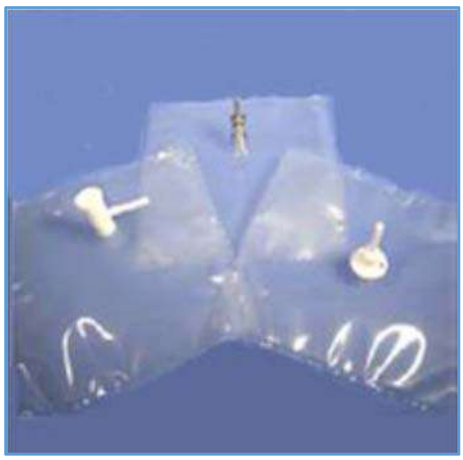
# Uniphos Technical Note

Updated: June 1, 2016

## Gas Sampling Bag Properties

**Gas Sampling Bags**



Gas sampling bags are air sampling devices that come in several different types for the purpose of collecting gases to be tested. Gas sampling bags should be selected based on specifications for types of gases to be sampled, bag thickness, tensile strength, operating temperature, vapor permeability and gas permeability. Uniphos Envirotronic Inc. specializes in three types of bags: Tedlar®, ALTEF® and Multi-Layer Foil. Before ordering gas sampling bags, it is important to understand the difference between types.

**Tedlar®**

Tedlar® gas sampling bags are made from classic DuPont® film with good stability for VOCs, sulfur compounds, carbon monoxide, carbon dioxide, methane, and sulfur hexafluoride.

**Tedlar® Film Properties**

- Low gas permeation levels
- High tensile strength
- Continuous temperature range from –98°F to 225°F
- Unaffected by the chemical components of gases commonly sampled, like carbon monoxide, sulfur dioxide, hydrogen sulfide, radon, and mercaptons

**Advantages of Tedlar® Film**

- Low gas permeation levels
- Less permeable than FEP, PFA and TFM
- Mechanically strong - Bags resist puncture in the field
- Less expensive than FEP and PFA film
- Recommended in many EPA testing methods
- Chemically inert
- Minimal sample loss
- No Plasticizers
- Reusable/cleanable
- Leak tested
- Non-contaminating

**ALTEF®**

ALTEF® is a proprietary fluoropolymer film developed uniquely for the air sampling market. ALTEF® meets or exceeds many of the desired characteristics of Tedlar® at a significantly lower cost.

**ALTEF® Film Properties**

- Thickness: 0.003”
- Specific Gravity: 1.78
- Tensile Strength: 6100 psi
- Max. Operating Temp.: 300° F
- H2O Vapor Permeability: 12-15 cc/cm $^{3}$·d
- CO2 Permeability: 172 cc/cm $^{3}$·d
- O2 Permeability: 58 cc/cm $^{3}$·d

**Advantages of ALTEF® Film**

- Inert to most compounds including acids, alcohols, chlorinated solvents, and aromatics
- Very stable for sampled compounds including CO, CO2, methane, and most VOCs
- Longer storage times for most VOCs than Tedlar®
- Inherently pure material with no additives, fillers, or pigments
- Does not release DMAC or phenols into the gas sample, as Tedlar® does, and has lower VOC and sulfur compound background than Tedlar®
- Abrasion resistant

**Multi-Layer Foil**

Multi-Layer Foil bags provide light and moisture protection for low molecular weight compounds such as hydrogen that are unstable when collected into standard Tedlar® bags. They use a low flow air sample pump with exhaust port.

**Multi-Layer Foil Film Material**

- 60 gauge Nylon
- Aluminum (Metallized)
- Polyethylene
- 0.0003" Aluminum Foil
- 0.002" Polyethylene

**Advantages of Multi-Layer Foil Film**

- For Methane, CO, CO2 and other gases
- The only gas bag material that can sample and store hydrogen sulfide
- Collect low molecular weight compounds and inert gases not stable for Tedlar®
- Water and vapor-proof
- Sample stability up to 5 days
- Available with Polypropylene Locking Combo Valve with Septum, Polypropylene Screw Cap Combo Valve with Replaceable Septum, and Stainless Steel Combo Valve with Replaceable Septum
- Custom bags available
- Minimal adsorption
- Samples protected from light by opaque material.
- Protect light-sensitive compounds without the use of an outer container
- The inside surface is inert, minimizing absorption and adsorption of compounds
- Multi-Layer Foil bags have strong, even seals, making them ideal for mailing or shipping to a laboratory for analysis. The multi-layer material is tough, flexible, and water/vapor-proof

**Multi-layer Foil Bag Applications**

- Biogas and landfill gas sampling: *Sewage treatment plants and landfills, Emission control, Fruit warehouses, Fermentation cellars*
- Site sampling; Mobile surveys
- Assessing exposure from leaks and spills
- Transfer of calibration gases to instrument from lab
- Indoor air studies; Testing of workplace air quality: *OSHA ID-172 (Carbon Dioxide), OSHA ID-210 (Carbon Monoxide)*

**Table 1. Gas Bag Film Properties**

| Property | ALTEF® | Tedlar® | Multi-Foil | Method |
|---|---|---|---|---|
| Thickness | 0.0030" | 0.0020" | 0.0046" | ASTM-D-374 |
| Specific Gravity | 1.78 g/cc | 1.70 g/cc | 1.09 g/cc | |
| Tensile Strength | 6100 psi | 8100 psi | | |
| Tensile (MD, CD) | | | 23, 24 lbs/in. | ASTM-D-882 |
| Elmendorf Tear (MD,CD) | | | 116, 147 g | TAPPI T414 |
| Max. Operating Temp. | 300°F (150 °C) | 400°F (205 °C) | 190°F (90 °C) | |
| $H_2O$ Vapor Permeability @ 90%RH & 100°F | 12-15 g/m$^2$d | 9-57 g/m$^2$d | .0093 g/m$^2$d | ASTM-F-1249 |
| $CO_2$ Permeability @ 0%RH & 73°F | 172 cc/m$^2$d | 172 cc/m$^2$d | 0.0078 cc/m$^2$d | |
| $O_2$ Permeability @ 0%RH & 73°F | 58 cc/m$^2$d | 50 cc/m$^2$d | 0.0006 cc/m$^2$d | ASTM-F-3985 |

**Table 2: Summary of Gas Bag Features & Benefits**

| Film | Unique Properties | Advantages | Limitations |
|---|---|---|---|
| **ALTEF®** | • Developed specifically for gas sampling applications<br>• Chemically inert to most acids, aliphatic and aromatic organic compounds, chlorinated solvents, and alcohols<br>• Max. operating temp: 302°F<br>• ALTEF bags are made of .003" thick film vs. competitor's bags of .002" thick | • Economical<br>• Readily available<br>• Suitable for sampling VOC's and sulfur compounds<br>• Low VOC background<br>• Longer sample storage times than most other bag materials<br>• Does not exhibit background levels of DMAC or phenol, as Tedlar® does | • More permeable than Tedlar® (.003" thickness is recommended versus .002" for Tedlar®)<br>• Not suitable for sampling ketones and esters in high concentrations (>30%)<br>• Lower resistance to UV light than Tedlar® |
| **Tedlar®** | • Low gas permeation levels<br>• High tensile strength<br>• Withstands temperatures up to 400°F<br>• Unaffected by the chemical components of gases commonly sampled, like carbon monoxide, sulfur dioxide, hydrogen sulfide, radon and mercaptons | • Less permeable than FEP, PFA and TFM<br>• Bags resist puncture in the field<br>• Less expensive than FEP and PFA film<br>• Recommended in many EPA testing methods | • Exhibits background levels of DMAC and phenol<br>• Not readily available<br>• Substantial recent price increases due to global shortage |
| **Multi-Layer Foil** | • Multiple layers provide low permeability and a moisture barrier<br>• Opaqueness protects samples from ultraviolet light | • The only bag material that adequately holds H2S for long periods (>5 to 7 days)<br>• Ideal for collecting low molecular weight compounds<br>• Sample stability for up to 5 days for most compounds<br>• Good VOC stability<br>• Readily available | • Not suitable for collecting low ppm to high ppb VOCs |

## Chemical Storage Stability Charts

| Sulfur Compounds @ ~100 ppb | | |
|---|---|---|
| Test Compound | Bag Material | |
| | ALTEF® | Multi-Layer Foil |
| n-Butyl mercaptan | | |
| tert-Butyl mercaptan | | |
| Carbon disulfide | | |
| Carbonyl sulfide | | |
| Diethyl disulfide | | |
| Diethyl sulfide | | |
| Dimethyl disulfide | | |
| Dimethyl sulfide | | |
| 2,5-Dimethylthiophene | | |
| Ethyl mercaptan | | |
| Ethyl methyl sulfide | | |
| 2-Ethylthiophene | | |
| Hydrogen Sulfide | | |
| Isobutyl mercaptan | | |
| Isopropyl mercaptan | | |
| 3-Methylthiophene | | |
| Methyl mercaptan | | |
| n-Propyl mercaptan | | |
| Tetrahydrothiophene | | |
| Thiophene | | |

**Key:**

| | |
|---|---|
| | Recommended |
| | Suitable if analyzed within 24 hours |
| | Suitable for medium to high ppm levels* |
| | Not Suitable |

**Multi-Layer Foil bags can be used to sample most VOCs at moderate to high ppm levels but are not recommended for low ppm levels or less due to background from the bag materials.*

ALTEF® bags are recommended for most VOCs if analyzed within 48 hours and for many sulfur compounds if analyzed within 24 hours.

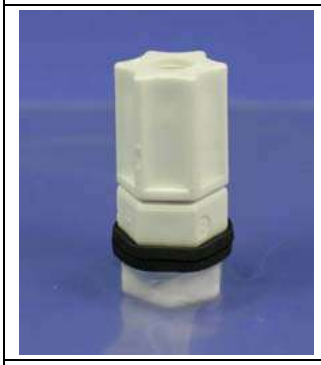
Multi-Layer Foil bags are recommended for methane ($CH_4$), hydrogen sulfide ($H_2S$), carbon monoxide (CO) and carbon dioxide ($CO_2$) if analyzed within 24 hours.

| VOCs @ 200 – 300 ppm | | | |
|---|---|---|---|
| Test Compound | Bag Material | | |
| | ALTEF® | Multi-Layer Foil | Tedlar® |
| Acetone | | | |
| Acetonitrile | | | |
| Acrylonitrile | | | |
| Allyl chloride | | | |
| Benzene | | | |
| Bromoethane | | | |
| Butyl acetate | | | |
| Carbon tetrachloride | | | |
| Chloroform | | | |
| Carbon dioxide | | | |
| Carbon monoxide | | | |
| 1,2-Dichloroethane | | | |
| Dichloropropane | | | |
| Ethyl acetate | | | |
| Ethylene | | | |
| Heptane | | | |
| Hexane | | | |
| Isooctane | | | |
| Isopropyl alcohol | | | |
| Methane | | | |
| Methyl ethyl ketone | | | |
| Methylene chloride | | | |
| Methyl tert-butyl ether | | | |
| Octane | | | |
| Perchloroethylene | | | |
| Propylene | | | |
| Propylene oxide | | | |
| Tetrahydrofuran | | | |
| Toluene | | | |
| 1,1,1-Trichloroethane | | | |
| Trichloroethylene | | | |
| Vinylidene chloride | | | |
| p-Xylene | | | |

**Gas Bag Fittings**

A variety of fittings are available on the Uniphos Gas Bags:

| | |
|---|---|
|  | **Polypropylene Screw-Cap Combo Valve**<br>• On/Off valve function with replaceable septum in a single unit. Side port for tubing connection<br>• Uses fluoropolymer-faced, low-bleed silicone septum<br>• Inexpensive<br>• Lightweight. Easier to carry multiple bags in the field<br>• Made of inert polypropylene. Ensures sample purity<br>• Quick, easy opening and closing of valve, even in harsh conditions with no tools required. Less than one half turn opens/closes valve<br>• Visual confirmation that valve is open or closed prevents accidental sample loss |
|  | **Polypropylene Locking Combo Valve With Septum**<br>• On/Off valve function with replaceable septum in a single unit<br>• Uses fluoropolymer-faced, low-bleed silicone septum. Allows repeated punctures with syringes without leakage<br>• Inexpensive<br>• Lightweight. Easier to carry multiple bags in the field<br>• Made of inert polypropylene. Ensures sample purity<br>• Push/Pull (On/Off) valve stem. Quick, easy opening and closing of valve (< 1 second) Faster than “twist-action” valves<br>• Quick locking function requires no tools, and visual confirmation prevents accidental sample loss |
|  | **Stainless Steel TCLP Fitting with Septum**<br>• Stainless steel body with aluminum cap and replaceable fluoropolymer faced septum<br>• Durable: withstands use in austere sampling conditions<br>• Inert: Sample contacts only stainless steel & fluoropolymer<br>• Lower cost than 1/4” Swagelok type fittings and nickel plated Halkey Roberts fitting<br>• Designed for use with Zero Headspace Extractors<br>• Validated fitting style for EPA TCLP (Toxicity Characteristic Leaching Procedure) method |
|  | **Stainless Steel Combo Valve with Replaceable Septum**<br>• Design combines on/off valve and septum into a single fitting to lower cost & weight<br>• Stainless steel body with aluminum cap and replaceable fluoropolymer faced septum<br>• Durable: withstands use in austere sampling conditions<br>• Inert: Sample contacts only stainless steel & fluoropolymer<br>• Lower cost than 1/4” Swagelok type fittings and nickel plated Halkey® Roberts fitting |

| | |
|---|---|
|  | **Swagelok® type Stainless Steel Fitting for Tubing or Septum**<br>• Stainless steel construction. Durability and ability to withstand use in austere sampling conditions<br>• Allows attachment of tubing or syringe sample extraction by switching caps<br>• Replaceable fluoropolymer-faced septum with large area allows repeated punctures with common lab syringes |
|  | **Plastic Jaco® Fitting for Tubing or Septum**<br>• Compression ferrule secures tubing onto fitting with superior grip compared to metal fittings<br>• Polypropylene molded construction<br>• Inexpensive compared to metal fittings<br>• Allows attachment of tubing or syringe sample extraction by switching caps<br>• Replaceable fluoropolymer-faced septum with large area allows repeated punctures with common lab syringes |
|  | **PFA Fitting for Tubing or Septum**<br>• PFA fluoropolymer construction Sample only comes into contact with high purity, inert fluoropolymer PFA, the ultimate in chemical resistance and non-contaminating material<br>• Allows attachment of tubing or syringe sample extraction by switching caps<br>• Compression ferrule secures tubing onto fitting with superior grip compared to metal fittings<br>• Replaceable fluoropolymer-faced septum with large area allows repeated punctures with common lab syringes |
|  | **Nickel Plated Halkey® Roberts Barbed On/Off Valve**<br>• Nickel Plated. Resists damage from most aggressive chemicals<br>• Barbed stem for attaching tubing.<br>• Leak resistant seal prevents sample loss in closed position. However, when stem is not closed, sample air passes into ambient air outside valve |

**For more information, contact Uniphos Envirotronic Inc.**
**Tel: 1-844-247-0450**