

# Airgas Inc

# SF6 Cylinder Filling Process

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El Bullard  
Operations Manager  
Airgas Specialty Gases  
Montgomeryville, PA

**Airgas**

## MSDS Facts

- Vapor Pressure 320 PSIG @ 70 degrees F
- Heavy gas, vapor density 5.114 (Air = 1)
- Freezing point -83.5 F

# Safety

- Average cylinder tare weight (TW) 125 pounds, fill weight 115 pounds, +/- 1%
- Cylinder cap collars are “peined” on, maintaining an average cylinder cap weight of 3 pounds, the design is not made for lifting or dragging
- SF6 reacts similar to CO2. If the vapor pressure is dropped quickly in the cylinder “dry ice” forms which may create a slurry, snow or ice in the cylinder at low pressure
- Verify the valves are shut after use, especially if the cylinder appears frozen with little or no vapor pressure

## Safety (Cont.)

- Snow or ice pellets may form in lines or system components having an orifice upstream of an expansion chamber which may cause line blockage
- New connections should be made using 3 – 4, low pressure, slow gas purges. Quick, full pressure purges will produce frost, condensing contaminants on wetted surfaces.
- Consider replacing soft, porous components with stainless steel to facilitate purges

# Containers

- 2015 PSI cylinder rating
- Cylinder liquid capacity ranges from 5 to 130 pounds
- Tonners are customer specific 1100 to 1150 pounds
- Tare weights are checked and stamped on evacuated, empty, valved cylinders, without a CGA plug or cylinder cap

# New or Retested Containers

- RPV valve (Residual Pressure Valve)
- Internal inspection, clean walls, clean threads
- A DOT 10 year retest involves evacuation and purge for each refill
- Airgas packages SF6 with an RPV valve which requires a five year retest, evacuation/purge is not required to maintain product purity previous to refilling

## New or Retested Containers (Cont.)

- Clean internal surfaces without pitting and gouges release contaminants (air and moisture) readily during prep
- UE/UT testing is completed when possible. Retesting equipment has to be capable of handling packages with SF6 product in the container
- Evacuation/purge or bake out is required for new cylinders or cylinders exposed to atmosphere for any reason

# Valves

- Non-RPV and RPV
- Clean threads on valve and cylinder
- RPV, 15 – 25 PSI residual pressure equates to 1 – 2 lbs of residual product typically in a 115 lb cylinder
- 85% of Airgas' cylinders are returned with one pound of residual product
- Airgas' concerns were considered during development of our preferred package valve



# Source Certification

- Is the product purity liquid phase or gas phase when doing a comparison?
- Specific to ASTM Dielectric grade or better
- Analytical of incoming products is mandatory in our operation
- Source container inspections may help prevent issues downstream. Specifically leak testing and component operation.
- Purge process developed for flexible line connections. Cap/plug when not in use.

# Standard Operating Procedure (SOP)

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**Developed specifically for SF6  
Airgas does not consider SF6 a  
generic liquefied gas.**

# Pre-fill inspection

- Company owned assets, Airgas converts all CGA straight 590's to RPV
- Customer owned assets, we suggest an RPV conversion. Pay back 100% on second fill
- Valves, RPV tampering, CGA threads, oil contaminates
- Oil contaminates on valve surfaces and internal CGA ports. Possibly on cylinder caps, collars or threads

# Filling process

- Locating transfill and pump isolation valves close to the receiving containers prevents venting of product
- Operators are educated on equipment performance which includes audible and control indicators tracking permissible efficiencies
- Soft, porous wetted surfaces retain moisture and contaminants. Clean material may be contaminated during transfer. Stainless steel is preferred.
- Size components to equipment capacity. Why use a ¾" hose when a ¼" hose is sufficient?
- Leakage may erode soft seals if exposed to gas flow under pressure
- Scales are checked against calibrated weights weekly, accuracy of scales maintained at .01%

# Filling Process (Cont.)

- Filling scales are calibrated and certified bi-annually
- Packages filled within 1% of specified volume
- Inspected, weighed and logged containers are staged for filling in batches of twenty
- Leak tests are performed 3 – 6 times throughout individual container filling
- Leak tests are performed again, after fill, minimally at thirty minutes allowing dissimilar materials to reach equilibrium
- Packages are static for twenty-four hours before analytical
- Liquid and gas phase filling processes allow “zero” venting to atmosphere

# Analytical Field Use

- Portable analyzers along with fittings and sample lines need to be maintained contaminate free during transportation and use
- Care should be high on the technicians list to keep all analytical equipment clean and dry
- Equipment, cases and padding should be protected from extreme weather conditions

# Analytical In House

- Calibration of analyzers are completed weekly
- Liquefied gases require specific regulators preventing pressure surges to analytical equipment
- False, inaccurate readings may develop due to varying pressure and flows
- ASTM D2472 is the analytical guideline for SF<sub>6</sub>, references to ASTM D2029 for water vapor, D2284 acidity, D2685 for Air/R14. They all incorporate and suggest methods of analytical and material for good reason!!!!

## Analytical In House (Cont.)

- Gas phase analysis versus liquid phase analysis is typically a 5 to 1 ratio
- SF6 has a tendency of reacting with some instrument electronics due to insulating values
- Soft components will retain contaminants which may indicate product failure when actually the product is good



# Questions?

Sharing ideas in the reduction of SF6  
emissions to the atmosphere

Office: 215-591-0450, ext. 202

Email: [el.bullard@airgas.com](mailto:el.bullard@airgas.com)

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