M210-17020

RIKEN KEIKI

Applications at Universities and Research Institutions and Introduction to Gas Detectors and Alarms for Safety and Security

Document contents

- About Riken Keiki
- Why do we need gas detectors?
  Risks associated with toxic gases
- Applications at universities and research institutions
- Major examples of accidents
- Product information
- International agents

RIKEN KEIKI

About Riken Keiki

About Riken Keiki

RIKEN KEIKI

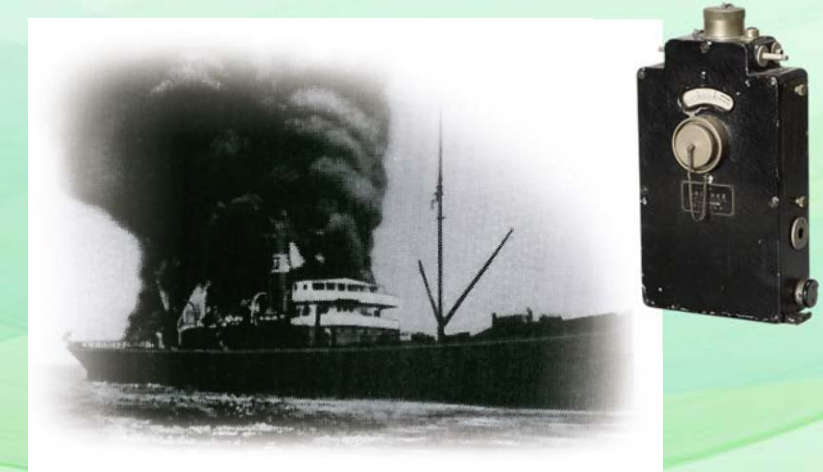
RIKEN

1939

Riken Keiki

Headquarters
To be completed in September 2018 (conceptual drawing)

Riken Keiki was originally established to commercialize and sell detectors for preventing explosions in coal mines and on oil tankers.



About Riken Keiki

Methane gas measurements in coal mine

Optical Gas Indicator Model 3 (1939)

Certification

National heritage of analytical and scientific instruments
2014

Company profile

Company name	Riken Keiki Co., Ltd.	
Established	March 15, 1939	
Location	Headquarters: Development Center:	2-7-6 Azusawa Itabashi-Ku, Tokyo 2-3 Minamisakae-cho, Kasukabe-shi, Saitama
Factories	Hakodate-shi, Hokkaido; Sakurai-shi, Nara (affiliated company)	

Headquarters

To be completed in September 2018
(conceptual drawing)

Development Center

About Riken Keiki

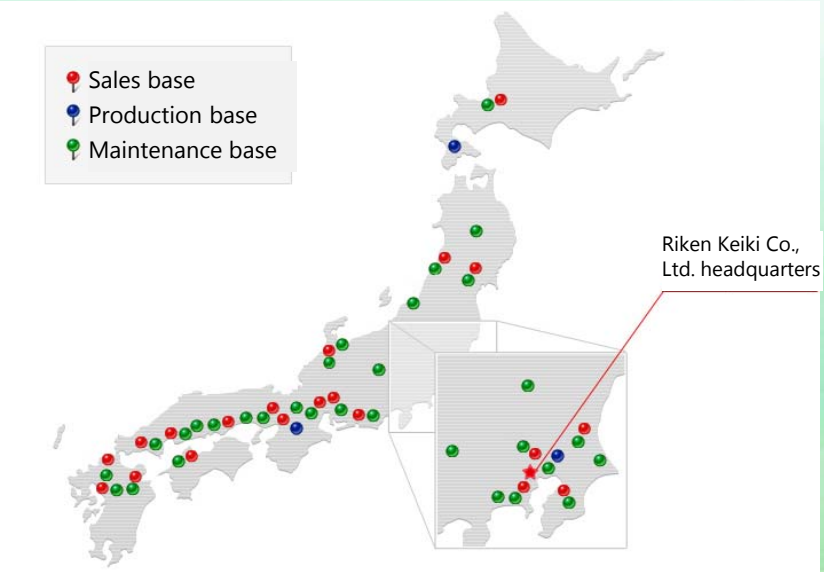
Headquarters
(Itabashi-Ku, Tokyo)

Development Center
(Kasukabe-shi, Saitama)

To be completed in September 2018
(conceptual drawing)

Locations of sales offices

◆Domestic◆



◆Global◆

Company profile

Various bases	Domestic sales and branch offices: 20 locations Service stations: 32 locations Global bases: 7 locations
Major sales items	Combustible gas detectors and alarms Gas detectors and alarms designed to prevent oxygen deficiency accidents Toxic gas detectors and alarms Combined gas detectors and alarms Various measuring instruments for environmental measurements and other instruments
Capital	2,565.5 million yen
Number of employees	965 (non-consolidated), 1,127 (consolidated) * As of September 30, 2017

Hakodate Factory
(Hakodate-shi, Hokkaido)

Nara Factory
(Sakurai-shi, Nara)

Company history

1939	Riken Keiki Co., Ltd. established to produce and sell optical gas detectors, photo-elasticity apparatuses, and other precision instruments invented and developed by RIKEN
1959	Start production and sale of combustible gas alarms and detectors (catalytic combustion type).
1967	Start production and sale of oxygen measuring instruments (OX-1).
1970	Start production and sale of monitoring tape type measuring instruments (FP-200).
1972	Start production and sale of non-dispersive infrared measuring instruments (RI-550).
1975	Start production and sale of electrochemical type measuring instruments (EC-231).
1986	Start production and sale of photoemission yield spectrometers (AC-1).
2009	70th anniversary of founding
2014	Start production and sale of portable X-ray diffractometers equipped with XRF (DF-01).
2015	Start production and sale of portable multi gas detectors (GX-6000), first product of its kind in Japan capable of housing photoionization detectors (PID).

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Why Do We Need Gas Detectors?
Risks Associated with Toxic Gases

Need for gas detectors (combustible gases)

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Criteria set by United Nations' Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

According to the United Nations' Globally Harmonized System of Classification and Labelling of Chemicals (GHS), a combustible gas (or flammable gas) is defined as follows:

A combustible or flammable gas is a gas having an explosive (flammable) range when mixed with air under atmospheric conditions of 20°C and standard pressure of 101.3 kPa.

Gases falling under this definition are further subdivided into the following two categories based on the severity of the associated risk:

Category 1 (Danger: Extremely flammable gas)

Gases capable of igniting at 20°C and standard pressure of 101.3 kPa when occurring in a mixture of 13% or less by volume with air or having an explosive (flammable) range of at least 12% when mixed with air regardless of the lower explosion (flammable) limit

Category 2 (Warning: Flammable gas)

Gases, other than those in Category 1, which are gaseous at 20°C and a standard pressure of 101.3 kPa and have an explosive (flammable) range when mixed with air

We need gas detectors because flammable gas leaks can lead to explosions.

Need for gas detectors (definition of permissible concentration)

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Definition of permissible concentration

Even when workers are exposed to hazardous substances at work sites, no adverse health effects should emerge as long as the airborne concentration of the **hazardous** substance remains below the permissible concentration.

Recommended permissible concentrations have been set by the American Conference of Governmental Industrial Hygienists (ACGIH) and the Japan Society for Occupational Health. We use the **ACGIH** permissible concentrations.

Types of permissible concentrations

- **TWA (Time Weighted Average)**
  Time Weighted Average refers to time-weighted average concentrations over an 8-hour workday and 40-hour workweek of routine work to which workers may be repeatedly exposed without adverse health effects.

- **STEL (Short Term Exposure Limit)**
  Short Term Exposure Limit refers to exposure that does not lead to adverse health effects if each exposure does not exceed 15 minutes, the number of daily exposures does not exceed four, and the exposures are separated by at least one hour.

- **C (Ceiling value)**
  Ceiling Value refers to the upper limit that can never be exceeded.

We need gas detectors because leaks exceeding permissible concentrations can lead to accidents.

How human body reacts to oxygen-deficiency

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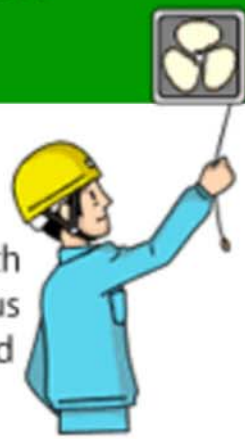
O2 Concentration 21%

Symptoms

Natural air

O2 Concentration 18%



Symptoms

Limit level for not causing serious health problems. Continuous ventilation is required

O2 Concentration 16%-12%

Symptoms

Rapid breathing, Increase in pulse rate, Loss of concentration, Headache, Nausea, Ear ringing

O2 Concentration 14%-9%

Symptoms

Stupor, Headache, Nausea, Cyanosis, Faintness on the entire body

O2 Concentration 10%-6%

Symptoms

Comatose, Loss of consciousness, Muscle spasm on the entire body

O2 Concentration 6% or less

Symptoms

Unconsciousness, Comatose, Cessation of breathing, Cardiac arrest, Die in 6 minutes

Effects of hydrogen sulfide (H_2S) on human body

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Concentration (ppm)	Effects and Toxicity
0.025	Smell vaguely. (It varies according to the individual.)
0.3	Smell clearly.
3 - 5	Smell moderate degree of objectionable odor.
10	Lower-level to irritate eyes' mucus membranes.
20 - 40	A strong odor. Lower-level to irritate lungs' mucous membranes.
100	Sense of smell is impaired in 2 - 15 minutes. Eyes and respiratory tract are irritated in 1 hour. 8 - 48 hours continuous exposure can lead to death.
170 - 300	1 hour exposure is the limit for not causing serious health problems.
400 - 700	Life-threatening exposure in 0.5 - 1 hour.
800 - 900	Bring on loss of consciousness, cessation of breathing and death.
1000	Bring on immediate loss of consciousness and death.

Effects of carbon monoxide (CO) on human body

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Concentration (ppm)	Effects and Toxicity
100	No noticeable effects even after breathing for a few hours.
200	A mild headache in around 1.5 hours.
400 - 500	Headache, nausea and ear ringing in around 1 hour.
600 - 1000	Loss of consciousness in around 1 - 1.5 hours.
1500 - 2000	Headache, vertigo and disabling nausea in around 0.5 - 1 hour, and losing consciousness.
3000 - 6000	Headache, vertigo, disabling nausea...etc. in a few minutes. 10 - 30 minutes exposure can lead to death.
10000	Bring on immediate loss of consciousness and death.

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Applications at Universities and Research Institutions

Hazardous areas hidden in research facilities

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Unexpected accidents can occur in any areas where gases are used or where gases may be generated by specific reactions. These workplace hazards demand appropriate protective measures.

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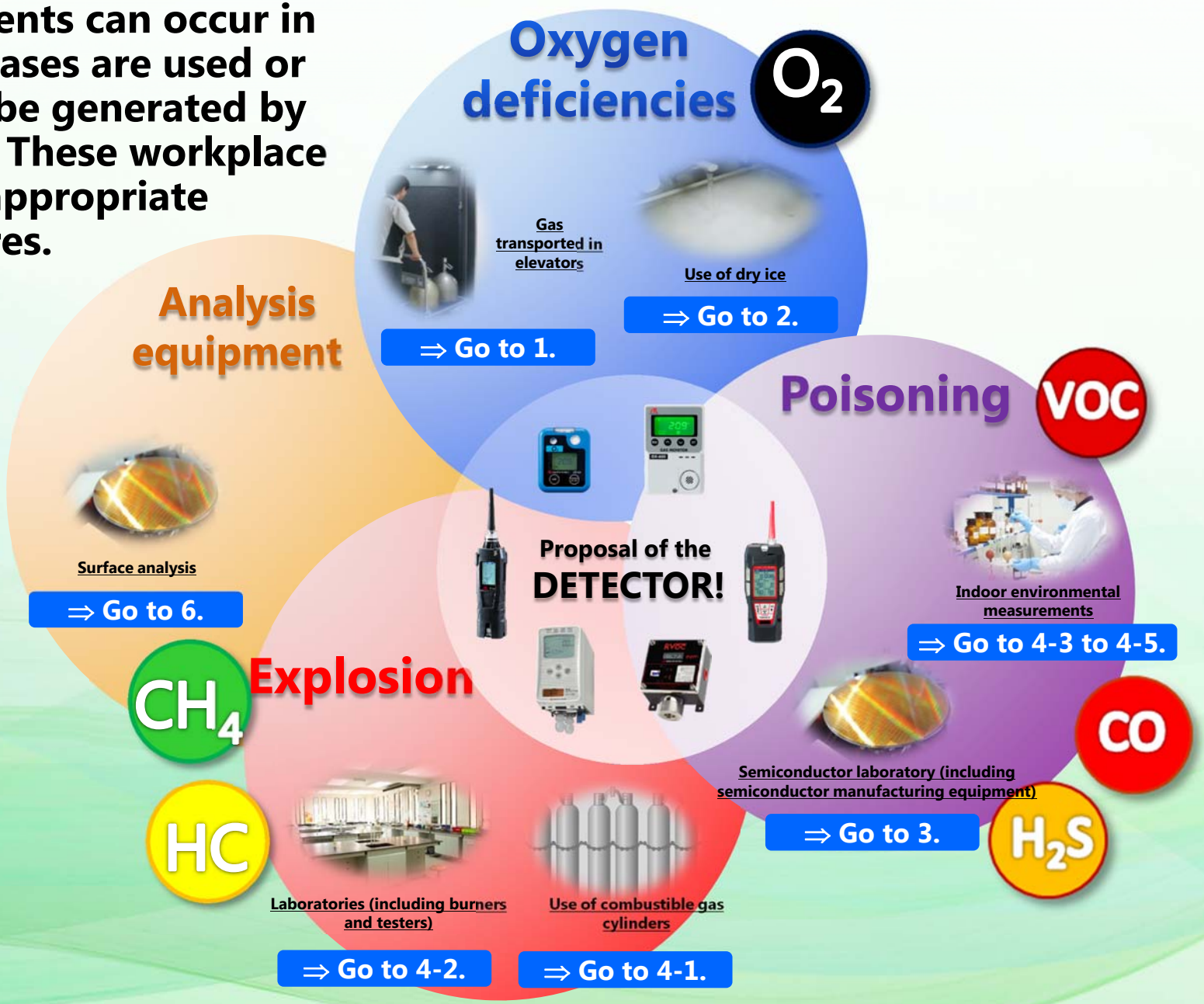
proposes gas detectors and alarms to safeguard against such accidents.



Applications at universities and research institutions

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Hidden risks in research procedures

1. Carrying cryogens in elevators
2. Dry ice used to cool objects in experiments
3. Semiconductor laboratory
4. Applications in laboratories
   - 4-1: Use of gas cylinders
   - 4-2: Use of burners in heating test
   - 4-3: Experiments involving use of glove box
   - 4-4: Tests using draft chamber
   - 4-5: Risks around waste liquid storage area
5. Analysis equipment for research
6. Gases used in analysis equipment

1. Carrying cryogens in elevators

Description: When carrying cylinders of cryogen (such as liquid nitrogen) on a hand cart, etc., a carrier may use elevators.

Hazardous risks: **Leaks of cryogens (e.g., liquid nitrogen) from the cylinder if the container is overturned may cause oxygen deficiencies in the elevator.**

⇒ **Measuring oxygen concentrations to prevent oxygen deficiencies**

Indoor Oxygen Monitor
Model: OX-600

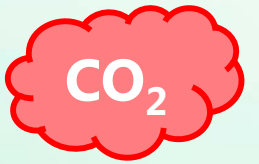
Personal Single Gas Monitor
Model: OX-03

2. Dry ice used to cool objects in experiments

Description: Substances like dry ice (CO_2) are used to cool chemicals used in experiments.

Hazardous risks: **The CO_2 generated by dry ice sublimation may cause CO_2 poisoning or oxygen deficiencies.**

⇒ **Detecting CO_2 to prevent poisoning**
Measuring oxygen concentrations to prevent oxygen deficiencies



Indoor Oxygen Monitor
Model: OX-600

CO_2 Monitor
Model: RI-600

Personal Single Gas Monitor
Model: OX-03

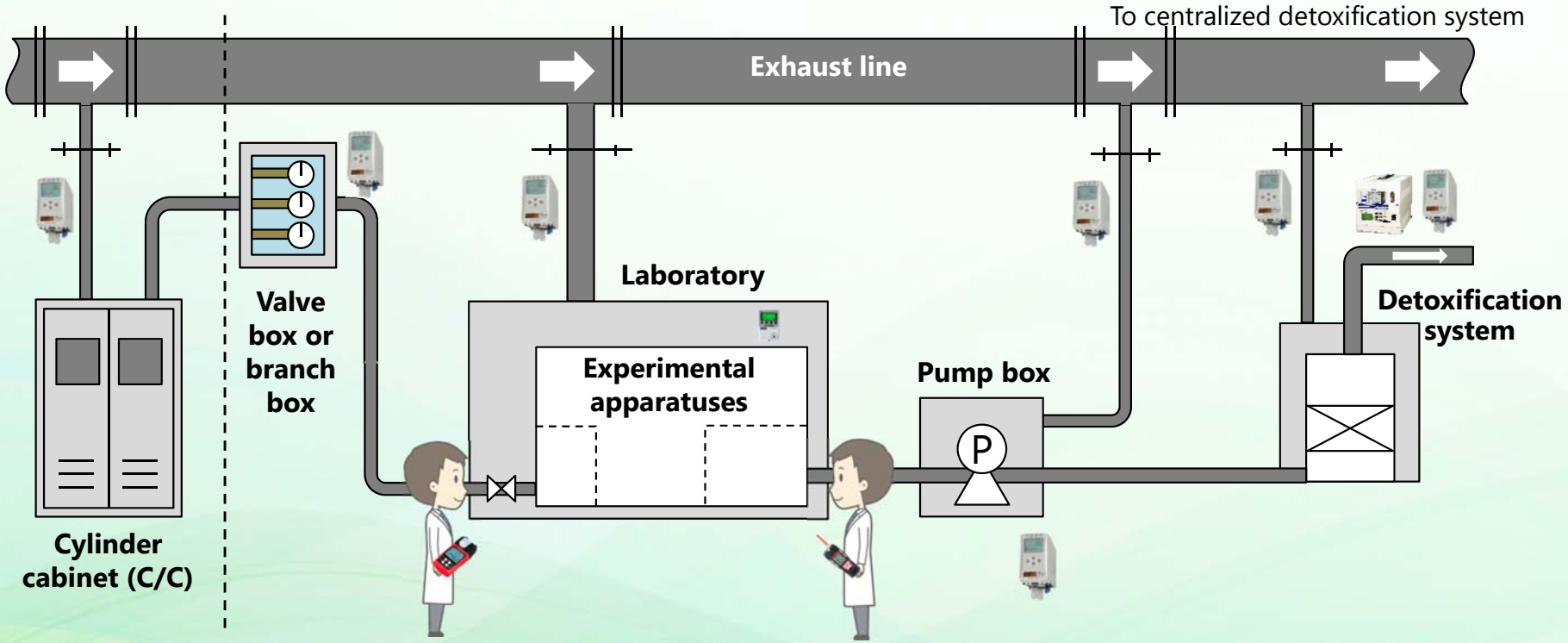
Four Gas Personal Monitor
Model: GX-2009

Personal Four Gas Monitor
Model: GX-6000

3. Semiconductor laboratory

Description: In semiconductor laboratories, researchers seek to improve semiconductor products in processes that involve the use of semiconductor material gases.

Hazardous risks: **Semiconductor material gases may cause poisoning or oxygen deficiencies.** ⇒ **Detecting semiconductor material gases to prevent poisoning or oxygen deficiencies**



Smart Transmitter/ Gas Detector
Model: GD-70D

Highly Sensitive Toxic Gas Monitor
Model: FP-300

Indoor Oxygen Monitor
Model: OX-600

Personal Four Gas Monitor
Model: GX-6000

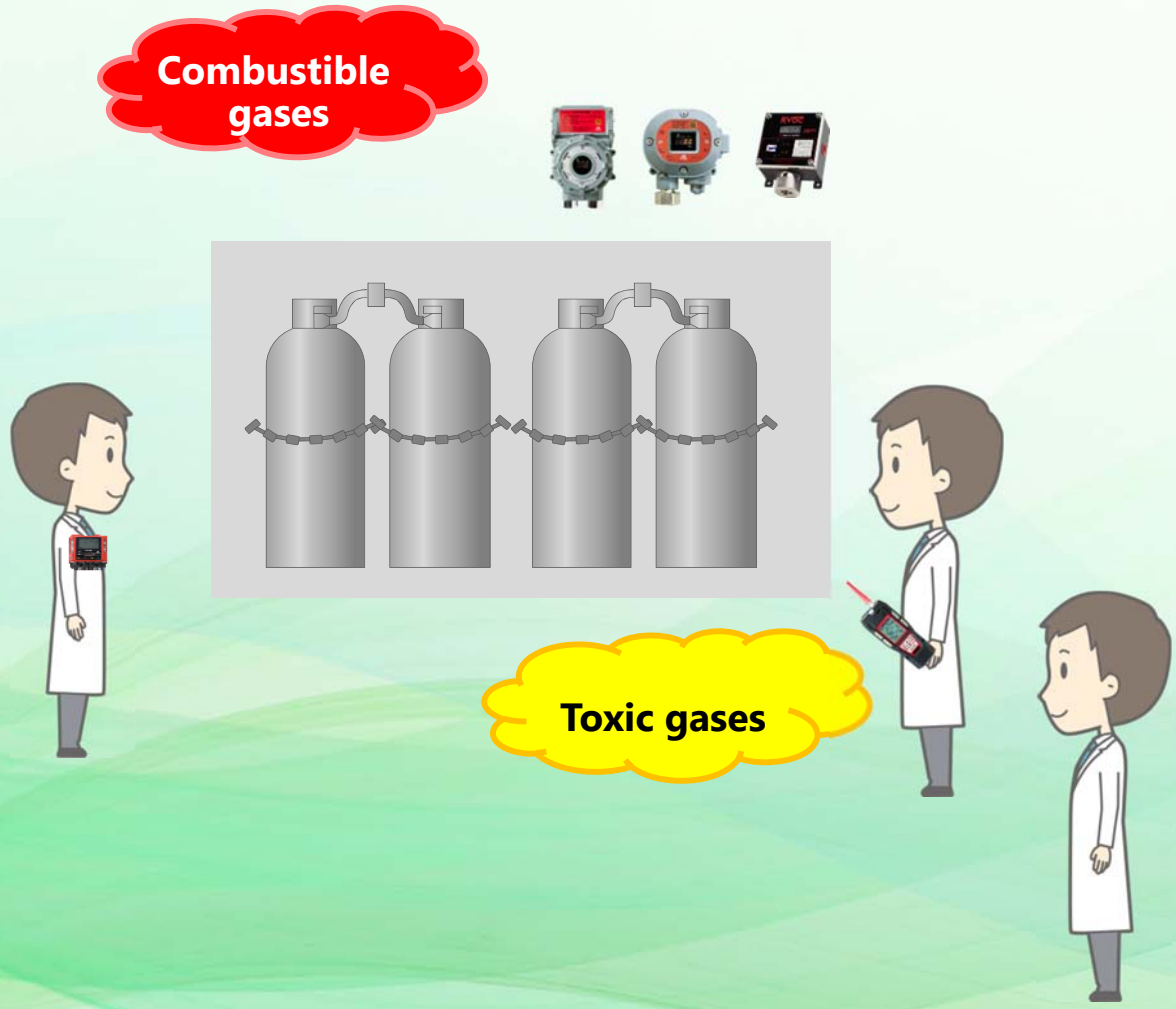
Formaldehyde Gas Detector
Model: FP-31

Personal Single Gas Monitors
Model: 03 series

4-1: Use of gas cylinders

Description: Some laboratories are equipped with cylinders of combustible or toxic gases required for experiments.

Hazardous risks: **Gas leaks from combustible or toxic gas cylinders may cause explosions or poisoning.** ⇒ **Detecting combustible gases to prevent explosions**
Detecting toxic gases to prevent poisoning



Fixed PID VOC Monitor
Model: RVOC

Flame-proof Suction Type Gas Detector
Model: SD-D58

Smart Transmitter/ Gas Detector
Model: SD-1

Smart Transmitter/ Gas Detector
Model: GD-70D

Four Gas Personal Monitor
Model: GX-2009

Personal Four Gas Monitor
Model: GX-6000

4-2: Use of burners in heating test

Description: Burners fueled by town gas, propane gas, and other combustible gases may be used in heating tests.

Hazardous risks: **Leaks of town gas, propane gas, and other combustible gases from burners may cause explosions.**
Incomplete combustion of burner fuel may cause CO poisoning.

⇒ **Detecting town gas, propane gas, and other combustible gases to prevent explosions**
Detecting CO to prevent poisoning

Flame-proof Suction Type Gas Detector
Model: SD-D58

Smart Transmitter/ Gas Detector
Model: SD-1

Indoor Carbon Monoxide Monitor
Model: EC-600

Four Gas Personal Monitor
Model: GX-2009

Personal Single Gas Monitor
Model: CO-03

Portable Gas Leak Checker
Model: SP-220 TYPE SC

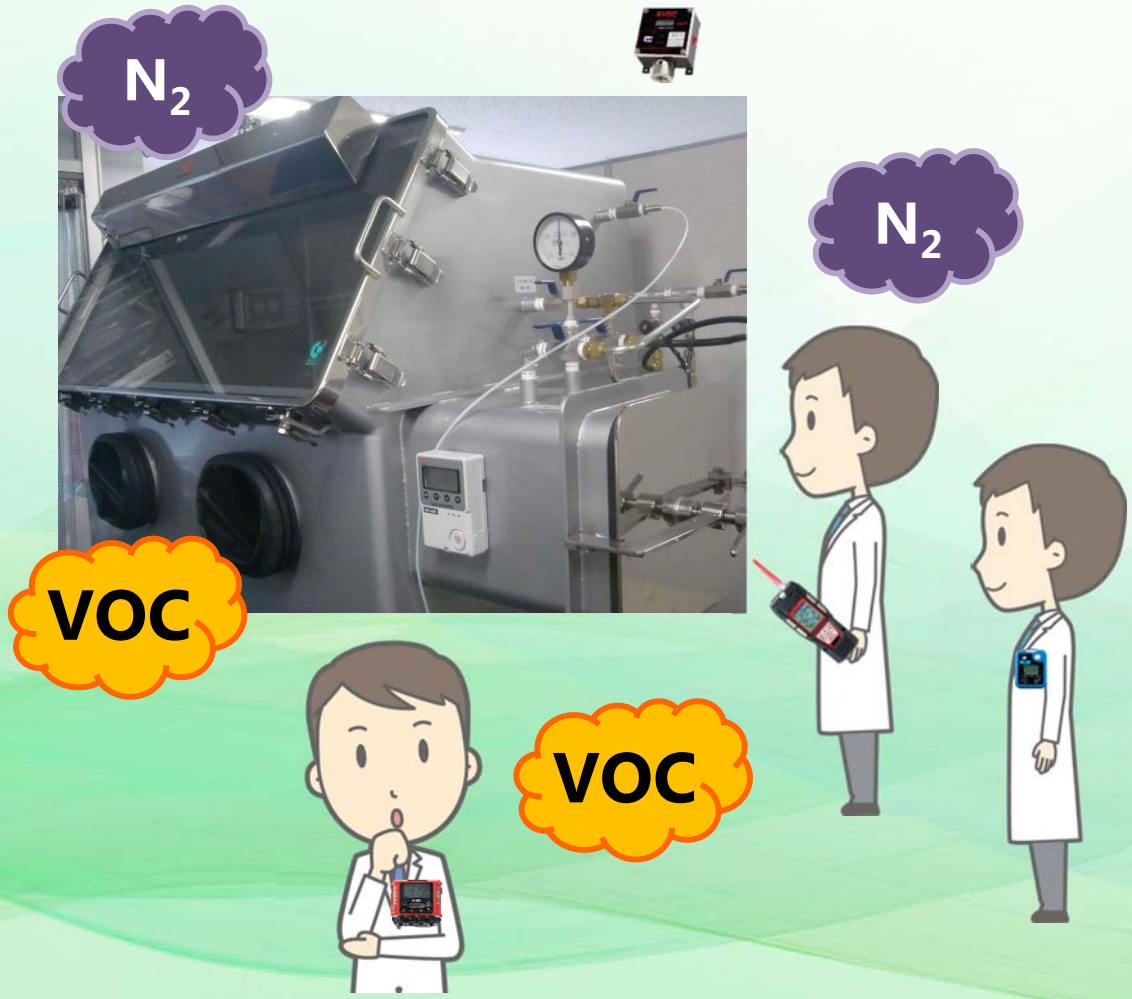
Personal Four Gas Monitor
Model: GX-6000

4-3: Experiments involving use of glove box

Description: A glove box is used to handle substances unstable in air via gloves by filling the inside of the box with N_2 or other inert gas of high purity.

Hazardous risks: **N_2 leaks from the glove box may cause oxygen deficiencies.**
Volatile organic compounds (VOCs) evaporating from organic solvents handled in the glove box may result in cases of poisoning.

⇒ **Measuring oxygen concentrations to prevent oxygen deficiencies**
Detecting VOCs to prevent poisoning



Indoor Oxygen Monitor
Model: OX-600

Fixed PID VOC Monitor
Model: RVOC

Personal Single Gas Monitor
Model: OX-03

Four Gas Personal Monitor
Model: GX-2009

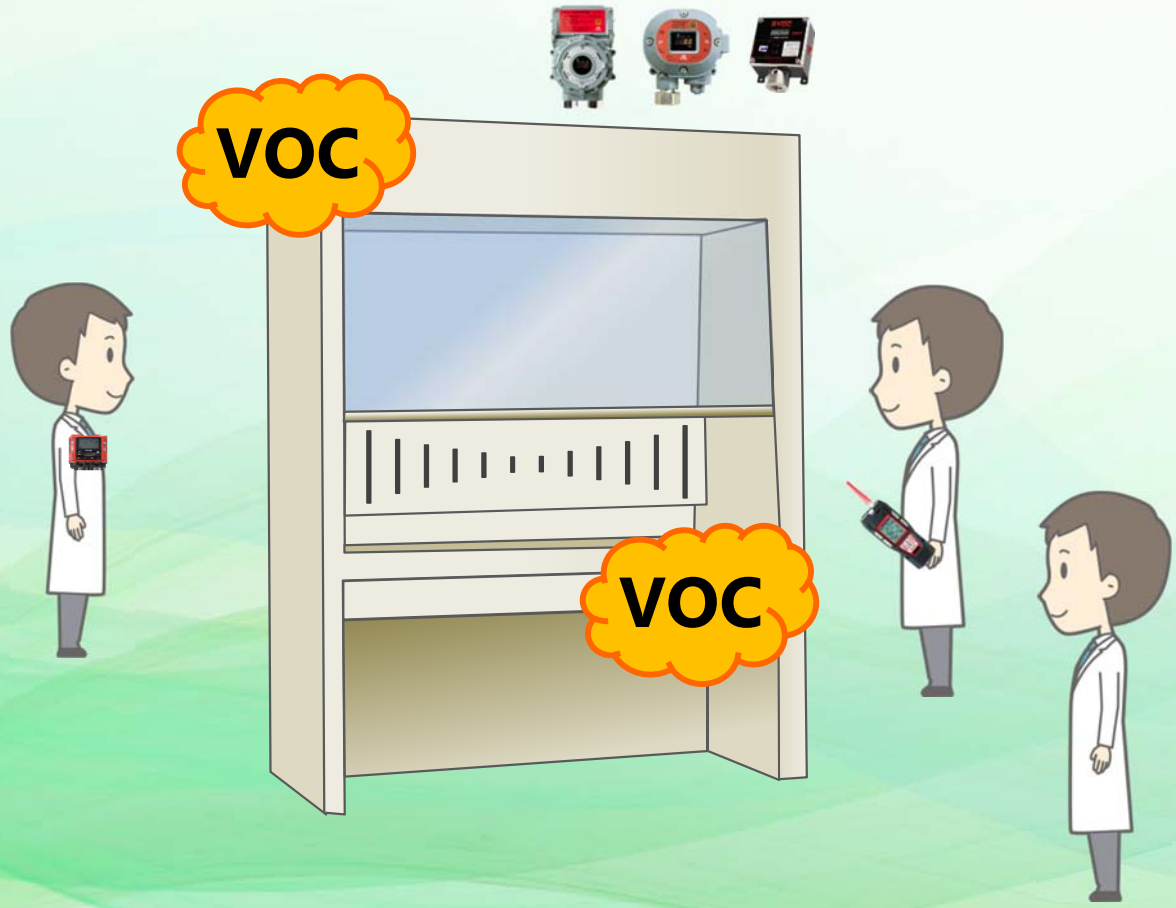
Personal Four Gas Monitor
Model: GX-6000

4-4: Tests using draft chamber

Description: A draft chamber is local ventilation equipment that ensures the safety of workers (such as researchers) by discharging toxic gases generated when using organic solvents in the draft chamber from the room.

Hazardous risks: **During the treatment of waste organic solvents, spills or evaporated volatile organic compounds (VOCs) may cause explosions, poisoning, or oxygen deficiencies.**

⇒ **Detecting VOCs to prevent explosions or poisoning**



Flame-proof Suction Type Gas Detector
Model: SD-D58

Smart Transmitter/ Gas Detector
Model: SD-1

Fixed PID VOC Monitor
Model: RVOC

Four Gas Personal Monitor
Model: GX-2009

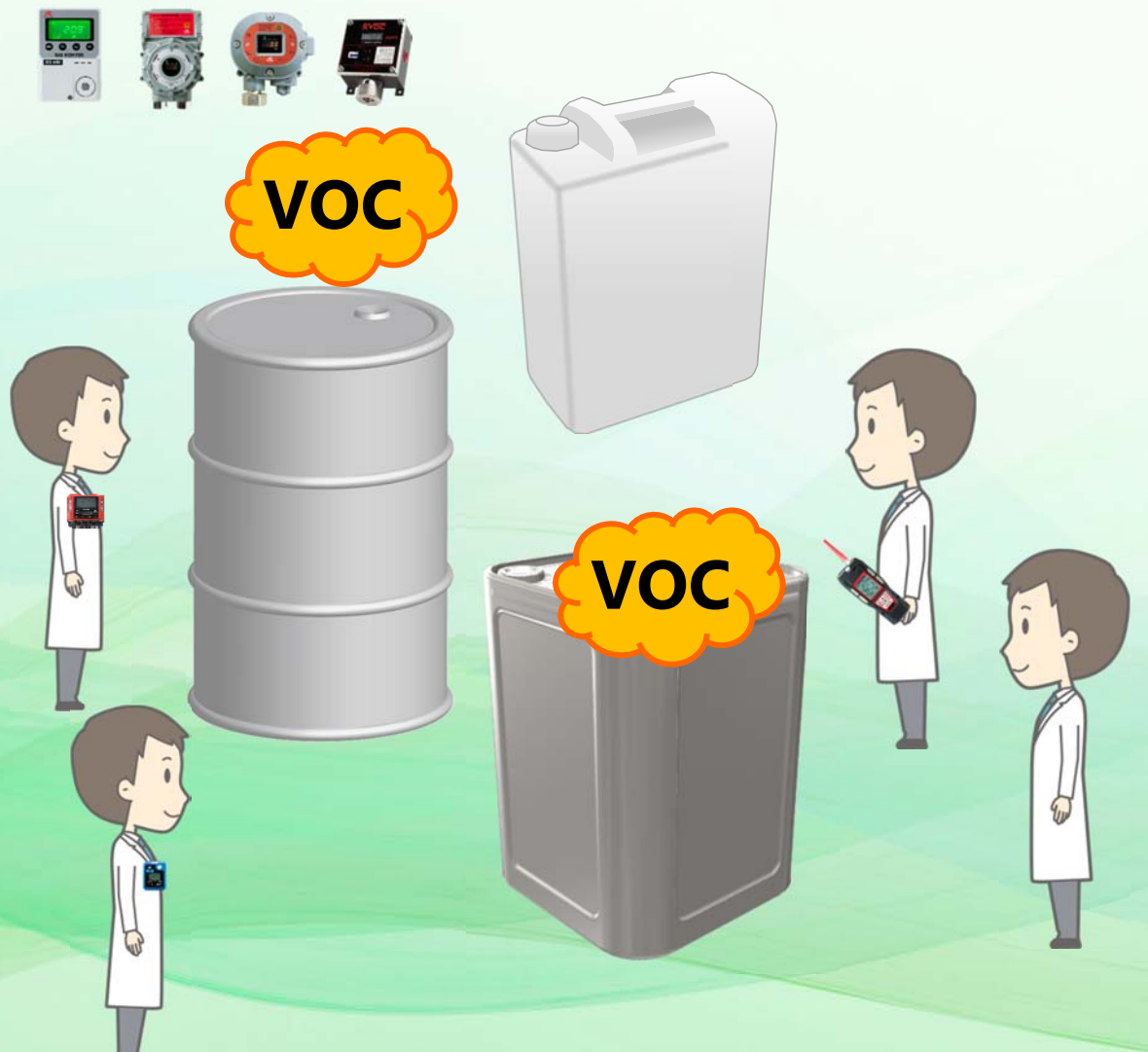
Personal Four Gas Monitor
Model: GX-6000

4-5: Risks around waste liquid storage area

Description: In the waste liquid storage area, plastic containers and drums containing various waste organic solvents are stored until treatment or disposal.

Hazardous risks: **During the treatment of waste organic solvents, spills or evaporated volatile organic compounds (VOCs) may cause explosions, poisoning, or oxygen deficiencies.**

⇒ **Detecting VOCs to prevent explosions, poisoning, or oxygen deficiencies**



Fixed PID VOC Monitor
Model: RVOC

Flame-proof Suction Type Gas Detector
Model: SD-D58

Smart Transmitter/ Gas Detector
Model: SD-1

Indoor Oxygen Monitor
Model: OX-600

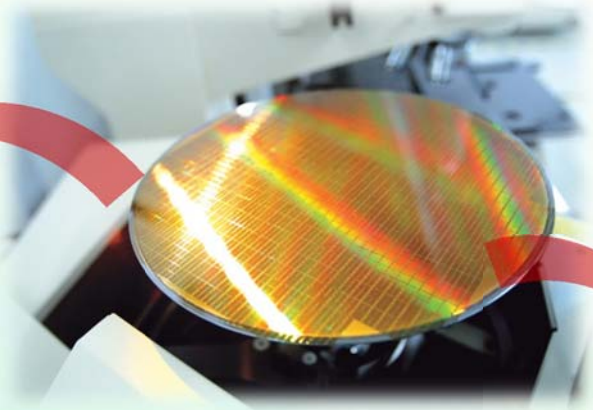
Personal Four Gas Monitor
Model: GX-6000

Personal Single Gas Monitor
Model: OX-03

Four Gas Personal Monitor
Model: GX-2009

5. Analysis equipment for research

Description: To select and manage the materials for charge transfer devices, including organic solar cells, organic EL, organic transistors, and drums for copying machines, the energy level of the highest occupied molecular orbital (HOMO) of the material is important, creating a need to measure HOMO levels. Additionally, glass plates on which transparent conductive oxide (such as ITO, FTO, and SnO_2) films are formed are used as electrodes for displays and solar cells. The extent of the contamination of the surface of the glass plate can be checked by assessing changes in work function.



Atmospheric measurement of the work function and the ionization potential of the measured surface

Photoelectron spectrometer
Model: AC-5

Photoelectron spectrometer
Model: AC-3

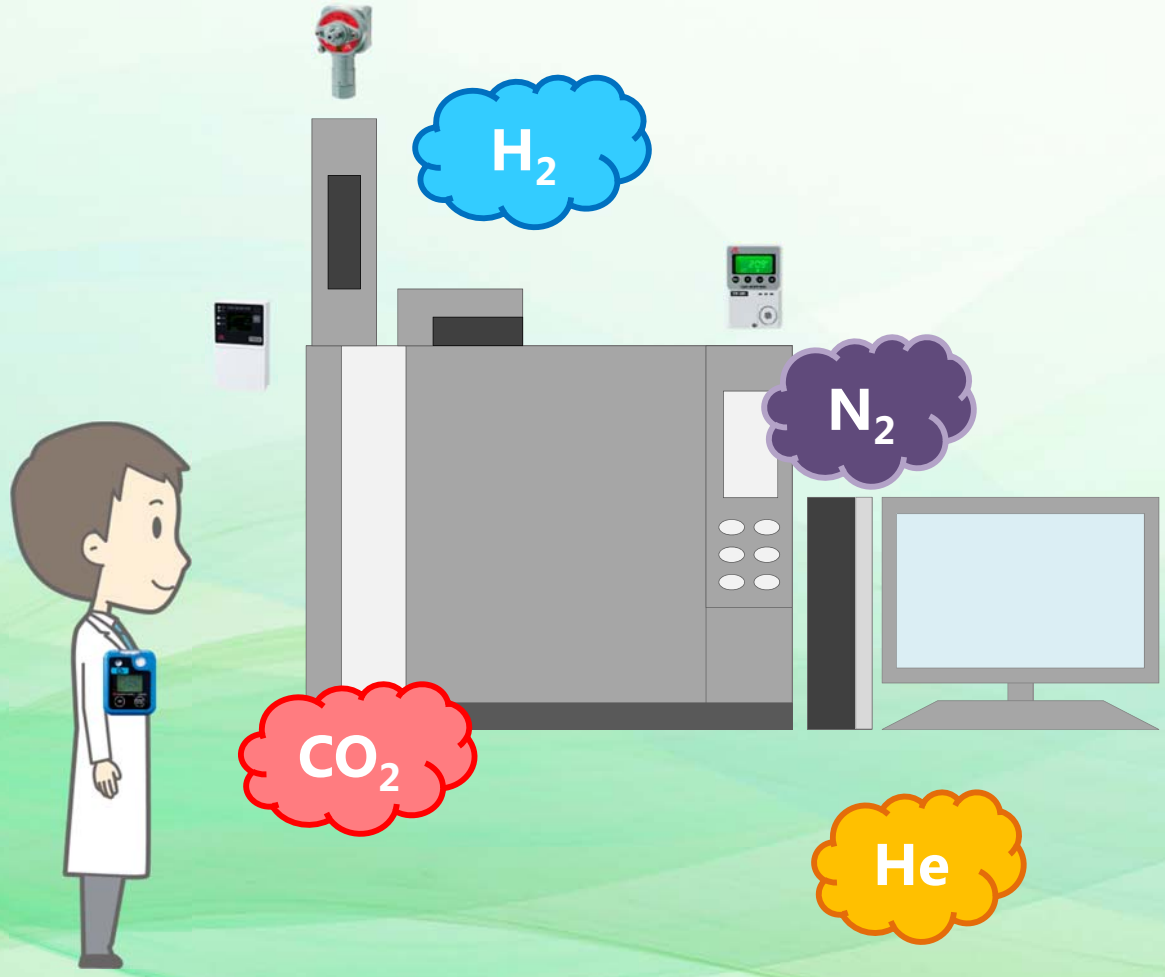
6. Gases used in analysis equipment

Description: Experiments using analysis equipment (such as gas chromatography) may use substances such as dry ice, nitrogen (including liquid nitrogen), helium, and H_2.

Hazardous risks:

The accumulation of gases generated from dry ice, nitrogen (including liquid nitrogen), and helium may cause oxygen deficiencies. ⇒ **Measuring oxygen concentrations to prevent oxygen deficiencies**

Combustible gases (such as H_2) used as carrier gas may cause explosions. ⇒ **Explosion monitoring of combustible gases to prevent explosions**



Combustible Gas Detector Head
Model: GD-A80

Single-Channel Gas Monitor
Model: RM-6000

Indoor Oxygen Monitor
Model: OX-600

Personal Single Gas Monitor
Model: OX-03

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Major Examples of Accidents

Prepared by extracting and processing materials from the Safety at Work Site (Ministry of Health, Labour and Welfare: http://anzeninfo.mhlw.go.jp/index.html)

Hydrogen sulfide poisoning during replacement of hydrogen sulfide cylinders

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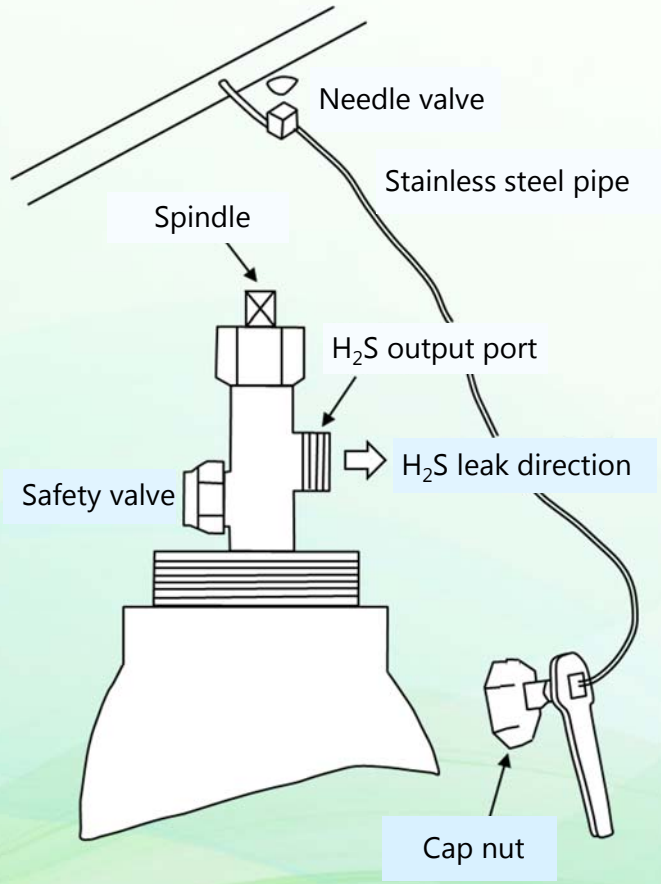
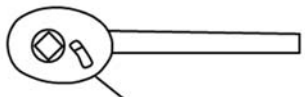


Spindle handle (commonly known as a ratchet)



Switch with selectable direction of rotation (The handle rotates in idle in the opposite direction.)

[Location of accident]

Outdoor cylinder yard in a business establishment performing various inspections and analyses of steelmaking raw materials and products

[Cause of accident]

While replacing the cylinders, the victim moved a cylinder with the spindle handle attached. The cylinder struck the wall, opening the spindle and releasing hydrogen sulfide gas.

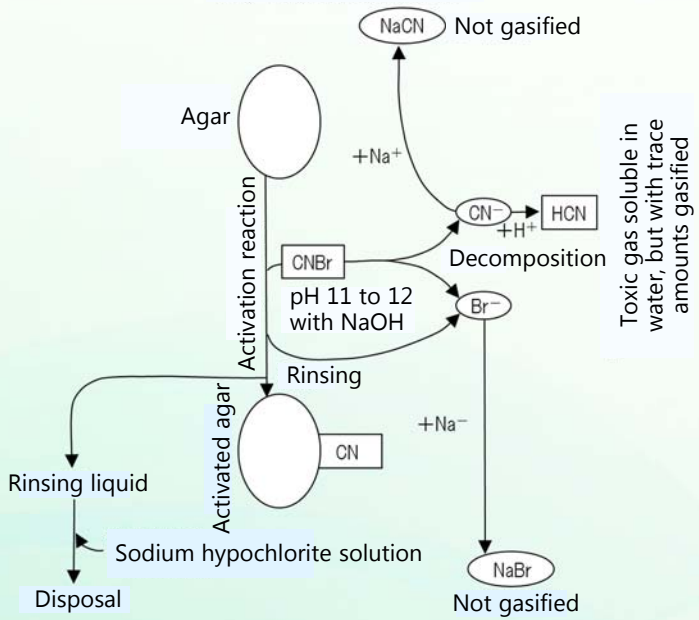
[Damage/injuries]

The victim inhaled the gas and immediately fell unconscious. He was found by a colleague who noticed a noxious odor and was taken to the hospital.

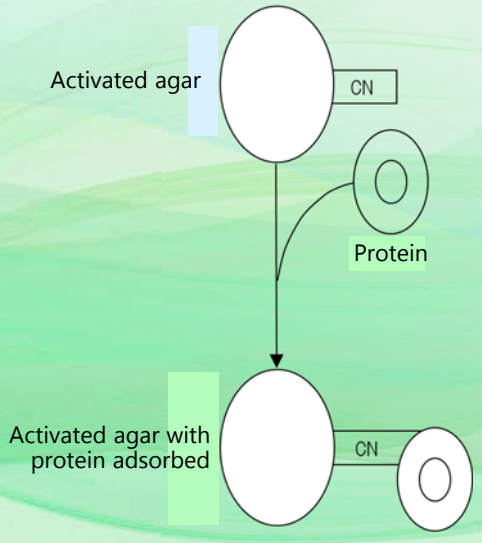
Wearing gas detectors on a routine basis enables early detection of used gas leaks and improves work safety.

Hydrogen cyanide poisoning during research work

(a) Flow of absorbent preparation



(b) Absorption reaction of protein



[Location of accident]

Campus road just outside the laboratory

[Cause of accident]

In the post-treatment process after the adsorbent was prepared, when sodium hypochlorite was added to treat the water from which cyanobromide had been removed, a chemical reaction generated hydrogen cyanide. Since no measures had been implemented to prevent exposure, the worker was exposed to hydrogen cyanide.

[Damage/injuries]

Approximately 30 minutes after the work ended, the worker began to feel nauseous. At the hospital, he was diagnosed with cyanic poisoning and admitted.

Wearing gas detectors on a routine basis enables early detection of toxic gas leaks and improves work safety.

Pouring waste liquid into a waste liquid tank containing water resulted in chlorine gas poisoning and chemical conjunctivitis and subsequent hospitalization.

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[Location of accident]

Waste liquid tank in perfume research procedure

[Cause of accident]

As part of a perfume research procedure, the victim poured waste phosphoryl chloride reagent into a waste liquid tank filled with water for fire prevention. The waste liquid reacted with the water in the tank, generating chlorine gas, to which the victim was exposed.

[Damage/injuries]

The victim was transported to the hospital by ambulance, diagnosed with chlorine gas poisoning and chemical conjunctivitis, and hospitalized.

Wearing gas detectors on a routine basis enables early detection of toxic gas leaks and improves work safety.

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Product Information

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Portable
Multi Gas Detector

Model:
GX-6000

Features

- A single unit can simultaneously display up to six types of gases, including VOCs. This is the first product of its kind from a Japanese manufacturer.
- The PID sensor enables measurements of more than 200 types of chemical substances subject to regulation.
- Ideal for checking the risks and hazards of chemical substances as required under the Industrial Safety and Health Act
- Support for multilingual display (Japanese, English, French, Spanish, etc.)
- Equipped with convenient new functions, including panic alarm and LED flashlight

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Portable Gas Leak Checkers

Model: SP-220 series

Features

- Compact, lightweight; tough, stylish housing
- Fast, reliable detection of gases occurring in low concentrations
- Direct reading of gas concentration level by button operation
- Equipped with data logging function (records up to 256 separate gas detection dates/times + gas concentrations.)
- Equipped with LED light for accurate measurements even in dark locations

List of types

Type	Gas to be detected
TYPE FUM	Fumigant gas
TYPE SC	Semiconductor material gas
TYPE M	Town gas
TYPE L	LPG
TYPE ML	Town gas/LPG (switchable)
TYPE F	Fluorocarbon gas
TYPE H2	Hydrogen gas

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Features

- Suitable for use as an explosion-proof product, even in a hydrogen/acetylene atmosphere
- IP 67 equivalent protection for safe use in outdoor work
- Three-direction alarm lamps and two-direction alarm buzzers to alert both the carrier and those in surrounding areas
- Buzzer volume of 95 dB or more can be clearly heard even in noisy factory environments.
- Simultaneous display of gas concentrations of four components on large LCD screen
- Also equipped with clock display and data logger functions

Four Gas Personal Monitor

Model: GX-2009

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GP-03 (For combustible gases)

OX-03 (For oxygen)

HS-03 (For hydrogen sulfide)

CO-03 (For carbon monoxide)

Features

- Models for use with rechargeable batteries have been added to the product line.
- Standard protective covers protect the main unit from scratches, dirt, and shock.
- Compact, lightweight design doesn't interfere with work.
- Inherently safe and explosion-proof enclosure is ideal for use in hazardous locations.

Personal Single Gas Monitors

Model: 03 series

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Indoor Oxygen Monitor

Model: OX-600

Features

- Large, easy-to-read three-color LCD screen display

First alarm (orange)

Second alarm (red)

- Equipped with pressure correction function to prevent fluctuating readings due to atmospheric pressure
- The product line offers three types of power supply specifications (AC power supply, DC power supply, and dry battery) to suit the power supply available at the installation location.
- Continuous operation for approximately one year on two AA alkaline batteries
  * No alarm; backlight switched off
- Remote measurement at distances of up to 20 m with the remote sensor (sold separately)

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Features

- The high visibility LCD screen illuminates in green, orange, or red, depending on the operational state.
- Allows selection of one of three power supply types based on the usage environment: AC power, DC power, and dry battery specifications
- Allows remote measurement of up to 20 m with optional remote sensor.

Indoor Carbon Monoxide Monitor

Model: EC-600

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Features

- Select from five CO_2 detection ranges:
  0 to 2,000 ppm; 5,000 ppm; 10,000 ppm;
  0 to 2% vol; and 5% vol.
- Compact and lightweight, easy operation

CO_2 Monitor

Model: RI-600

RIKEN KEIKI

SD-D58
(With concentration indicator)

GD-D58
(Without concentration indicator)

Features

- Suitable for use as an explosion proof product even in hydrogen atmospheres
- Equipped with automatic flow rate abnormality detection function
- Integrated assemblies of replacement parts improve maintainability.
- Dustproof/waterproof enclosure (IP 67 equivalent)
- One-person maintenance possible

Flame-proof Suction Type Gas Detector

Model: SD-D58

Model: GD-D58

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SD-1
SD-1RI
(For combustible gases)

SD-1GH
(For combustible/ toxic gases)

SD-1EC
(For carbon monoxide/ hydrogen sulfide)

SD-1OX
(For oxygen)

Smart Transmitter/
Gas Detectors

Model: SD-1 series

Features

- Suitable for use as an explosion-proof product, even in a hydrogen/acetylene atmosphere
- Waterproof/dustproof enclosure (IP 65 equivalent) allows deployment in severe environments.
- Supports HART Communication Protocol, allowing transmission of more information over legacy analog 4-20 mA connection.
  * Excluding SD-1 (TYPE NC)
- SD-1RI, SD-1EC, and SD-1OX are SIL 2 certified in all parts of the functional safety standard, marking a first for Japanese manufacturers.
- Using the suction cap for the SD-1 series and connecting the detector to a suction pump or an aspirator unit enables suction type operation.

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GD-A80
(For combustible gases)

GD-A80V
(For combustible/toxic gases)

Features

- Explosion-proof rating Exd II CT4 allows use in hydrogen and acetylene atmospheres.
- Suction type and aspirator suction type operations are supported.
  (* A pump unit and a power supply [available separately] are required.)

Combustible/Toxic Gas Detector Heads

Model: GD-A80 series

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Features

- Equipped with photoionization detector (PID) optimum for VOC detection
  Support for three measurement ranges (0-10/100/1,000 ppm)
  Sensor structure resists effects of humidity and keeps foreign materials away from lamp.
  Measurement cycles configurable up to 5 minutes and 50 seconds at intervals of 10 seconds (Default: 1 minute)

- Various functions with high working efficiency
  Easily installed in control system (4-20 mA output)
  Switchable type (RVOC-10s) models are available.

Fixed PID VOC Monitor

Model: RVOC

RIKEN KEIKI

Features

- Easy-to-read three-color LCD display recognizable from a distance
- Single-point indicator/alarm unit
- Lock-in specification selectable (optional)
- RS-485 communication support (optional)

Single-Channel Gas Monitors

Model: RM-6000 series

RIKEN KEIKI

Features

- Measures the work function and ionization potential in air in approximately 5 minutes.
- Measures samples of up to 180 mm × 180 mm.
- Capable of measuring 25 samples in succession

Atmospheric Photoelectron
Yield Spectrometer

Model: AC-5

RIKEN KEIKI

Features

- Allows easy measurement of the density of states near the highest occupied molecular orbital, work function, and ionization potential in air.
- Measures the characteristics of the topmost surface at nanometer scales and the thickness of extremely thin films (0 nm to 20 nm).
- Measures powdered or liquid samples that can’t be moved into vacuum.
- Allows rapid measurement (around 5 minutes per measurement).

Atmospheric Photoelectron
Yield Spectrometer

Model: AC-3

RIKEN KEIKI

International Agents

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International Agents

North America

South America

Asia and Pacific

Russia and Central Asia

Europe

Middle East

Africa

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International agents (table of contents)

North America	U.S.A.				
South America	Brazil	Argentina	Peru	Chile	Uruguay
Asia and Pacific	China	South Korea	Taiwan	Singapore	Malaysia
	Indonesia	Thailand	India	Vietnam	Philippines
	Australia				
Europe	Germany	Greece	THE NETHERLANDS	Norway	Turkey
	U.K.				
Middle East	U.A.E.	Israel			
Africa	South Africa				
Russia and Central Asia	Russia				

RIKEN KEIKI

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