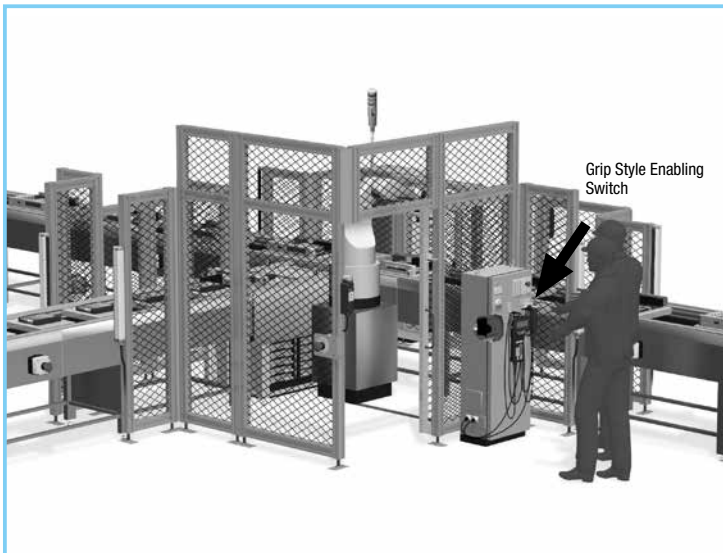
Hazard:

High-power robot operated at low speed in a teaching mode.

Hazardous event:

Collision of operators inside the guard and the robot operating at low speed.

1. Inherently Safe Design Measure

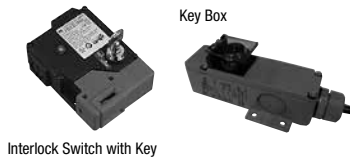


- Remove sharp edges from the robot.
- Disable auto mode when a teach pendant is used (IEC 60204-1, 9.2.3).
Examples: Mode selection using a key selector switch or access code. The selected operating mode shall be indicated (mode selector, pilot light, visual display indication)
- Using an enabling switch, the system can operate only when the operator feels safe. Power is shut down when the operator faces emergency.
Operator with a teach pendant uses an enabling switch provided on the teach pendant. Operator without teach pendant uses a grip style enabling switch.

Safety Measure Examples Based on ISO 12100

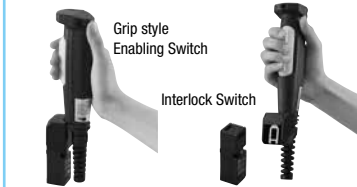
Mode selection using an interlock switch with key

Remove the key from the interlock switch, and insert the key into the key box (installed inside the hazardous area) and select teach mode. Configure a system so that it switches to auto mode only when the key is re-inserted into the interlock switch.



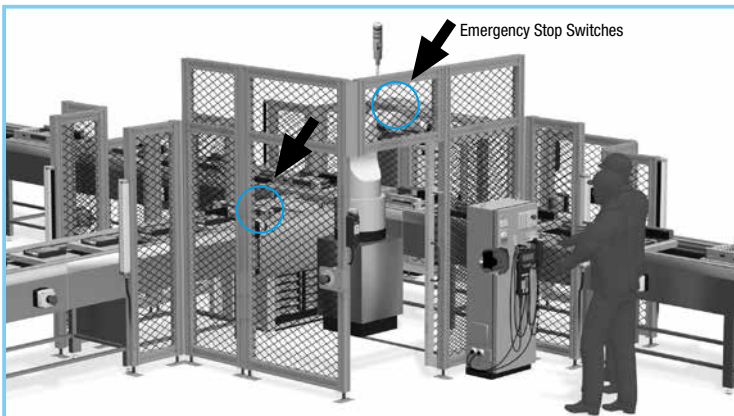
Mode selection using a grip style enabling switch and an interlock switch

A mode selection example using grip style enabling switch and interlock switch. The system switches to auto mode only when the grip style enabling switch is attached to the interlock switch.



Enabling switch can shut down power when the operator faces a hazardous event, however, there is no means available for the operator to stop the robot consciously in an emergency.

2. Complementary Protective Measure

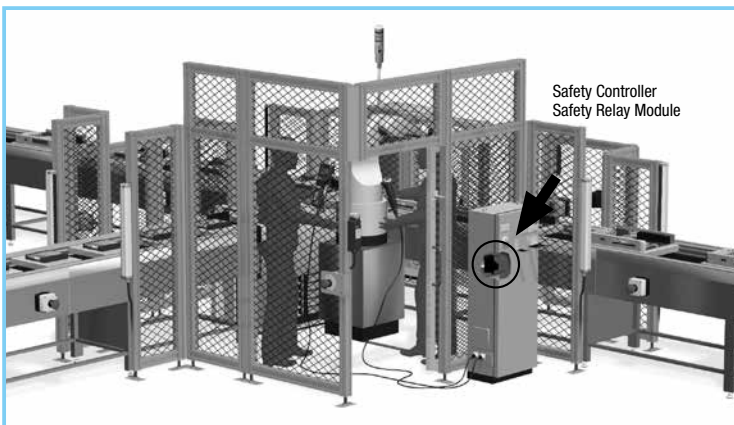
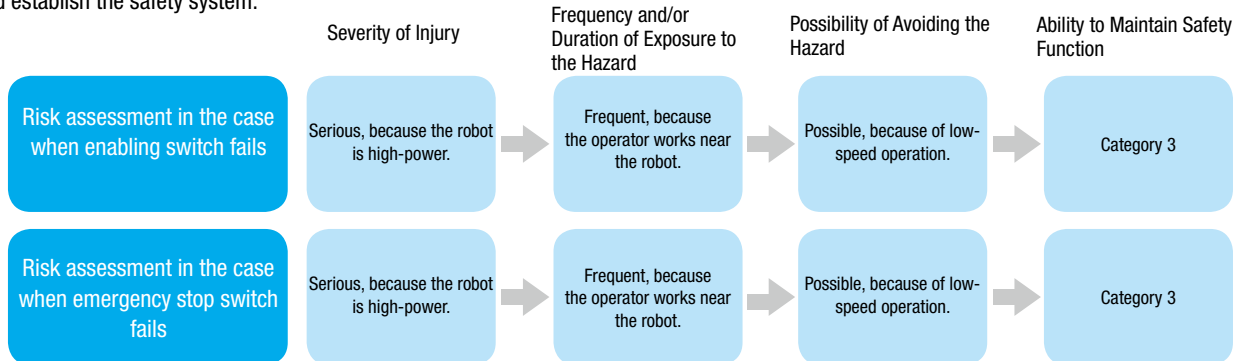


- Install emergency stop switches on the guards. Install an emergency stop switch on the teach pendant. (IEC 60204-1, 10.7.1 "Devices for emergency stop shall be readily accessible.")

If the safety components fail, the system shifts to a hazardous situation. A safe system must be established by selecting the ability to maintain the safety function.

3. Evaluating the Ability to Maintain Safety Function (Category Selection)

Evaluate the risk in the case when safety components fail, select the category (the level of ability to maintain safety function), and establish the safety system.



Establish a safety system of category 3 using safety controller, safety relay modules and other safety components.

Although risk has been reduced to a tolerable level, there is still residual risk.

4. Information for Use

Provide information about residual risk in an instruction manual, hazard sign, and warning device.

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