Cylinder HAZMAT & Fill Station Operations Compliance

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Purpose of Hazmat Training

- Department of Transportation (DOT) Code of Federal Regulations requires formal, function specific training
Training Standards

- PSI/PCI visual inspection protocol and training is currently the most recognized, complete and defensible standard.

- PSI/PCI has been cited by U.S. courts as the standard of practice for visual inspection of high pressure cylinders.

- Other entities that use and recognize PSI/PCI training include NOAA, NASA, DOD, DOT, all the branches of the US Military, and many others.
Regulatory Agencies

- Department of Transportation (DOT) regulates the transport and handling of high pressure cylinders.

- Occupational Safety and Health Administration (OSHA) regulates the safety of employees.
Mandates that all persons who handle, transport or are likely to be affected by the hazards of compressed gas cylinders and their contents shall receive appropriate safety training.

Hazmat Training within industries that utilize high pressure cylinders should provide specific safety awareness for all applicable groups such as employees, service technicians, air fill station operators (FSO), Nitrox gas blenders as well as volunteer helpers, and even customers (if they assist at fill station).
Each employer shall determine that compressed gas cylinders under his control are in a safe condition to the extent that this can be determined by visual inspection. Visual and other inspections shall be conducted as prescribed in the Hazardous Materials Regulations of the Department of Transportation (49 CFR, parts 171-179).
Training Objectives

- Understand what training is required
- Know how to safely handle and/or fill cylinders
- Identify illegal or damaged cylinders
- Understand the importance of a cursory inspection and identify cylinder markings
- Understand the hazards of high pressure air
- Understand common fill station components
Training Requirements

- Documented training should be provided to all employees before they encounter the real and potential hazards of compressed gas.
- Within 90 days of hire.
- Recurrent training every 3 years.
- By a certified instructor.
- PSI authorizes current PSI inspectors to teach this PSI/PCI Cylinder HAZMAT & FSO Compliance program.
If DOT Pipeline and Hazardous Materials Safety Administration (PHMSA) adopts a new regulation, or changes an existing regulation, that relates to a function performed by a HAZMAT employee, that HAZMAT employee must be instructed in those new or revised function-specific requirements without regard to the three year training cycle.
Training shall include:

- HAZMAT training whenever an employee is assigned new duties.
- General awareness/familiarization training
- Function-specific training
- Safety training to include:
  - Emergency response
  - Employee protection
  - Accident avoidance
  - Safe handling procedures
Required Documentation

- A written record of the training for each HAZMAT employee shall be maintained.
- A copy of the training material shall be maintained.
- Name and address of the person providing the training.
- Certification that the HAZMAT employee has been trained and tested.
Cylinder Handling

- Any cylinder over 40 psig is considered “HAZMAT”
- When you carry the cylinder by the valve - keep opening away from your hand.
  - Air embolism may occur through the skin if Secure cylinders to prevent movement
- Maximum operating temperature 130 deg. F
- Personal injury or cylinder damage may occur from dropped cylinder
Duties of the FSO

- Maintain the fill station
- Responsible for the safe handling of all cylinders to be filled
- Must give *informal* inspection to each cylinder prior to filling
Informal Inspection

- Verify Codes
- Within Visual Inspection Interval
- Within Hydro
- Verify rated service pressure
- No apparent physical damage
- Contains positive pressure
 FSOSO Checklist

- Checklist ensures a thorough check of cylinder to mitigate potential dangers during filling.

Available as a laminated reference card from PSI/PCI
Oxygen or Enriched Air Cylinders

- Open valves SLOWLY!
- Fill at NO FASTER than 200 psig per minute (pure O2, 60 psig per min)
- Avoid contact with any flammable materials
- DO NOT cross contaminate cylinders with inappropriate type of gas
  - Remember cylinders have to be placarded for the gas they contain
  - If cylinder is not labeled it is assumed to contain air
Government Approval

- Canadian and U.S. cylinders are required to be marked with an authorized government approval
  - either stamped in the crown of solid wall cylinders or listed on the label of a composite cylinder
- Markings accepted in USA:
  - ICC or DOT
  - CTC or TC
  - UN-USA
Cylinders must be marked with the approved specification:
- 3A, 3AA, 3AL, etc.
- If no specification, then an exemption or special permit number is required
  - eg. SP7277

Cylinder exemptions or special permits must be renewed
- 3 years for composite cylinders
- 5 years for solid wall cylinders
Service Pressure

- Service pressure must be clearly displayed on all cylinders
- The service pressure is established by a calibrated gauge at a constant 70° F / 20° C
- A fill station operator will have no defense against civil or criminal charges if the cylinder fails explosively due to cylinder over pressurization
Serial Number / Manufacturer

- **Serial Number**
  - each cylinder must bear a legible serial number
  - some have batch numbers stamped in bottom of cylinder
  - marks must be present and legible

- **Manufacturer**
  - must be identified by name, mark or assigned number
  - PST – PST Cylinders
  - M4002 – Catalina
  - M8303 – Faber
  - Luxfer – 
  - Worthington - XXXXXXXX
Hydrostatic Requalification

- Composite cylinders
  - 3 or 5 year intervals

- Solid wall Cylinders
  - 5 year intervals

- Most cylinders fail visual inspection not hydro
  - Why requalify if the cylinder fails the visual
Evidence of Inspection (EOI)  
Stickers

- Standard practice in SCUBA industry
  - Some organizations may use written reports instead of stickers for internally inspected cylinders or non-SCUBA cylinders
- The maximum time interval should not exceed one year
- The stickers should display:
  - Inspection standards used to evaluate the cylinder
  - The month/year when the inspection was conducted
  - The facility and/or inspector that conducted the inspection
  - PSI/PCI inspectors are required to include their inspection number
The FSO has the authority and responsibility to "reject" any cylinder for filling.

The FSO should not fill cylinders with questionable stickers.

The stickers should not be:
- placed on the bottom of the cylinder
- should be legible
- should not have an obscure legend
Air Fill Station

- The location and design of the air fill station is crucial.
- Ample space for components
- OSHA requires that all employees be protected when at or near the air fill station
- Should not be a customer “hang-out”!
The air fill station consists of six integrated components:

- The fill control panel
- The air intake
- High pressure fill whips
- The compressor
- The filters and moisture separators
- The air storage units
Control Panel

- Should be located so that the FSO is not directly exposed to the cylinders being filled

Why is this control panel in the wrong place?
Air Intake

- Location of intake is important
- Avoid exhaust ducts or other contaminated air sources!
- Inspect the intake on a routine basis or whenever a new activity takes place - such as construction
High Pressure Fill Whips

- The piping should be anchored a minimum of every 4 feet.
  - Local codes may be more stringent
- Use only specified fittings
- Annually inspect all lines for abrasions or other damage.

What’s wrong with the whips?
Air Compressor & Moisture Separators

- Compressing air into storage cylinders (cascade system) will reduce compressor maintenance
- The compressed air is filtered and oil residue and moisture are removed
  - Air purity
  - Reduce cylinder corrosion
  - Improve shelf life of gas
- Follow manufacturer’s guidelines on replacement of filters
Importance of Inspecting Moisture Separators

Any Questions?
Air Storage Systems

- DOT authorized storage vessels require a hydrostatic re-qualification **every five** years when used in a cascade system connected to a compressor.

- When air is pumped directly from the compressor, the storage cylinder **does not** meet the “Star Service” standard.

  - **Star Service** – Special consideration requiring conformity to a specific set of standards to qualify for 10 year hydro interval.
  - Most cascade systems do not meet the requirements.
Filling Procedures

- The fill station should be clean and well lighted.
- The environment must be free from any contaminates:
  - oils
  - lubricants
  - petroleum based products
- If needed - these items should remain outside the fill-whip area.
Fill Rates

- Fill rate for high pressure cylinders is 300-600 psi/min.
- Empty cylinders rated for 3000 psig should take approximately 10 minutes to fill.
- Over pressurizing cylinders is ILLEGAL.
- Fill to rated service pressure, cool down, top off.
- Calculations for fill rate are based on 70° F/ 20° C ambient temperature.
Fill Whips

- Fill fail when used beyond rated service pressure
- Adapters should not exceed the rated pressure of any connection components!

- Most yoke mounts are rated for 3000 psig
- DIN are rated for 3500 psig
- SCBA connections are rated at 4500 psig
Injuries caused by thread worn bleeder valves blowing out of the block have been reported.

- Always check whips for abrasions.
- Check adapters and bleeder valves for wear and tear.
Wet Fill or Dry?

- Wet filling appeared during the early years of SCUBA diving.
- There were many reasons given for the use of the water bath among them:
  - explosive energy absorption
  - cooling cylinders
  - providing fresh water bath for the cylinder
“Contains Explosive Force”

- Filling in water bath DOES NOT dissipate explosive forces
- Water is virtually incompressible - the force transfers to the container
- The result can be catastrophic
“Cooling Cylinders”

- Wet fills do not significantly reduce the temperature of a fill at 300-600 psig/min.

- Only when left long enough (typically 1.5 or more hours) in the water would this make a difference.

- Cooling the cylinder does not cool the gas inside at the same rate.
Most facilities do not regularly change their water.
- Becomes a concentrated salt bath increasing chance of corrosion.

Water can enter cylinders during fills in a water bath whenever the cylinder valve drops into the water or fill whip terminal ends can reach the water.
- Increases chances of corrosion.
Fill Dry!
Avoid Moisture and Contaminates

- Ensure moisture separator discharges properly
- Fill the cylinder DRY
- Store cylinders in a vertical, valve side up position, to isolate corrosion
Questions for the Owner

- Has the cylinder been functioning properly?
- Has the cylinder been involved in any unusual situations?
- Has the cylinder been repainted or exposed to heat?
- If filled, what gas does it contain?
- Make certain questionable empty cylinders are inspected.

  - The owner should not be evasive with their answers as to why the tank is empty
Transportation

- Valved high pressure cylinders, greater than 1000 lbs. (approximately 28 SCUBA cylinders) the following are required:
  - Transported by licensed HAZMAT driver
  - Vehicle must be labeled on all 4 corners
  - Carry no passengers
SCBA

Self Contained Breathing Apparatus

- OSHA 1910.134
  - Written standard operating procedures
  - User instructed/trained in proper use of respirators
  - Respirator cleaned and disinfected after each use
  - Respirators for emergency use shall be thoroughly inspected at least once a month and after each use
SCBA Information

- **Cylinder Types:**
  - Steel (1800 - 4500 psig)
  - Aluminum (2216 - 3000 psig)
  - Composite (2216 - 4500 psig) hoop/full wrap
  - Carbon Fiber Full Composite (CFFC) – 4500 psig

- Solid wall cylinders have an unlimited service life (5 year requalification interval)

- Composite cylinders are limited to a 15, 20 and 30 year service life (3 or 5 re-qualification interval). Check exemption or Special Permit

- For additional information:
  - Review “Inspecting Cylinders” by William L. High and Mark A. Gresham
  - CGA C 6.2
  - Special Permit or Exemption
  - Take a PSI/PCI Visual Inspection Course
Certain SCBA’s are authorized for emergency quick fills of 6,000 psig/min.

This should ONLY be done by trained personnel in the event of an emergency for cylinders with the proper adapter.

Composite cylinders are not authorized for plus mark and should not be overfilled.
Cylinder HAZMAT and FSO Compliance Review

- Each employee is required to have function specific training regarding cylinder HAZMAT
- Training should be documented
- Enriched air or oxygen cylinders require special handling, cleaning and filling procedures
- Transporting cylinders may require meeting specific regulations
- Everyone working around it should have at least basic understanding of the fill station and its set up
It is “OK” to ask customers questions about their cylinders
And equally “OK” to follow specific requirements for filling or not filling their cylinders
Dry filling is the best possible process for cylinders
The owner is ultimately responsible for the cylinder and its condition
Consequences of Improper Handling, Filling and Inspection

- Possibility for explosive failure
- Property damage
- Injury
- Loss of life
- Possible legal action
Final Point

- If a cylinder is in question
- Follow your training
- Don’t fill it, REJECT IT!
- Inspect cylinder by a trained inspector
Training Completed

Any Questions?