

Training Package
TP 11/20
(Revision of TP 11/12)

Safe use and handling of portable liquid cylinders (PLCs)

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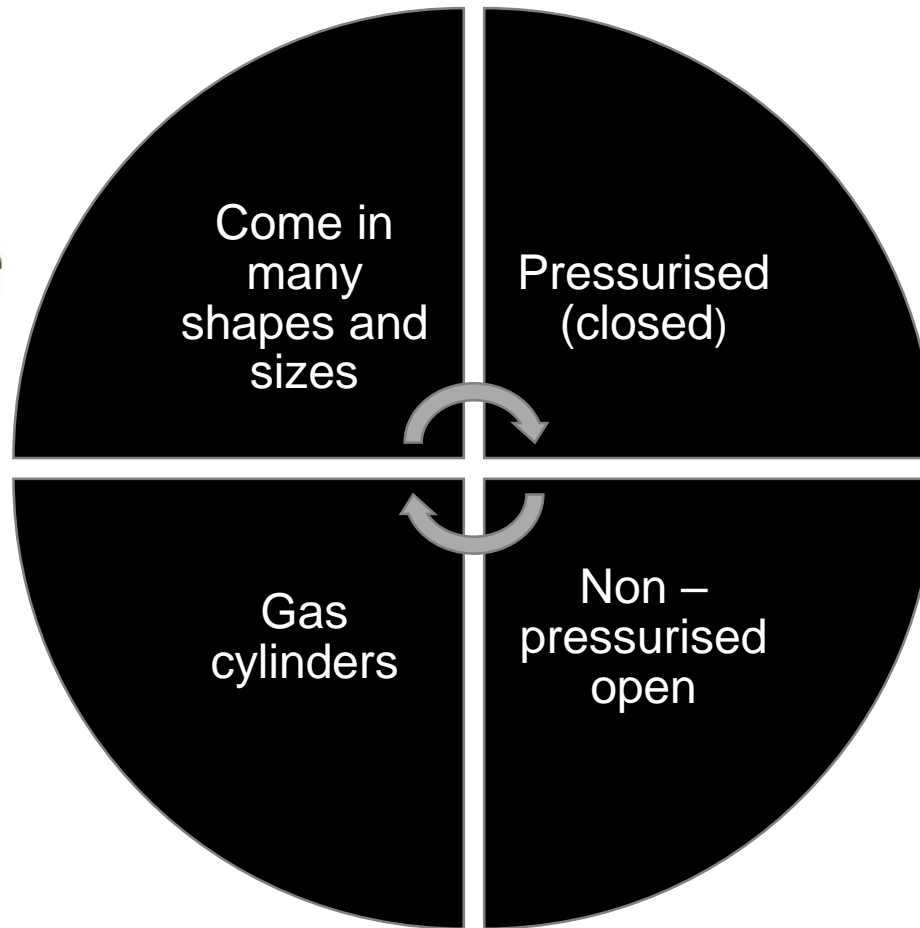
Safe Handling and Use Practices

Cryogenic containers



Cryogenic container with round base (left) and square base (right)

Non-cryogenic cylinders



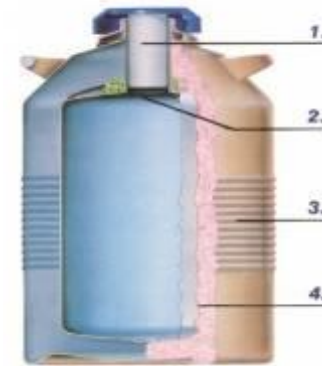
Cryogenic containers & equipment

Must be designed to store/handle cryogenic products

**Pressurised PLC'S
fitted with suitable
safety devices (x2)**

**Manufactured to
international standards**

**Material embrittlement
can occur if incorrect
equipment is used**



Product Supplier's Responsibilities

- Ensure containers are correctly labeled and fitted with the appropriate connections.
- Visual inspection of connections prior to filling - verify no damage and are suitable for the intended service.
- Ensure correct mating connections are in use at the customer's sites and avoid use of adaptors.
- Ensure the pressure relief device installed is set at or below the design pressure of the PLC.
- Provide training and/or training materials as required.

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Identification and Labeling

- Proper labeling of PLCs is critical for product identification.





- Should meet the guidelines in AIGA 017 'Labeling of Gas Containers (including associated equipment)'

OR

- Meets Globally Harmonized System (GHS) of Classification and Labeling of Chemicals requirements.

- Identification tags should be affixed to the gas, liquid and vent outlet connections.

- A warning label "DO NOT TAMPER WITH CONNECTIONS" should be visible on the container.

HANDLING INSTRUCTION: <ul style="list-style-type: none">Keep container upright at all times.Keep container away from heat and ignition sources.Do not allow oil, grease or fuel to come into contact with container.Do not drop container.Handle container with extreme care.  	OXYGEN Refrigerated Liquid <ul style="list-style-type: none">UN No.: 1073UN Class: 2.2UN Subsidiary Risk: 5.1  	DANGER: <ul style="list-style-type: none">Oxidizer, strongly supports combustion. May cause or intensify fire. Keep away from combustible material.May react violently with oil or grease.Store and use in well-ventilated area. WARNING: <ul style="list-style-type: none">Contains refrigerated gas. Extremely cold, may cause cryogenic burns, frostbite or injury. Avoid contact with clothing, skin and eyes.Liquid or cold gas will freeze air and vent lines. After use, close valve and/or cap off container.Wear appropriate personal protective equipment. FIRST AID: <ul style="list-style-type: none">In case of burns or frostbite, rinse with plenty of warm water.Obtain medical treatment immediately and seek medical advice. OTHER INFORMATION: <ul style="list-style-type: none">Refer to or call supplier for container operating instruction and gas safety data sheet.
SPECIALIST ADVICE: Supplier's LOGO Supplier's Name Supplier's Address Emergency ☎: (00) 1234 5678 (00) 5876 5432		
DO NOT REMOVE THIS PRODUCT LABEL		

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Connections for PLCs

- There are clear standards for product outlet connections and other means of product identification.
 - Failure to follow these standards can lead to wrong product being introduced to the consumer's supply system resulting in loss of production, property damage and personal injury
 - Liquid connection standards not discriminating between products should be avoided (e.g. BSP standard that are currently used in some countries).
- ❑ Standardization of outlet connections for PLCs based on the AIGA 019 'Connections for Portable Liquid Cylinders' is recommended.

CGA Connections for PLCs

Product	Outlet connection	CGA connection number
Oxygen	Liquid	CGA 440
	Gas Use	CGA 540
	Vent	CGA 440
	<u>Yoke</u>	<u>870</u>
Nitrogen	Liquid	CGA 295
	Gas Use	CGA 580
	Vent	CGA 295
Argon	Liquid	CGA 295
	Gas Use	CGA 580
	Vent	CGA 295
Carbon Dioxide	Liquid	CGA <u>622</u>
	Gas Use	CGA 320
	Vent	CGA <u>295</u> , <u>622</u> (limited standard)
	<u>Yoke</u>	<u>940</u>
Nitrous Oxide	Liquid	CGA <u>624</u>
	Gas Use	CGA 326
	Vent	CGA 624
	<u>Yoke</u>	<u>910</u>

Refer to AIGA 019 ‘Connections for Portable Liquid Cylinders’ for more details

Primary Standard and guidance

- AIGA has adopted the CGA connections as the primary standard for connections for PLCs due to:-
 - Regional commonality
 - Compliance to selection of discriminated connections between gases
- Use of connection adapter is strictly prohibited.
- The liquid, gas and vent outlet connections should be silver brazed, welded or attached by other methods to the valve body to prevent customers from removing the connections.

Silver Brazed or Welded Joint to the Valve Body



Different locking methods to deter removal of Liquid cylinder connections are commercially available that meet CGA SB-26 and US FDA (for medical) requirements.

Example of a device to deter removal of the fitting



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Pressure relief devices shall be changed or tested at intervals in accordance with the international standards to which PRVs are manufactured and the local regulations (if available) at a period not exceeding five years.

The pressure relief device shall only be changed or tested by an appointed competent person. Test results shall be documented.

Manufacturer's original sized and fitted safety devices shall not be modified or replaced

It is not recommended to allow fitment to a PLC dual pressure relief devices



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Safety hazards of PLCs

- Contact & non-Contact hazards
- Asphyxiation
- Cold Burns or Frostbite
- Can strongly support fire
 - ✓ Follow codes of practice
 - ✓ Ventilation
 - ✓ Access
 - ✓ Conduct risk assessments
 - ✓ Much heavier than normal cylinders-400kg. Risk of serious injury if it falls / manual handling .



Asphyxiation hazard

Ruptured of PLCs – Serious Incidents

Summary of Incident

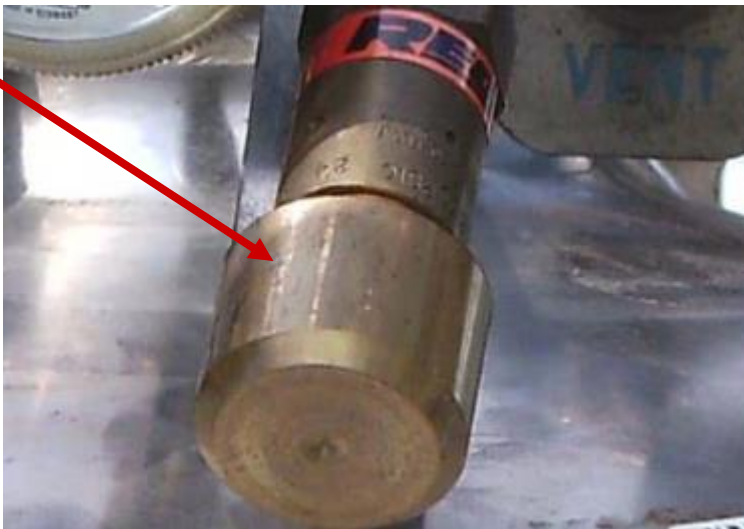
- Relief Devices failed to operate properly, due to
 - 1) Safety valves were blocked due to corrosion / jammed by foreign body (**inadequate maintenance and inspection**)
 - 2) Bursting disc not operate because it was wrong specification. (**unauthorized customer modification**)



Capped relief valve – Near miss

Summary of Incident

- Customer blanked relief valve outlet on liquid nitrogen cryogenic container because it was lifting and making a noise.
- Potential for excess pressure and burst container.



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Handling equipment

- Full PLCs are heavy: Use pallets, carts or trolleys to safely move.
- Many types are available: choose the right type for your needs.



PLCs in Frames with wheels

- PLCs permanently fixed in frames with wheels are also used in Asia. Safety precautions are necessary. PLCs can topple due to:
 - Uneven surfaces/roads/ramps
 - Pushing up and down the ramps..
 - Damaged wheels
 - Higher CG/Poor design of the frame



Handling and Use

- All personnel must be adequately trained prior to handling or connecting PLCs.
- Training should include, but is not limited to:-
 - ✓ Personal protective equipment requirements.
 - ✓ Product safety.
 - ✓ Operation of equipment.
 - ✓ Emergency procedures.
 - ✓ Safe handling of the containers.

PPE Requirements

- Personal protective equipment (PPE) requirements should be assessed for each activity and the correct type provided (ref to AIGA 066, Selection of PPEs)
- This should not be restricted to employees but should be advised to customers.



Best practices

- All containers must be kept upright.
- Burst discs and relief valves to be turned away from face.
- Never drop cylinders, wherever possible PLCs should be restrained to prevent them from falling.



Connecting/Disconnecting

The user must counteract the torsion applied to the valve and tubing when the coupling is removed.



Provide training and/or training materials to prevent potential serious incidents.

Inspection and maintenance

- Inspection and maintenance is critical in safe operation of cryogenic containers.
- Tanks have systems for building up pressure.
- Built in systems for extra gas supply.
- Add on systems for excessive gas supply.
- Inspection, testing and maintenance needs to be performed at the specified periodic interval.
- For both PLCs and Fill Systems, all control and safety devices must be kept clean and free of any hydrocarbon

Loading and securing

- Use suitably rated loading ramps to load.
- Secure using suitably rated devices for use in load security: Nylon ropes, nylon webbing harnesses etc.



Manual handling of PLCs

- Train personnel to be aware of the work environment.
- Use the correct tools – Push, do not Pull PLCs.



Handling of PLC's on Wheelbases

- Plan for moving path – smooth and even surfaces, recommended inclines not > 8 degrees.
- Inspect the wheels and wheels brake for any signs of wear or damage.
- On downslope surface, stand behind the container and guide it down the slope
- Use either handling ring or handle to turn container into position.



Ref to AIGA 108, '*Safe Handling of PLCs On Wheel Bases*', for more details

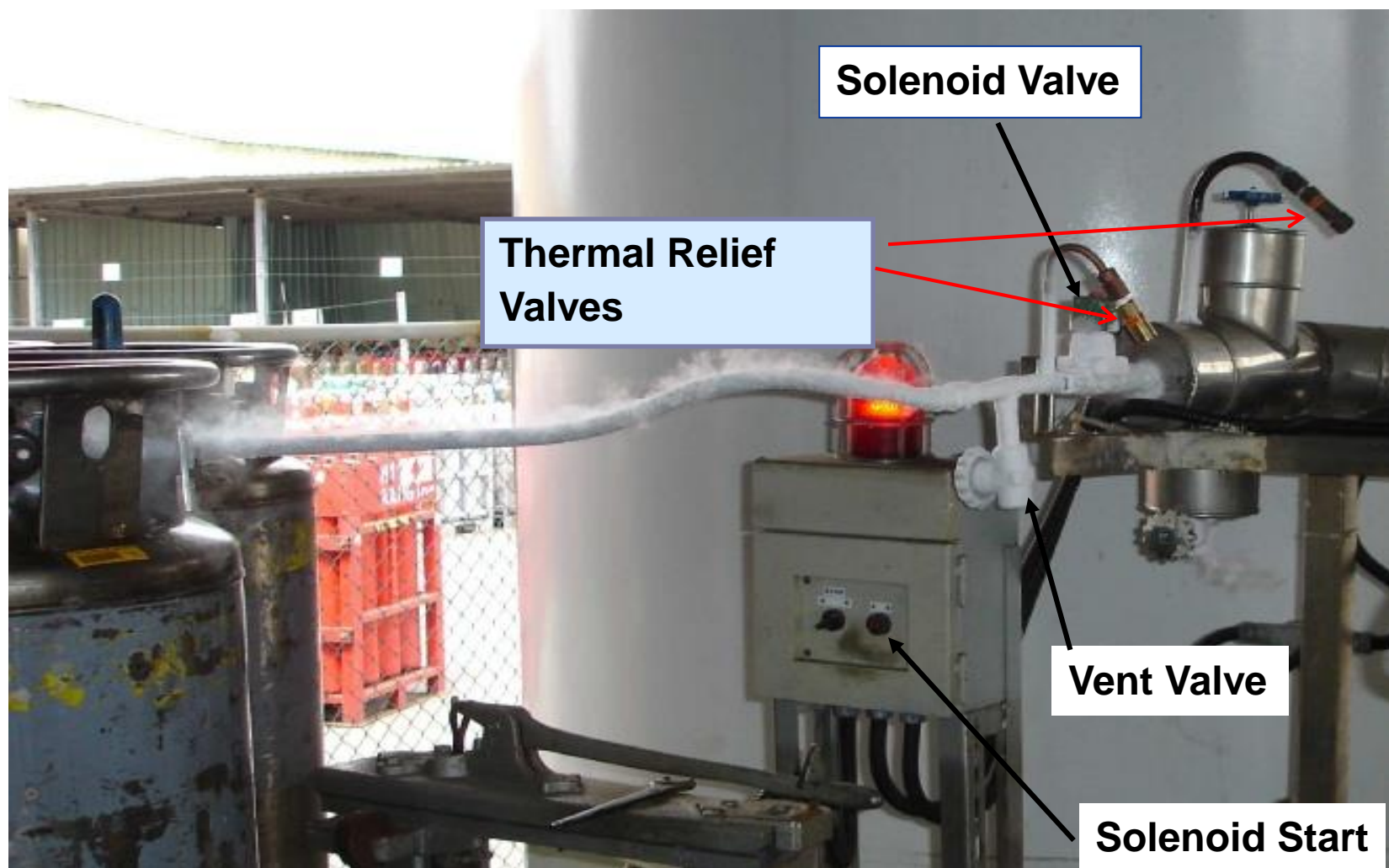
Transporting PLCs in Elevators

- Where possible, a freight elevator rather than a passenger elevator should be used.
- If the elevator is equipped with a floor lock device, it shall be used.
- Where possible, should have sole and exclusive use of the elevator during the delivery.
- Best Practice - use two persons when transporting PLCs in the elevators. Post a person for loading and another person for unloading at the two different floors
- A fully charged, emergency escape, five minute air pack must be with personnel who accompany the transported PLC in the event of a product release.

Storage Requirements

- Containers should be stored outdoors or in well ventilated environments.
- Verify the need to include atmosphere monitoring equipment with alarms in areas such as laboratories.
 - This atmosphere monitoring equipment must be tested regularly to ensure it operates as intended.
- Do not store PLCs near elevators, stairs or exit routes
- Cryogenic liquid when spilled, can spread far and cause a hazardous environment. Atmospheres may not be suitable for sustaining life.

Example Of Fill Piping System



Pre-Fill Checks

Pre Fill Inspections

Key part of the Operation

Ensure all who are involved with pre fill checks are trained and understand the importance of their job

Our employees are on “the front line”.
They are the first to see problems

PLCs- Key Messages

Equipment - Must be designed to store/handle cryogenic products

Connections - Follow AIGA guidance - AIGA 019

Testing Inspection and maintenance - Critical in safe operation of cryogenic containers

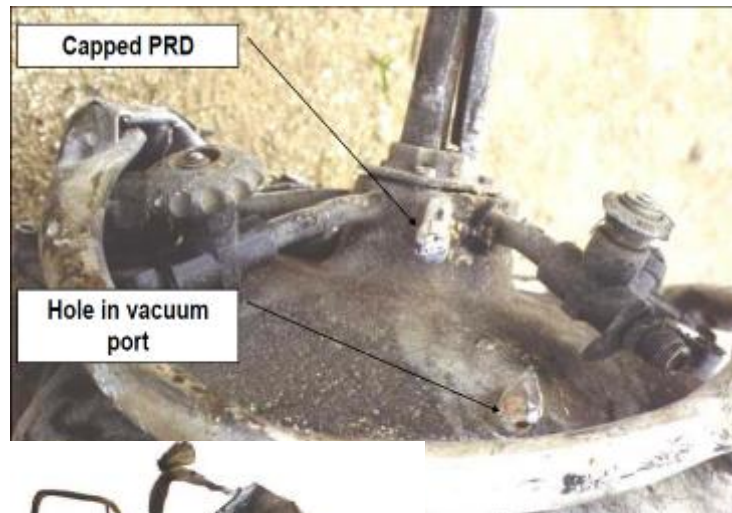
Training - All personnel must be adequately trained prior to handling or connecting PLCs

Follow Best Practice - Adopting and following the guidance issued by AIGA will help to avoid incidents and improve safety.



Benefits of following AIGA standards and guidelines

Adopting and following the guidance issued by AIGA will help to avoid incidents (as in the photos) and help to improve safety.



References

- AIGA 016, Safety Features of Portable Cryogenic Liquid Containers for Industrial and Medical Gases
- AIGA 017, Labeling of Gas Containers (including associated equipment)
- AIGA 019, Connections for Portable Liquid Cylinders
- AIGA 066, Selection of Personal Protective Equipment
- AIGA 108, Safe Handling of PLCs with wheelbases
<http://www.asiaiga.org/publications.asp>
- CGA: V1, Compressed Gas Association: Standard for Compressed Gas Cylinder Valve Outlet and Inlet connections
- CGA: SB-26, CGA Safety Bulletin: Cylinder Connections on Portable liquid Cryogenic Cylinders
- CGA: P-84, Guideline for Safe Handling of Liquid Containers on Wheelbases
- EIGA: IGC Doc 93, Safety Features of Cryogenic Liquid Containers for Industrial and Medical Gases
<http://www.eiga.eu/index.php?id=181>
- Chart Industries: CGA Fitting Restraints
http://www.chart-ind.com/main/app_csd_packaged_gas_cga_fitting_restraints.aspx
- ISO 21029-2 Cryogenic Vessels – Transportable vacuum insulated vessels of not more than 1000 litres volume Part 2: Operational requirements.

Incidents and publication references listed with the permission of CGA & EIGA