

Training – Gas Cylinder Safety

TECHNICAL OFFICE




VERSION NO: 1

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Basic Knowledge about Gas Cylinder & Gas Regulator

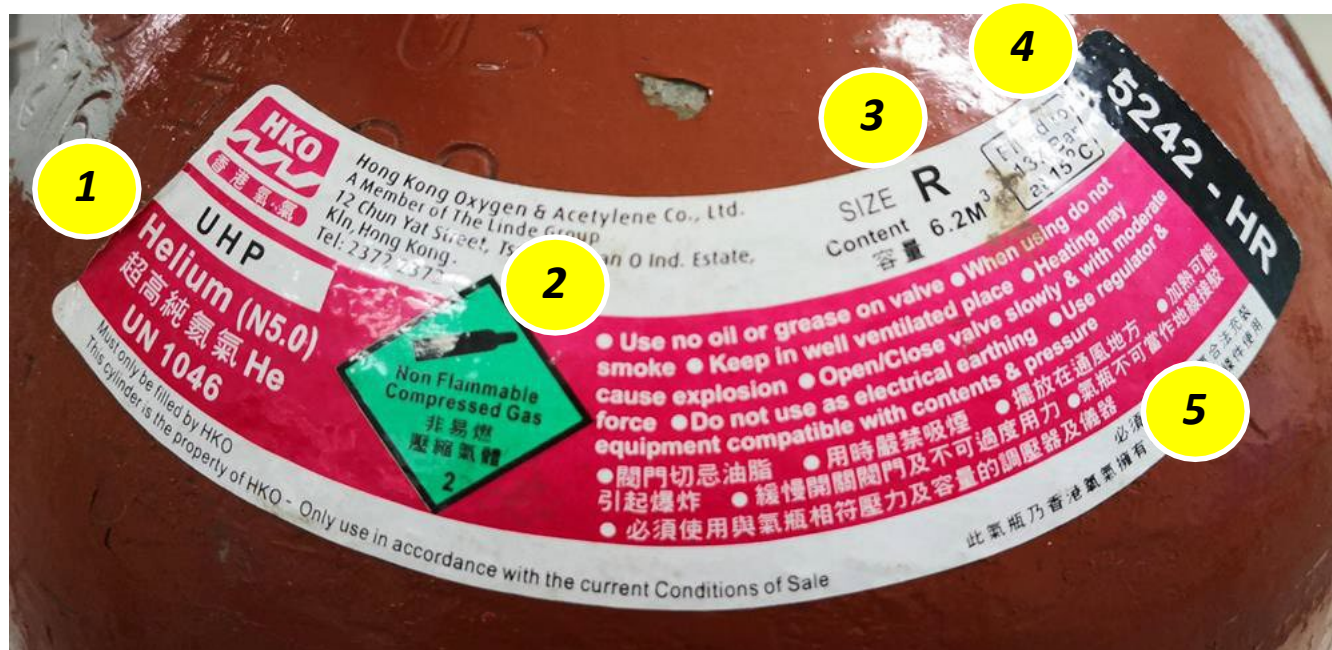
Understanding a Gas Cylinder

- Physical States of Gases

<p>Compressed Gas</p> 	<p>A gas which when packaged under pressure is entirely gaseous at -50°C; this category includes all gases with a critical temperature less than or equal to -50°C;</p> <p>Example: Argon, Nitrogen, Oxygen, Helium</p>
<p>Liquefied Gas</p> 	<p>A gas which when packaged under pressure is partially liquid at temperatures above -50°C;</p> <p>Example: Ammonia, Chlorine, Methane, LPG</p>
<p>Refrigerated Liquefied Gas</p> 	<p>A gas which when packaged is made partially liquid because of its low temperature.</p> <p>Example: Liquid Nitrogen, Liquid Argon</p>
<p>Dissolved gas</p>	<p>A gas which when packaged under pressure is dissolved in a liquid phase solvent.</p> <p>Example: Acetylene</p>

Understanding a Gas Cylinder




- Gas Cylinder Labeling



1. Name and purity of gas with the United Nations (UN) number
2. Dangerous good classification
3. Cylinder size and content of cylinder at standard temperature & pressure
4. Nominal filling pressure at standard conditions (for permanent gas)
5. Caution and safety information

Understanding a Gas Cylinder

- Dangerous Good Classification

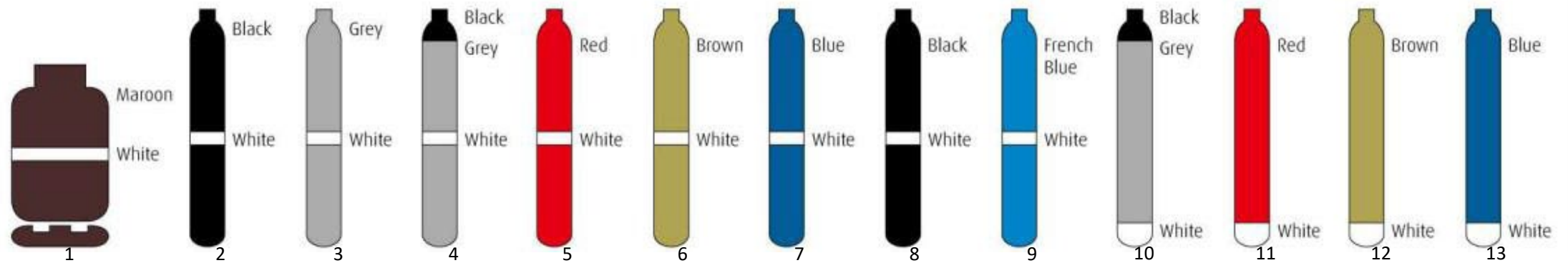
<u>Flammable gases</u>	<u>Non-flammable, non-toxic gases</u>	<u>Toxic gas</u>
<p>Class Diamonds</p>  <p>Class 2.1 Diamond: Red Lettering: Black or White</p>	 <p>Class 2.2 Diamond: Green Lettering: Black or White</p>	 <p>Class 2.3 Diamond: White Lettering: Black</p>
Definition		
<p>Gases which at 20°C and a standard pressure of 101.3 kPa:</p> <ul style="list-style-type: none"> (a) are ignitable when in a mixture of 13% or less by volume with air; or (b) have a flammable range with air of at least 12 percentage points regardless of the lower flammability limit. 	<p>Gases which:</p> <ul style="list-style-type: none"> (a) are asphyxiant: gases which dilute or replace the oxygen normally in the atmosphere; or (b) are oxidizing: gases which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does; or (c) do not come under the other classes. 	<p>Gases which:</p> <ul style="list-style-type: none"> (a) are known to be so toxic or corrosive to humans as to pose a hazard to health; or (b) are presumed to be toxic or corrosive to humans because they have a LC₅₀ value equal to or less than 5,000 ml/m³ (ppm).
Examples		
<p>Hydrogen, Methane, Ethane, Acetylene, Hydrocarbon Gas Mixture</p>	<p>Compressed Air, Argon, Helium, Nitrogen, Carbon Dioxide</p>	<p>Carbon monoxide, Chlorine, Ammonia, Nitric Oxide, Fluorine</p>

Always refer to Material Safety Data Sheet (MSDS) for different gases to know their hazards and precautions.

Understanding a Gas Cylinder - Color Code Identification

Gas Cylinder Identification Color Chart – from Linde HKO

特殊氣體 Special gases



- 1 Acetylene: Instrument grade
- 2 Oxygen: High purity grade
- 3 Synthetic Air
- 4 Nitrogen: High purity grade
- 5 Hydrogen: High purity grade

- 6 Helium: High purity grade
- 7 Argon: High purity grade
- 8 Carbon Dioxide: High purity grade
- 9 Nitrous Oxide: Instrument grade
- 10 Nitrogen: Ultra high purity grade

- 11 Hydrogen: Ultra high purity grade
- 12 Helium: Ultra high purity grade
- 13 Argon: Ultra high purity grade

Understanding a Gas Cylinder - Hydraulic Test

According to **Dangerous Goods (General) Regulations (Cap. 295B)**, no person shall use any cylinder unless such cylinder has been tested and examined within the **preceding 5 years** by a person approved by the authority for that purpose.

How to check the hydraulic test date?



You can find the previous test date near the top of a gas cylinder.

The dent (4) 20 indicates that the test was conducted in the fourth quarter of year 2020, which means that the test will expire in Oct 2025. You need to return the cylinder to the supplier by this date for compliance and safety.

The dent (3) 19 indicates that the test was conducted in the third quarter of year 2019, which means that the test will expire and the cylinder will need to be returned by July 2024.

FYI: Q1: January 1 – March 31. Q2: April 1 – June 30.
Q3: July 1 – September 30. Q4: October 1 – December 31.

Understand a Gas Regulator

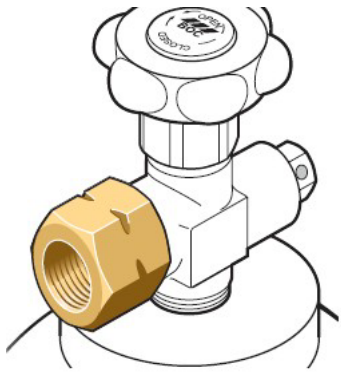
1. Outlet or Regulated pressure gauge
2. Inlet or Cylinder pressure gauge
3. Regulator outlet connection
4. Regulator outlet valve
5. Cylinder connection valve
6. Cylinder valve
7. Regulator control knob



Understanding a Gas Cylinder

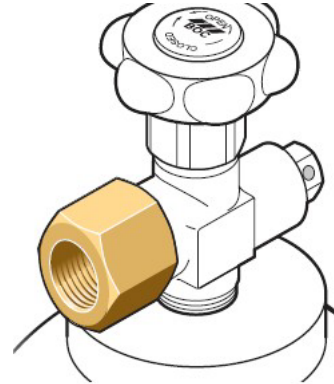
- Valve Outlets Threaded

For safety reasons, flammable gases and non-flammable gases have their cylinder valve outlets threaded opposite hand. This prevents the connection of the incorrect regulator to cylinder valve outlets.



Left-hand thread - Notched

Valve outlets for flammable gases are screwed LEFT-HAND (anti-clockwise to tighten).
e.g. acetylene, hydrogen, propane and mixtures containing fuel gas all have left-hand threads.



Right-hand thread - Plain

Valve outlets for non-flammable gases are screwed RIGHT-HAND (clockwise to tighten).
e.g. oxygen, nitrogen, argon and air.

Understand a Gas Regulator

Before installation, check carefully and make sure the correct type of gas regulator is going to be used. NEVER force any regulator connection that does not fit.

- Check whether the valve is Left-hand thread or Right-hand thread.
- Check the type and size of the gas connection valve, e.g. British (BS), American (CGA), German (DIN).



GAS	Chemical symbol	Dimensions	Standard
COMPRESSED AIR		G 5/8"	BS 341 nr.3
NITROGEN	N ₂	G 5/8"	BS 341 nr.3
ARGON	Ar	G 5/8"	BS 341 nr.3
HELIUM	He	G 5/8"	BS 341 nr.3
HYDROGEN	H ₂	G 5/8" LH	BS 341 nr.2
METHANE	CH ₄	G 5/8" LH	BS 341 nr.2
CARBON MONOXIDE	CO	G 5/8" LH	BS 341 nr.4
OXYGEN	O ₂	G 5/8"	BS 341 nr.3
CARBON DIOXIDE	CO ₂	0,860" x 14 TPI	BS 341 nr.8
NITROUS OXIDE	N ₂ O	11/16" x 20 TPI	BS 341 nr.13
ACETYLENE	C ₂ H ₂	G 5/8" LH	BS 341 nr.2
AMMONIA	NH ₃	G 1/2" A	BS 341 nr.10
SULPHUR DIOXIDE	SO ₂	G 1/2" A	BS 341 nr.10
PROPANE	C ₃ H ₈	G 5/8" LH	BS 341 nr.4

Examples of standard BS connection

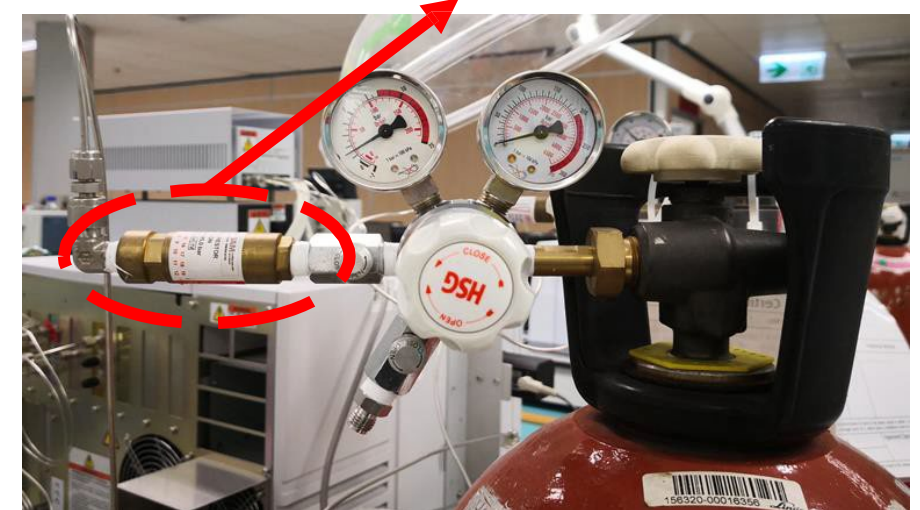
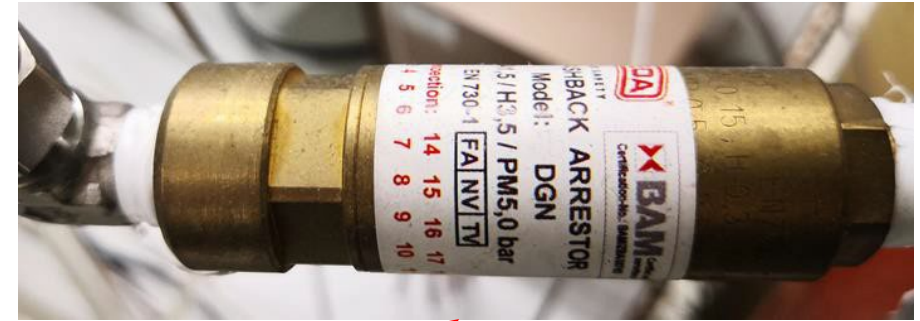
Understand other Accessories

-Flashback arrestors

A flashback is a flame, travelling at supersonic speed, in the opposite direction to normal gas flow in oxy-fuel gas equipment. The use of flashback arrestors is required to limit the potential damage that may result if a flashback occurs. If not stopped, a flashback can melt the equipment which, in the worst case, could explode and travel back to the cylinder.

To ensure total safety and protection from the causes and effects of flashbacks, flashback arrestors should be fitted to each gas line, as the risk of a reverse flow of gas exists with both oxygen and any flammable gases.

According to AS 4839 flashback arrestors should be tested / replaced every year.



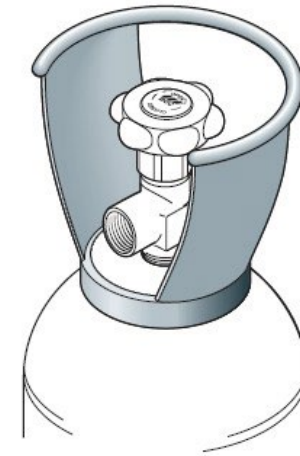
Safe Use of Gas in ACE

Hazards in Gas Cylinder Usage

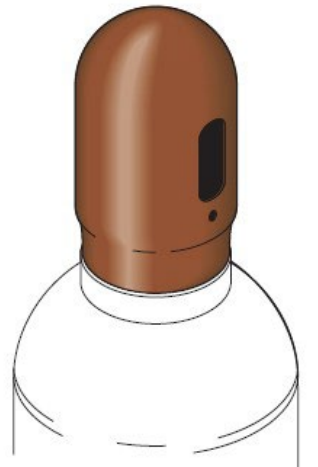
- Gas cylinders are heavy and difficult to move. Improper handling can result in strains, falls, bruises, or broken bones.
- Other hazards such as fire, explosion, chemical burns, poisoning, and cold burns could occur if gases accidentally escape from the cylinder due to mishandling.
- To prevent any accident, please:
 - Purchase smallest size of gas cylinder wherever and whenever possible.
 - Handle only by those who are trained in the proper handling techniques.

Receiving Gas Cylinder

- Ensure that the cylinder is properly labelled.
- Visually inspect for any damage, grease or oil.
- Ensure that the gas cylinders are received with valve guard / caps.
- Secure the cylinder in place with wall mount / chain.



Valve Guard



Valve Protection Cap

Storage of Gas Cylinder

- Flammable gas cylinder must be stored in flammable gas cabinet (min. 30 min fire resistance).
- Flammable gas cylinder must be stored separately with oxidizing gas (e.g. oxygen).
- Empty cylinder must be tagged, and be returned to the supplier ASAP.
- Gas cylinders must not be stored near exits and passages.
- Gas cylinders must be stored away from heat sources.
- Gas cylinders must always be kept chained.

Transportation of Gas Cylinder

Before moving any gas cylinder, please check:

- Gas cylinder valve must be closed.
- Gas regulator must be removed.
- Gas cylinder must be capped or with guard.
- Transport using gas cylinder cart (with chain), in which 4-wheel cart is preferred.



4-wheel Cart

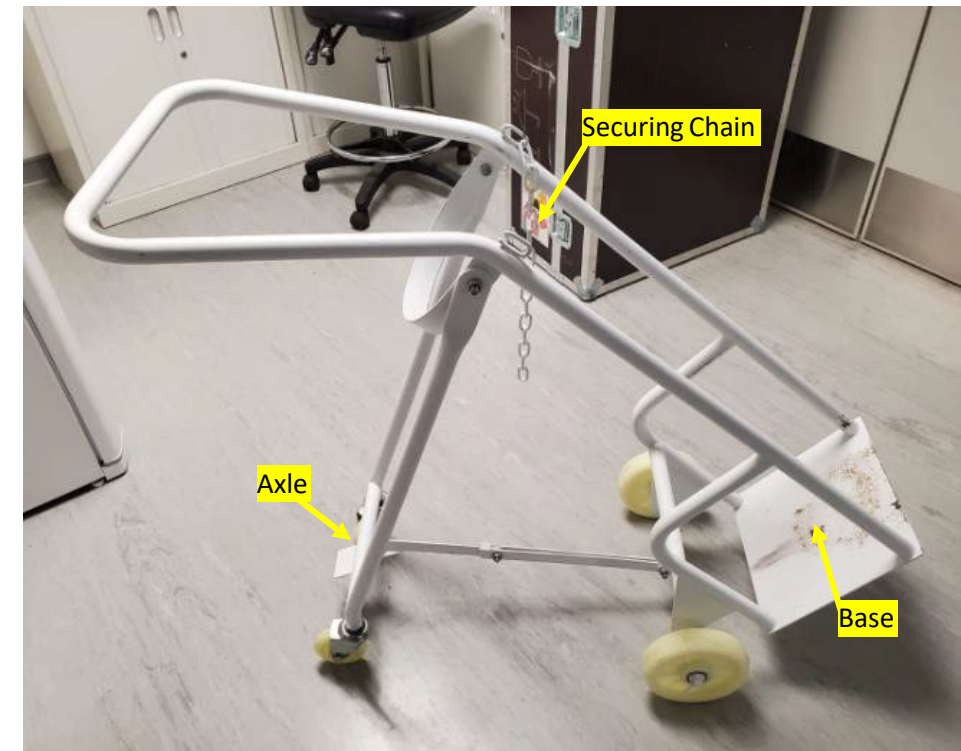


2-wheel Cart

Transportation of Gas Cylinder

- How to use Gas Cylinder Cart

1. Undo securing chain on cart and slide the cart near the cylinder
2. Get a firm grip on top of the cylinder neck
3. Tilt cylinder slightly forward so it rests on the rim of the base and use the other hand to rotate cylinder from rack to cart
4. Fasten securing chain on the cart
5. Place one foot on the axle and tilt the cart until the cart is fully opened and supported by 4 wheels (as shown by the photo)
6. Keeping back straight, pull cart and set it down to the gas bay / cabinet
7. Remove cylinder from cart, rotate it into its new position and secure it to using wall mount or chain.



Safe Use of Gas Cylinder

- Change of Gas Cylinders (1)

When a gas cylinder is emptied:

1. Close the gas cylinder valve completely.
2. Decrease the pressure in the system line, and make sure that both gauges on the regulator read zero.
3. Close the gas regulator control knob completely.
4. Disassemble the regulator from the cylinder with a wrench, slowly loosen the regulator fitting that is threaded into the neck of the gas cylinder.
5. Tag the empty cylinder with a “Empty” status card.
6. Wait for a collection or replacement.
7. Make sure the cylinder is always in an upright (vertical) position.

Safe Use of Gas Cylinder

- Change of Gas Cylinders (2)

When a new gas cylinder is arrived:

1. Secure it in a cart or a wall / bench mount with chain. Keep the cylinder in upright (vertical) position.
2. Confirm the gas regulator has the correct pressure rating and connection valve.
3. Attach the gas regulator carefully and tighten the fitting with a wrench.
4. Slowly open the cylinder valve, check for gas leakage.
5. Open the Regulator Control Knob to adjust the suitable working gas pressure
6. Close the cylinder valve whenever work is finished

Safe Use of Gas Cylinder

- Leak Test

Soapy Water Test: it allows you to search for telltale bubbles that are indicative of gas leakage.

1. Mix an ammonia-free liquid hand soap with water. Place the solution in a liquid spray bottle. (p.s. Ammonia can cause brass to become brittle and crack.)
2. After assemble a gas regulator to a gas cylinder, apply spray to the point of connection.
3. Open only the cylinder valve just enough to indicate pressure on the regulator gauge.
4. Look for any bubbling or foaming which indicates gas leakage.
5. If yes, turn off gas cylinder valve immediately.
6. If no, wash with some water and wipe the area dry with a clean lint-free cloth. The gas cylinder is safe to use



Safety Measure

- Ensure proper ventilation in the area where gas cylinders are stored and used.
- Ensure proper gas detection system installed in the area where gas cylinders are stored and used.
- If an uncontrollable gas leak occurs:
 1. Hit the EVI button, leave immediately with lab door closed.
 2. Evacuate everyone
 3. During Office hours, call Technical Office for help.
 4. During Non-office hours, call Security for help (3442 8888).
- If a hand-on training is required, please contact Technical Office.