Safe Handling, Storage, Transport & Use of Compressed Gas & Cryogenic Cylinders

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Agenda

- Gases Properties and Hazards
- Regulator Use and Selection
- Relief and check valves
- Flash arrestors & Flow Limit Shut Off Valves
- Storage
- Questions and Answers

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Common Gases

• Oxygen (Cryogenic/Compressed)
• Nitrogen (Cryogenic/Compressed)
• Carbon Dioxide
• Propane
• Hydrogen
• Air – all Air is not the same???
• Oxygen/Nitrogen Compressed Mixture
Hazard Communication

- Right to Know based on your Chemical Inventory
- Label – primary means of product identification
- DOT Hazard Class Label or Placard
  - limited information
  - does not address all the hazards
- Hazard Communication Standard (HCS)
  - requires **Pictograms** on labels + Product ID, Signal Word, Hazard Statement, Precautionary Statement
- Container Color – should never be used to identify contents
- Safety Data Sheets (SDS) @ www.airgas.com
First Place to Start

- SDS – Safety Data Sheet
  - Previously known as a MSDS
  - Available at Airgas.com
Commercial Families

• Industrial Gases
  – atmospheric - nitrogen, oxygen, argon
  – commodity - helium, hydrogen, carbon dioxide

• Specialty Gases
  – industrial gases purified to extreme levels
  – rare gases - Ne, Kr, Xe
  – manufactured gases – SF6, Halocarbons
  – mixtures not found in nature - 10% O2 / N2
DOT Hazard Classes

- Most gases act as asphyxiants
- Some are flammable
- Some are pyrophoric
- Some are oxidizers
- Some are toxic and/or corrosive
- Some exist as cryogenic liquids

• A hazard common to all gases: PRESSURE
Nonflammable Gases

- Largest volume of cylinders
- Colorless, Odorless, Tasteless, Non-Irritating
- NO WARNING PROPERTIES
- Hazards
  - Pressure 6000 psig
  - **Asphyxiant** 19.5% O2
  - **Cryogenic cold**
- Examples - argon, helium, nitrogen
Reality Is...

Rescue In Oxygen Deficient Atmospheres

- Fiction:
  - “I can hold my breath long enough to run in and save my buddy.”

- Fact: you CAN’T!!!!!
  - Over 50% of the workers who die in confined spaces are attempting to rescue other workers.
  - Never enter an oxygen-deficient atmosphere without self-contained breathing apparatus.
  - You can survive –
    - 3 weeks without food
    - 3 days without water/drinking
    - 3 minutes without air
    - Only 2 breaths of air without oxygen
Additional Hazards of Cryogens

- Cryogens have all the hazards normally associated with the product at ambient conditions plus the hazards of:
  - Extreme Cold
  - Fog Clouds
  - Large Expansion Ratios
    - 1 volume of Nitrogen liquid = 697 volumes of Nitrogen gas
  - Embrittlement of Materials
Over-Pressurization – Relief Valve
“Trapped Liquid or Gas”

Pressure Relief Valve

Valves
Check Valve

- **Check valves** are mechanical **valves** that permit gases (& liquids) flow in only one direction
  - Prevent process flow from reversing
- AKA one-way directional **valves**
  - Fluid flow in the desired direction opens the **valve**, while backflow forces the **valve** closed
- Ultimately prevent backflow into a process, or into the Airgas cylinder
Oxidizers

• The “Good” gases
• Oxygen - given to us by doctors when we have trouble breathing
• Nitrous oxide - “laughing gas” given to us by dentists as an anesthesia
• Intentionally inhaled
• How can these gases hurt us?
  – Oxygen/Oxidizer enrichment
  – Adiabatic heat of compression
• **Systems must be cleaned for oxidizer service**
Flammable Gases

• The same hazards of nonflammable gas
  – Pressure
  – Asphyxiation

• Plus – Flammability & Explosive impact

• Common Examples:
  – acetylene, propane, hydrogen, methane, carbon monoxide + flammable gas mixtures
Flash Arrestor & Excess Flow Shut Off

• Designed to prevent “flash back” of an oxidizer or flammable to the process (or ignition source)

• Excess Flow Designed from 10 to 3,500 psig
  – Used either between a high-pressure source at the inlet to the pressure regulator or low-pressure delivery line to a process
  – In both applications, this control valve will automatically shut off the delivery of gas if it exceeds a preset limit
Personal Protective Equipment

- General Cylinder Handling
  - safety glasses, leather gloves, safety shoes
- System Operations
  - Consult SDS
- Emergency Operations
  - Consult SDS
- There is no one piece of PPE that can protect against all hazards!
  - Product
  - Hazard exposure
  - Common sense
Basic Cylinder Handling

• **Always:**
  - Wear proper personal protective equipment.
    - leather gloves, safety glasses, safety shoes
  - Restrain the cylinder
    - during storage, moving, use
  - Make sure the cylinder cap is properly installed when the cylinder is not in use.
  - Use a cart when moving cylinders
  - Install outlet seals and cylinder caps for return
Basic Cylinder Handling

- **Never:**
  - Drag, roll or slide cylinders
  - Lift cylinders by the cap
  - Use cylinders as rollers
  - Submit to cylinders temperature extremes
  - Strike an arc on a cylinder
  - Allow cylinders to contact electrical circuits
  - Transport cylinders in enclosed passenger vehicles or a car’s trunk
LET IT FALL!!
Cylinder Storage

- In accordance with CGA pamphlet P-1
- Use good inventory control, first in first out
- Area should be protected from the elements
- Proper segregation of hazard classes, incompatible products, and fulls and empties
- Do not store oxygen cylinders within 20’ of cylinders containing flammable gases unless they are separated by a 5’+ partition with an at least 30 minute fire-resistance rating.
Storage of Cylinders

- Cylinders should be stored in approved areas, and marked. (Signs)
- Storage areas shall be prominently posted with the name or hazard class of the gases being stored
- Empty and Full Cylinders segregated from each other.
- Storage areas should be well ventilated, dry, and protected from extreme temperatures. (> -20°F, < 125°F)
- Cylinders should be secured, both when “In Use” and “In Storage”.
- Never store cylinders near a source of ignition or heat such as furnace or water heat
- Valves on all cylinders not-in-use must be kept closed and protected by caps.
- The bottoms of cylinders should also be protected against rusting by storing on grating, concrete, or well drained locations
CGA Connections

- **Cylinder CGA**
  - Oxygen  540
  - Nitrogen  580
  - Helium  580
  - Argon  580
  - Carbon Dioxide  320
  - Hydrogen  350
    (left hand) (hash marks)

- Determine use pressure... operate at 2/3 of scale for the regulator

Right Hand = Clockwise
  Fitting is smooth – No V-Groove
Left Hand = Counterclockwise
  Wrench flats are not smooth - with V-Groove
Pressure
Regulators Regulate…

pressure, *not flow*
The primary purpose of a regulator is to reduce pressure gas from a higher pressure to a lower use or application pressure.

How accurately the pressure is held depends on many variables from regulator design, supply source, physics of the gas, to flow rates.
Cylinder regulators

- Attaches directly to a cylinder
- Typically rated to 3500 psi
- Available in single and two stage
- Body design
  - Forged
  - Bar Stock
- Multiple body and material available
  - Brass
  - Stainless steel
  - Hastelloy
- Multiple Diaphragm material
  - Elastomeric
  - Metallic
Hand tight the regulator —
Tighten with a proper non sparking wrench

- Leave at a 45 degree angle
- Do not stand in front of the regulator
- Do not stand behind the regulator
- Do not stand on the regulator side

Typically... never a need for you to use “Teflon tape”
Attaching the Regulator

- After opening the valve a half turn, continue to slowly fully open the cylinder valve.
- Apply an approved leak solution to the connection to test for any leaks.
- The regulator may now be adjusted to the correct pressure.
  - Note: the pressure will be different in the static and flowing state, set the pressure accordingly.
- Open the outlet valve and the process is now complete.
Correct CGA nipple type is the most important on high purity Analytical Systems

- Check valve CGA
- Most critical component of the modern gas delivery system
  - Maintains the system under positive pressure
  - Minimizes the amount of air that can enter the system
When in Doubt, Ask!

Nothing is more important than… SAFETY!

• RISK REDUCTION!
• EDUCATION OF EMPLOYEES!
Other Questions & To Do’s???

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• Thank You