

High-pressure gas safety management  
committee

Incorporated Municipal University

Tokyo Metropolitan University

**How to use gas safely !**



大陽田中  
The Gas Professionals



**Nissan Tanaka Corporation**

**April 20 and 26, 2012**



# 1. Safe use

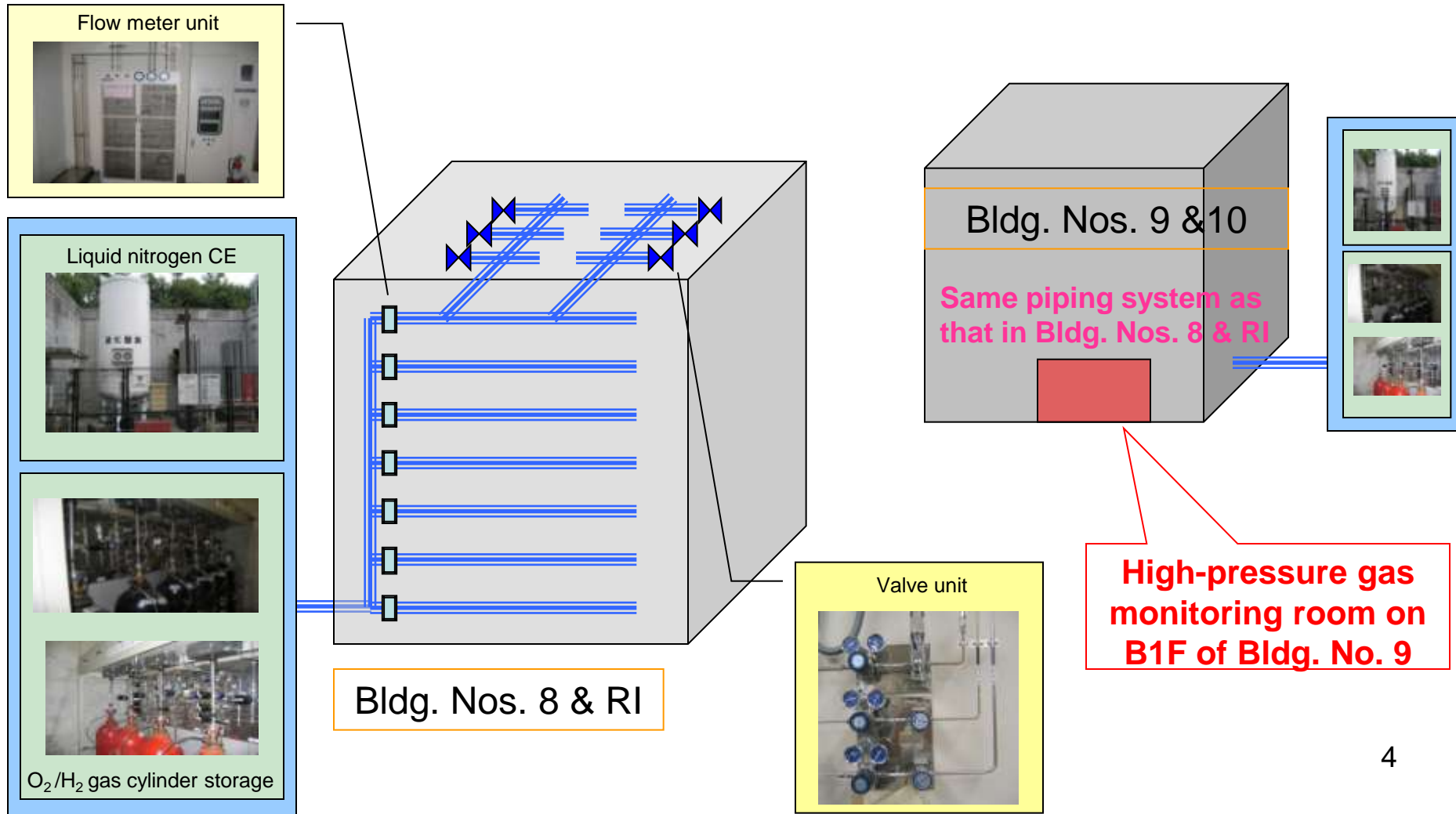


# Overview of centralized gas piping system



**TAIYO NIPPON SAN SO**  
The Gas Professionals

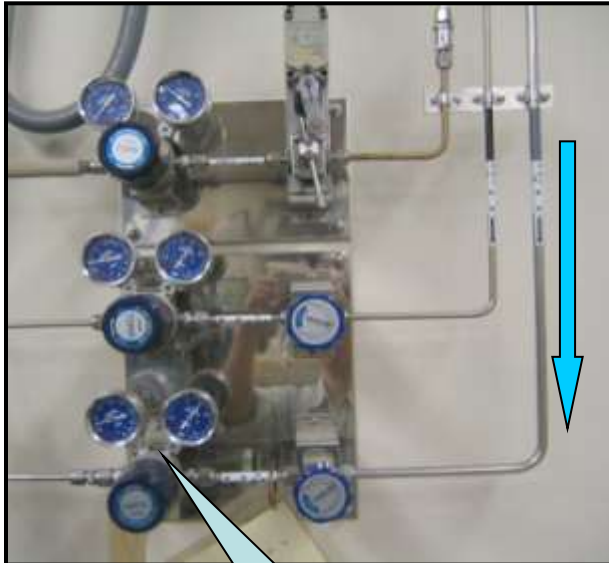
**Three gases ( $N_2$ ,  $O_2$ , and  $H_2$ ) are delivered from two supply facilities by the centralized gas piping system to more than 500 laboratory valve units.**





# Supplied gas NOT high pressure

## 1. Gas supplied from central pipes



Pressure of gas supplied from  
CE is set at 0.7 - 0.8 MPa

## 2. Gas from cylinders



Primary pressure: 14.7 MPa

Used with a pressure regulator  
(pressure-reducing valve)

Secondary pressure: Arbitrary  
pressure of <1 MPa

In either case, gas is  
used at <1 MPa

# Definition of high-pressure gas

(Article 2, High-pressure Gas Safety Act)



TAIYO NIPPON SAN SO  
The Gas Professionals

## 【Compressed gas】

1. **Compressed gas** that attains a pressure of  $\geq 1$  MPa at normal operation temperature, or is  $\geq 1$  MPa; or that attains  $\geq 1$  MPa at  $35^{\circ}\text{C}$
2. **Compressed acetylene gas** that attains a pressure of  $\geq 0.2$  MPa at normal operation temperature, or is  $\geq 0.2$  MPa; or that attains  $\geq 0.2$  MPa at  $15^{\circ}\text{C}$


## 【Liquefied gas】

3. **Liquefied gas** that attains a pressure of  $\geq 0.2$  MPa at normal operation temperature, or is  $\geq 0.2$  MPa; or that requires  $\leq 35^{\circ}\text{C}$  to attain a pressure of  $\geq 0.2$  MPa
4. Of the liquefied gases, the pressure of which is 0 Pa or higher at  $35^{\circ}\text{C}$ , those specified by a Cabinet Order
  - Liquefied hydrogen cyanide
  - Liquefied methyl bromide
  - Liquefied ethylene oxide



“Reduced-pressure gas” is used.

Obviously, it retains the physical properties of gas, such as combustion-enhancing, flammable, and toxic properties.



Naturally, the necessary safety measures should be taken.

For example:

- Eliminate harmful effects of exhaust gas and enforce measures for neutralization
- Enforce measures and conduct training in preparation for gas leakage
- Inspect gas equipment used



## 2. Pressure regulator

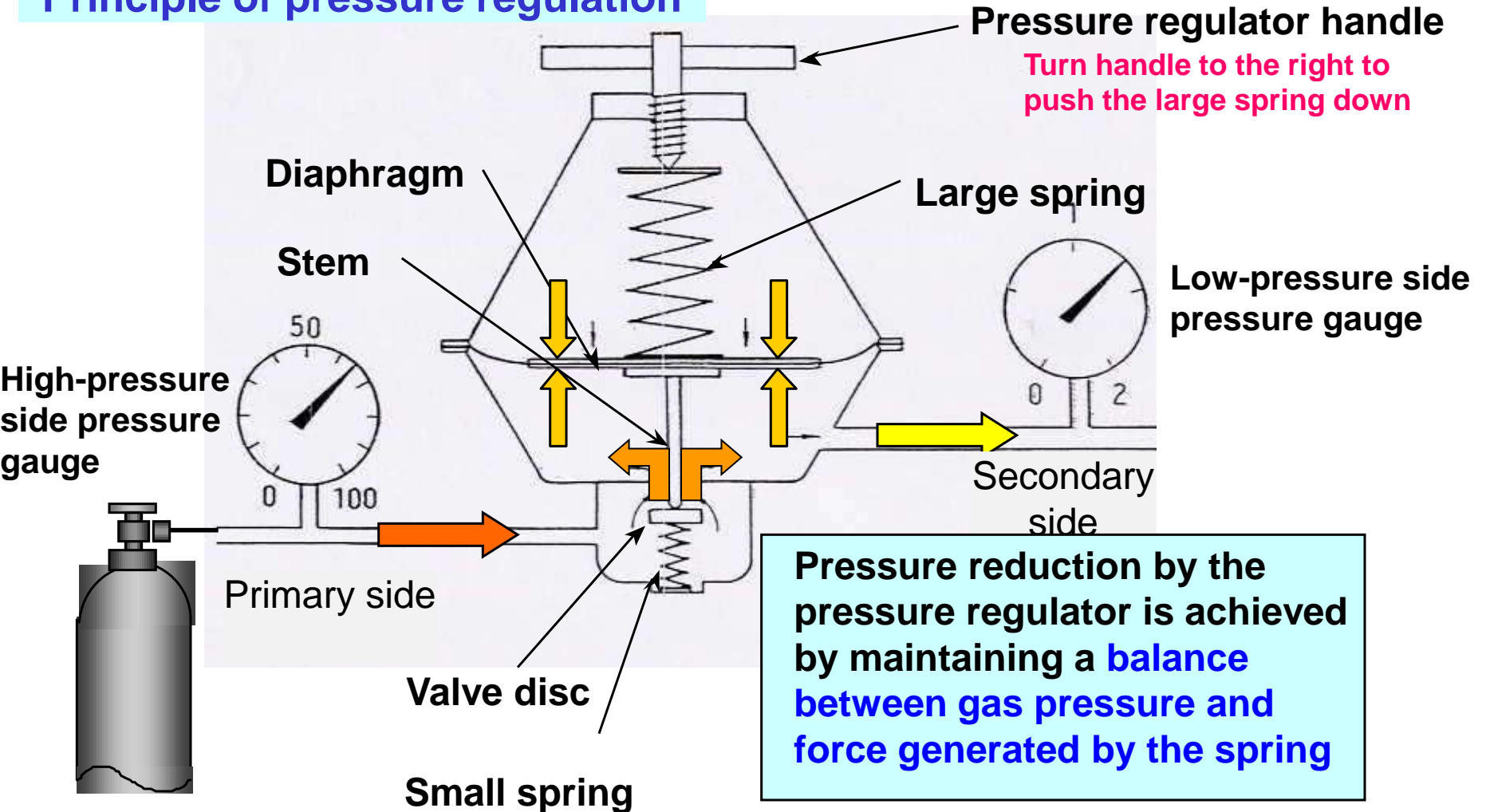


# Structure of the pressure regulator



TAIYO NIPPON SAN SO  
The Gas Professionals

## Principle of pressure regulation





# Pressure regulator damage



TAIYO NIPPON SANOS  
The Gas Professionals



## Cause

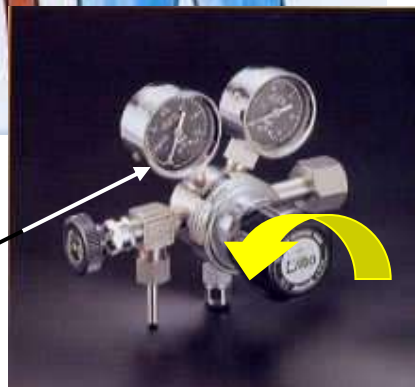
When the cylinder master valve is opened **with the regulator handle turned all the way to the right**, the full internal pressure of the cylinder (14.7 MPa) is directed to the regulator, **damaging the low-pressure side pressure gauge**.

## Measures

Before attaching the regulator to the cylinder, **loosen the regulator handle**.

**Do not face the front of the pressure gauge.**

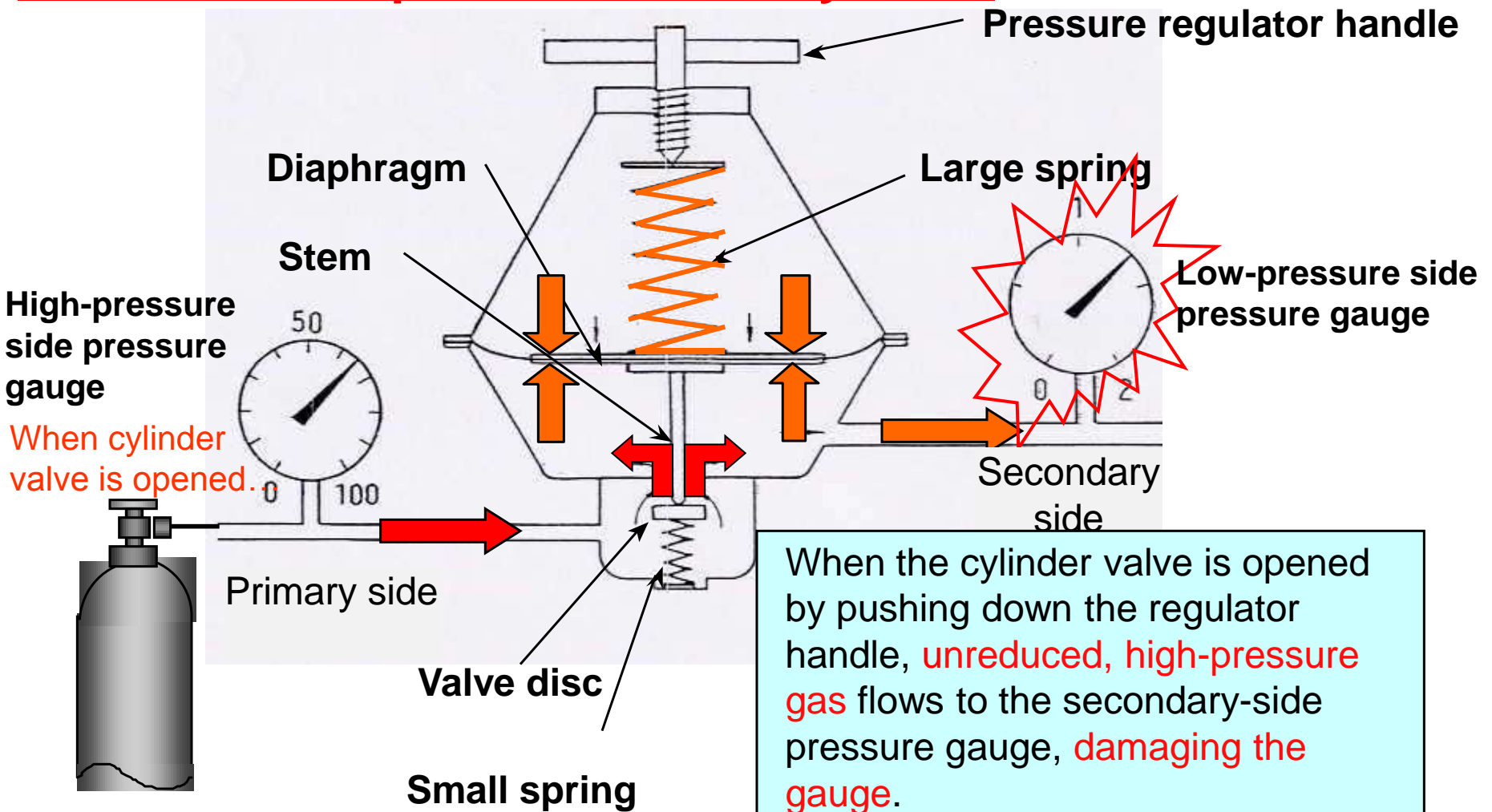
Low-pressure side  
pressure gauge





# Handling the pressure regulator

If the handle is pushed all the way down



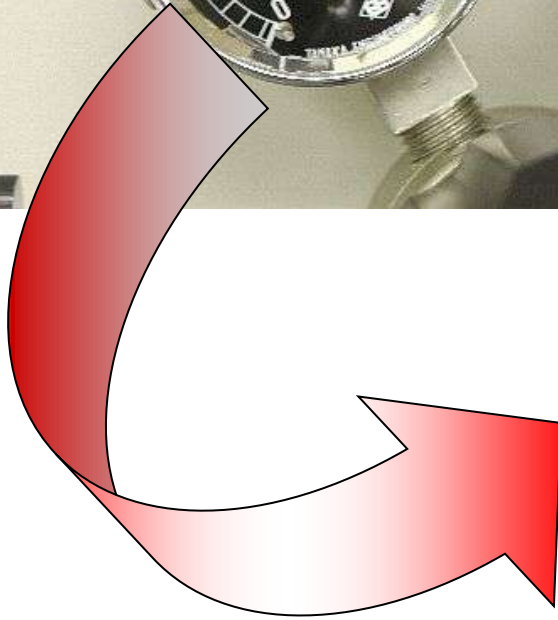
# Pressure regulator damage



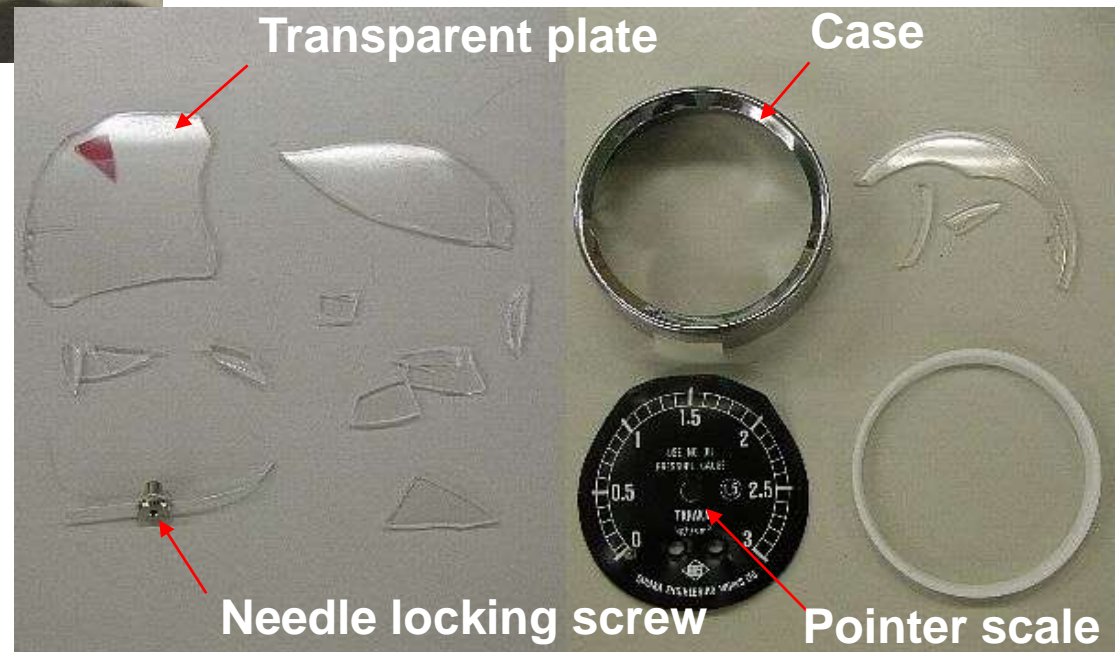
**TAIYO NIPPON SAN SO**  
The Gas Professionals



**Low-pressure side  
pressure gauge**



**Example of damage caused  
by high-pressure gas**



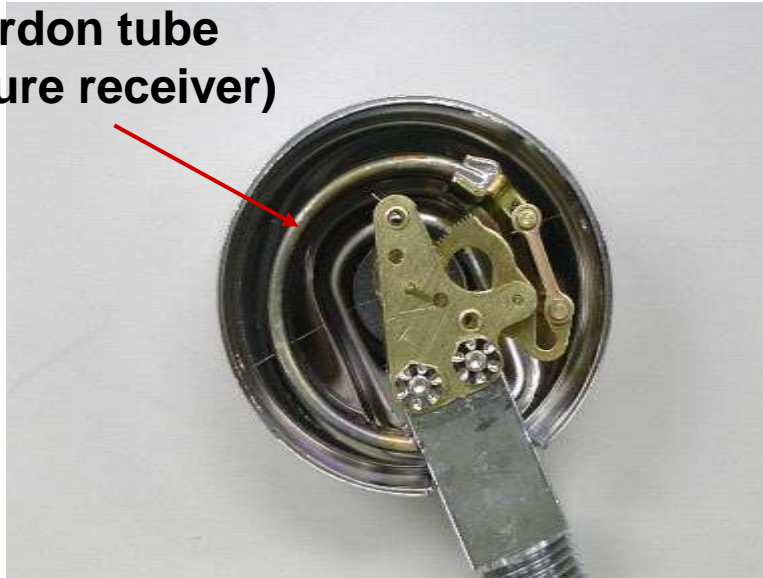
# Pressure regulator damage



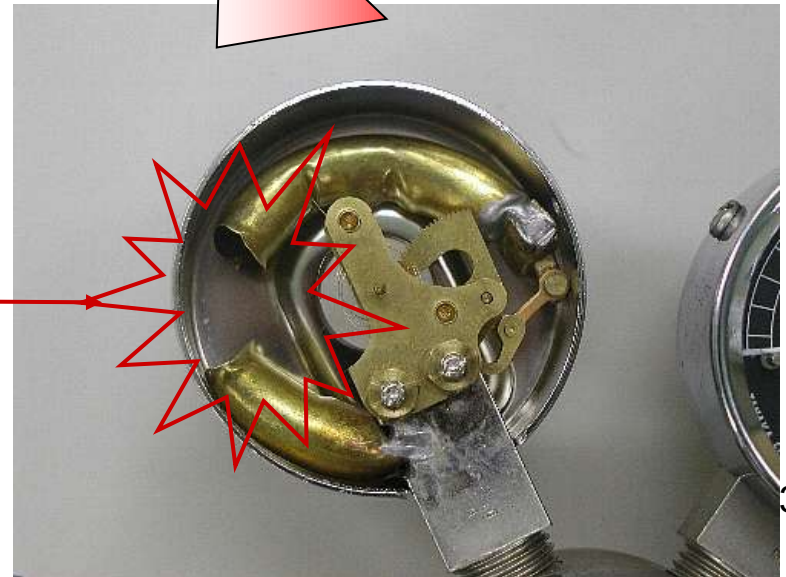
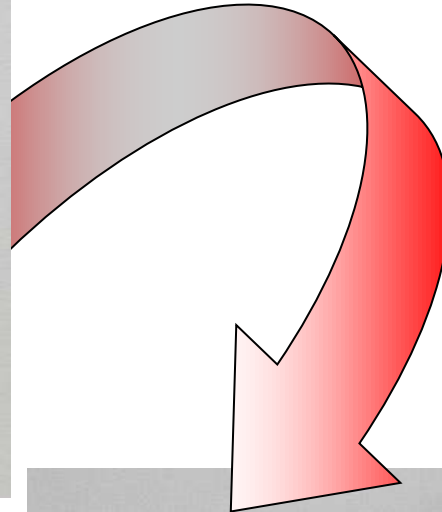
**TAIYO NIPPON SAN SO**  
The Gas Professionals

## Inside of the damaged low-pressure side pressure gauge

Bourdon tube  
(pressure receiver)



The Bourdon tube  
expanded and ruptured  
due to high pressure



Example of damage caused  
by high-pressure gas





## Handling the pressure regulator

**Caution!**

(1) Before attaching the regulator to the cylinder, **loosen the regulator handle**.

\*Loosen the handle by **turning to the left**.

(2) **Gently open the cylinder valve** so that the pressure gradually rises.

(3) **Check air tightness** of the attachment parts by using foaming liquid, etc.

(4) Set the regulator outlet pressure to an arbitrary pressure by **turning the handle to the right (clockwise)** while looking at the low-pressure side gauge.

(5) After use, **loosen the regulator handle**.

(6) **Do not face the front of the** pressure regulator **gauge**.





# Regulator and cylinder valves

Cylinder valve outlet	Regulator inlet	Typical gas
W22-14- <b>right</b> male screw	W22-14- <b>right</b> cap nut	Nitrogen, argon, carbon dioxide, air, oxygen, <b>inert gas</b> (mixed)
W22-14- <b>left</b> male screw	W22-14- <b>left</b> cap nut	Hydrogen, methane, ethylene, ethane, <b>flammable gas</b>
<b>W20.9</b> -14- <b>left</b> male screw	<b>W20.9</b> -14- <b>left</b> cap nut	<b>Helium</b>
<b>Screw is non-threaded</b>	M22-P2 (iron frame or clamp)	Acetylene
W22.5-14-left female screw	W22.5-14-L male screw	LPG (for household use)

**Cylinder valves have almost the same standards as those listed above.  
Cylinder valve combinations may differ depending on the filled gas.**



# 3. High-pressure gas cylinders

(1) Types of cylinders

(2) Cylinder label

(3) Reexamination period



### 3. High-pressure gas cylinder



TAIYO NIPPON SANSO  
The Gas Professionals

High-pressure gas cylinders include **those with welded seams** (welded gas cylinders) and **those without seams** (seamless gas cylinders).

Mainly liquefied, low saturated-vapor-pressure gases are filled in welded gas cylinders.

Typical gases: acetylene, LPG, liquefied nitrogen, liquefied oxygen, butane, Freon, etc.

Compressed gases having high filling pressure are filled in seamless gas cylinders.

Typical gases: compressed oxygen, compressed nitrogen, helium, argon, neon, compressed hydrogen, methane gas, carbon dioxide gas, etc.



# 3. High-pressure gas cylinder



TAIYO NIPPON SANSO  
The Gas Professionals

## Types of welded gas cylinders



### 3. High-pressure gas cylinder



TAIYO NIPPON SAN SO  
The Gas Professionals

## Cylinders without seams (seamless gas cylinders)



3.4L - 20L cylinders



20L - 68L cylinders



470L cylinder



700L cylinder

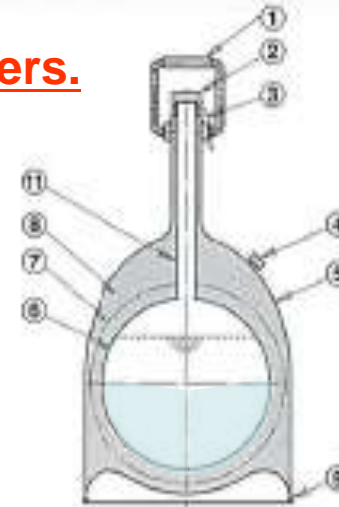
# 3. High-pressure gas cylinder



TAIYO NIPPON SANSO  
The Gas Professionals

## Structures of ultralow-temperature cylinders

These are not high-pressure gas cylinders.



CEBELL 5L/10L types

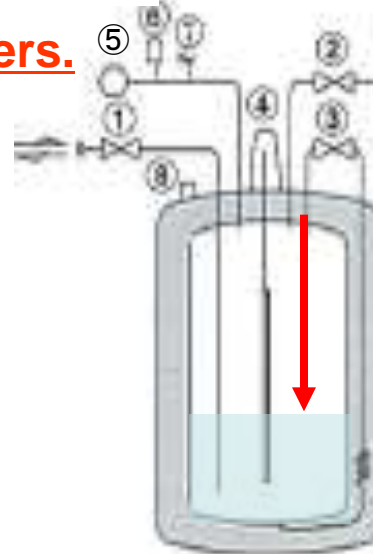
1. Handle
2. Cap
3. Chain for cap
4. Vacuum inlet valve
5. Outer tank
6. Inner tank
7. Special insulation material
8. Vacuum insulation layer
9. Outer tank rubber bottom

“CEBELL” small lightweight liquefied nitrogen cylinders

These are high-pressure gas cylinders.



Made of iron (left) and stainless steel (right)



1. Filling/outlet
2. Gas release valve
3. **Pressurization valve**
4. Liquid inlet/level meter
5. Pressure gauge
6. Inner tank safety valve
7. Inner tank explosion-proof valve
8. Exhaust and vacuum safety valve

Pressurization  
coil

# 3. High-pressure gas cylinder



TAIYO NIPPON SAN SO  
The Gas Professionals

**Cylinder label** (Article 46, High-pressure Gas Safety Act) Article 10, Container Safety Rules

## 1. Specified paint color: more than half of the cylinder surface area

Oxygen gas = Black, Hydrogen gas = Red, Liquefied carbon dioxide = Green, etc.

## 2. (1) Name of high-pressure gas

(2) Letters indicating high-pressure gas properties: “燃 (flammable),” and “毒 (toxic)”

## 3. Name or title of cylinder owner, address, and phone number



燃

毒



### 3. High-pressure gas cylinder



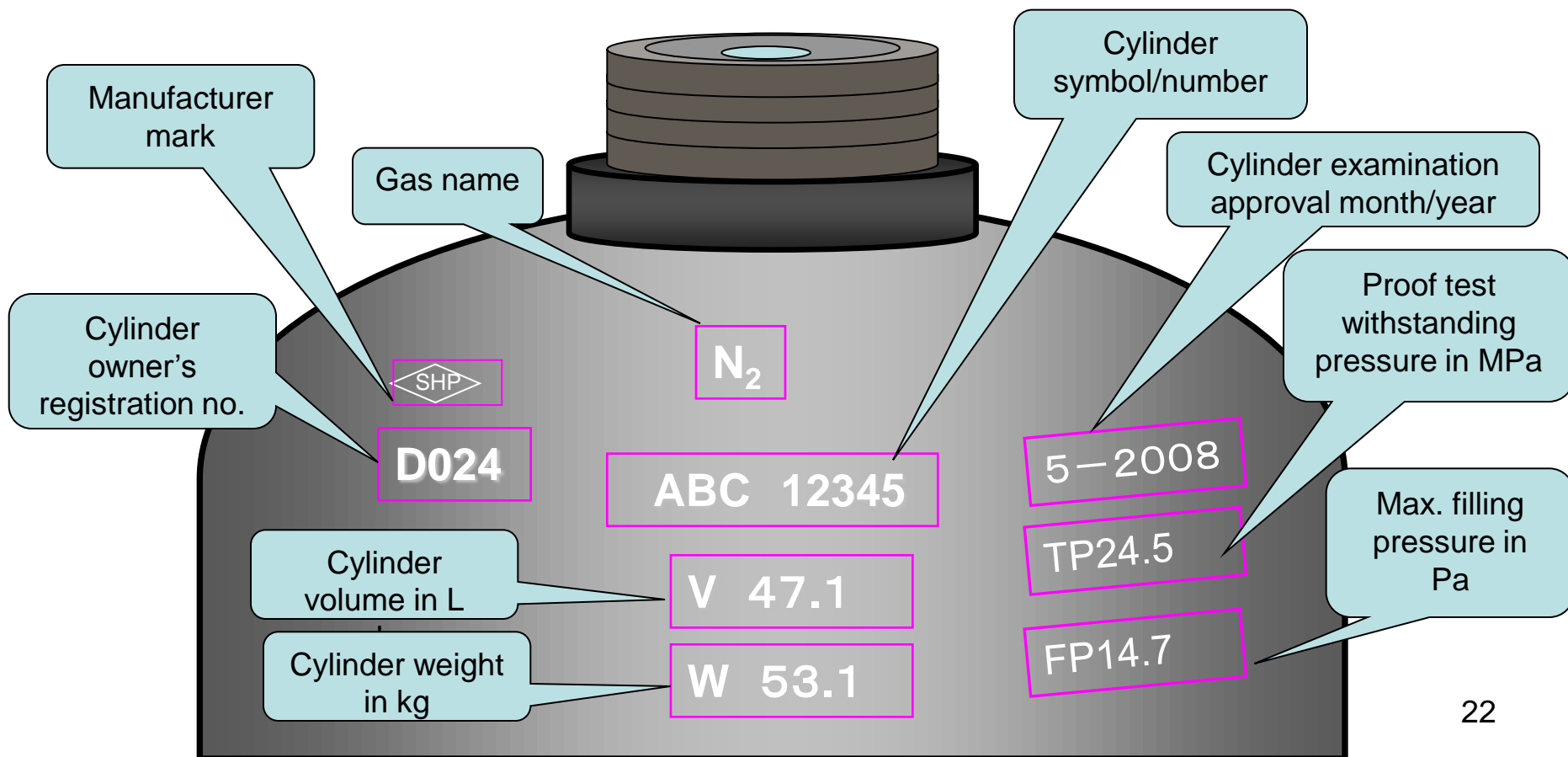
TAIYO NIPPON SANSO  
The Gas Professionals

#### Markings on the cylinder

(Article 48, High-pressure Gas Safety Act)

Article 8, Container Safety Rules

Provide clearly and inerasably the **following information** on a **thick and visible spot** of the cylinder.

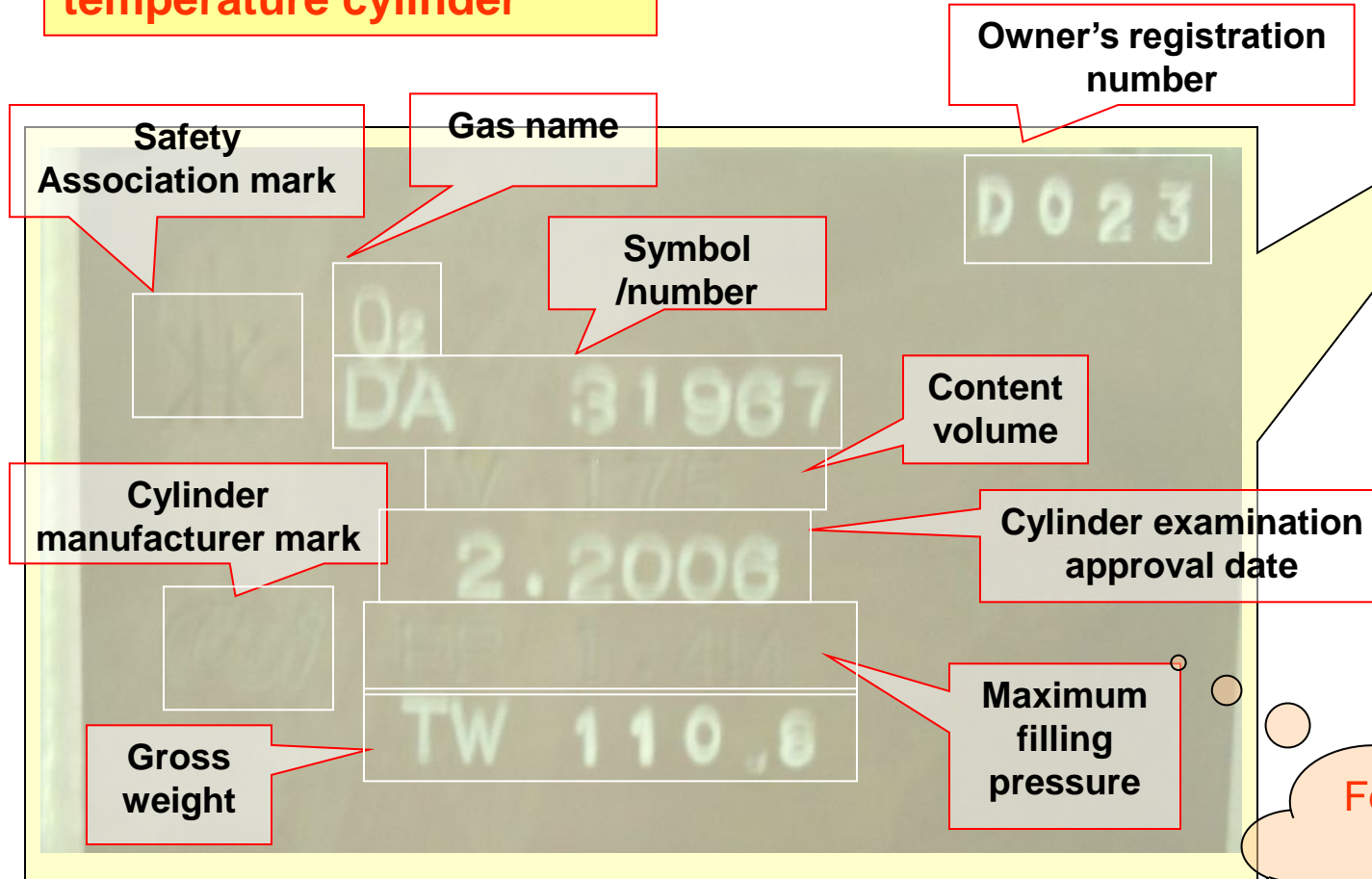


# 3. High-pressure gas cylinder



**TAIYO NIPPON SAN SO**  
The Gas Professionals

**\*Information on ultralow-temperature cylinder**



For this cylinder, refilling is possible until Jan 2011

# 3. High-pressure gas cylinder



TAIYO NIPPON SANSO  
The Gas Professionals

## Cylinder reexamination period

(Article 48.1.5, High-pressure Gas Safety Act )

Article 24, Container Safety Rules

*For high-pressure gas cylinders, a period during which filling is allowed is specified.*

### - General seamless cylinders: 5 years

However, for cylinders manufactured before March 31, 1989 (500 L or less), it is 3 years as in the past.

### - Welded cylinders:

< 20 years from year of manufacture ⇒ 5 years

≥ 20 years from year of manufacture ⇒ 2 years

However, for cylinders manufactured before March 31, 1989 (500 L or less), previous rules apply:

Years from manufacture < 15 years ⇒ 3 years

15 - 20 years ⇒ 2 years

≥ 20 years ⇒ 1 year

\*Also includes ultralow-temperature cylinders (self-pressurized cylinders)





# 4. How to prevent accidents

Frostbite

Explosion



Deficiency of oxygen

Bursting





## Accidents, etc. caused by high-pressure gas

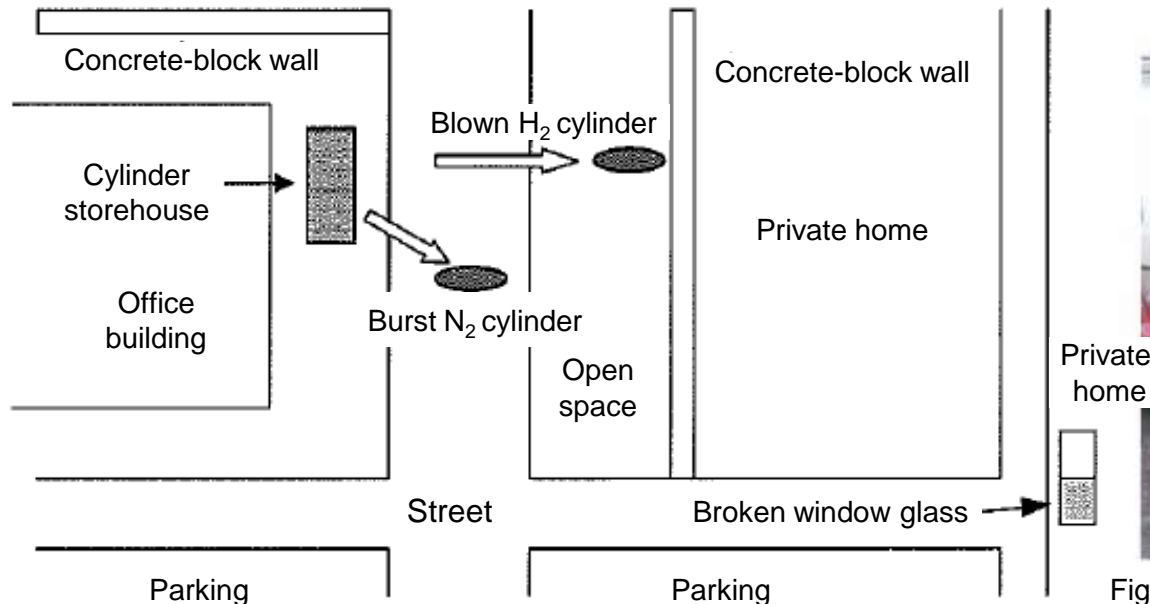
1. Accidents, etc. due to **high pressure**
2. Accidents, etc. due to **flammability**: Hydrogen, acetylene, etc.
3. Accidents, etc. due to **combustion-enhancing property**:  
oxygen
4. Accidents, etc. due to **toxicity**:
  - (1) Respiratory system contraction due to stimulus: chlorine, ammonia, etc.
  - (2) Brain and blood flow disorder: hydrogen cyanide, hydrogen sulfide, etc.
1. Accidents, etc. due to **oxygen deficiency**: nitrogen, helium, carbon dioxide gas, etc.
2. Accidents, etc. due to **low-temperature liquefied gas**:
  - (1) Frostbite
  - (2) Pressure increase due to rapid evaporation



# Explosion of neglected high-pressure gas cylinder

## On August 1, 2007 in Toyama Prefecture

$N_2$  and  $H_2$  gas cylinders (two each) purchased for analytical purposes were left for more than 20 years in a cylinder storehouse. One of the  $N_2$  cylinders exploded. Cause: The cylinder storehouse was located where rainwater tended to collect. Corrosion of the cylinder bottom was the cause of the explosion. No human casualty was reported, but the burst  $N_2$  cylinder broke the windows of a nearby house and the  $H_2$  cylinder was blown 15 m away, hitting the concrete-block wall of a private home.



Sketch of the scene



Fig. 3 Cylinder storehouse and scattered cylinders



Fig. 5 Cylinders left in the cylinder storehouse

# Return used cylinders promptly!!

---



1. Please **return promptly** used high-pressure gas cylinders to the vendor.
2. Please do not leave them where they may be stolen or lost.
3. Please report to nearby police in case of theft.
4. Please do not discard them as general garbage, non-flammable waste, or oversized trash.
5. If left for a long time, **explosion** may occur due to **corrosion**.
6. In general, cylinders belong to the **vendor** or **manufacturer** as you purchase only the gas inside.





# Summary





## Four principles to prevent accidents and disasters

1. Check equipment carefully and manage according to standards **(check and verify)**
2. Understand thoroughly the properties of the high-pressure gas to be handled **(appropriate judgment)**
3. Learn how to appropriately handle high-pressure gas equipment and cylinders, etc. **(appropriate operation)**
4. Be trained and understand measures to be taken in case of an emergency **(Emergency training)**



# Handle gas appropriately



# & safely!!





For further information, please contact:

High-pressure gas safety management contractor

- **Hachioji Sales Office, NISSAN TANAKA CORPORATION**

**Manager: Mr. Hiroki Sato**

**TEL: 042-631-9970**

**FAX: 042-631-9971**

**Email: Hiroki\_Sato@tanaka.sanso.co.jp**

**<http://nissantanaka.com/>**

- **On-campus staff**

**Persons in charge: Sato, Aizawa, Hashizume**

**Extension: 4993 (High-pressure gas monitoring room)**

**Mobile: 090-6487-8121**