
Resources Required for Adoption of the New Threshold Limit Value for Beryllium

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Issue: New TLV for Beryllium

In 2009 the American Conference of Governmental Industrial Hygienists (ACGIH) issued a revised Threshold Limit Value (TLV) for beryllium.

- 0.05 ug/m³, 8hr TWA.
- Inhalable particle fraction sample.

Significant resources are required to implement:

- Cost of sample analysis may increase.
- Samplers meeting the ISO inhalable fraction criteria must be purchased.
- Samplers require significant handling and processing.
- Sampling pumps may need to be upgraded or replaced.

Problem: Measuring Very Low Exposure Limit

Sample detection limit ($\mu\text{g}/\text{m}^3$) for a full shift sample (480 minutes) at various flow rates and analytical quantification limits.

Limit of Quantification ($\mu\text{g}/\text{sample}$)

	0.005	0.01	0.02	0.05
2.0	0.005	0.010	0.021	0.052
3.5	0.003	0.006	0.012	0.030
4.0	0.003	0.005	0.010	0.026

IH Comfort Factor*: ≥ 10 Green; ≥ 5 Yellow; < 5 Red.
(*Regulatory Limit \div Sample Detection Limit)

Problem: Real World Detection

Sample detection limit ($\mu\text{g}/\text{m}^3$) for median 2009 LANL sample (238 minutes; 1313 samples) at inhalable sampler flow rates and available analytical limits.

		Analytical Limits ($\mu\text{g}/\text{sample}$)	
		Detection (0.007)	Reporting (0.023)
Flow Rate (liters/minute)	2.0	0.014	0.048
	3.5	0.008	0.028
	4.0	0.007	0.024

IH Comfort Factor*: ≥ 10 Green; ≥ 5 Yellow; < 5 Red.
(*Regulatory Limit \div Sample Detection Limit)

Available Inhalable Samplers



Button

4 lpm
25 mm



IOM

2 lpm
25 mm



CIS

3.5 lpm
37 mm

Sampler Parameters

Sampler	Filter (diameter, pore)	Pressure* (cm H ₂ O)	Flow (lpm)	Weight (grams)
IOM	25 mm, 0.8 μm		52	2.0 20
CIS	37 mm, 0.8 μm		28	3.5 52
Button	25 mm, 1.2 μm		42	4.0 34
CFC	37 mm, 0.8 μm		14, 11	2.0 20
CFC	37 mm, 0.8 μm		NA, 18	3.5
CFC	37 mm, 0.8 μm		28, 21	4.0

*With new, clean filter. For CFC sampler, two lots of filters tested.

SKC XR pumps with NiMH battery are rated at 51 cm H₂O at 4 lpm.

General Sampler Handling Process

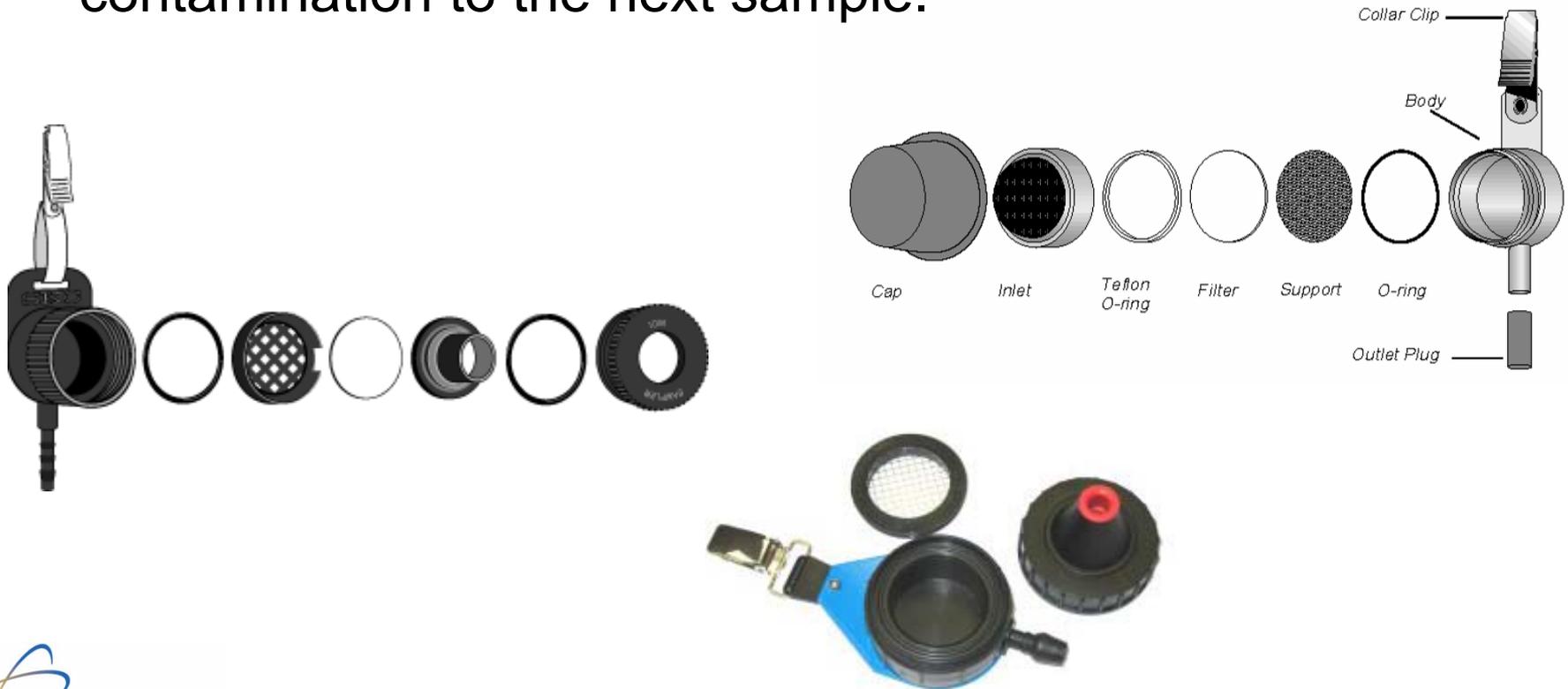
- Sample is collected in the field.
- Sampler is opened and filter is transferred to sample tube.
- Inner surfaces of filter cassette wiped with wetted filter paper and wipe is added to sample tube.
- Sample is sent to analytical lab.
- All sampler parts are carefully cleaned and dried.
- A portion of samplers are sampled to confirm cleanliness.
- Samplers are loaded with new filters and assembled for next use.

Indications from Commercial Lab Survey

- DOE sites may have to negotiate processes, procedures, responsibilities and costs for analyzing inhalable samples.
 - Very little demand for inhalable sampler analysis.
 - Majority of inhalable samples are for gravimetric analysis.
 - IOM is sampler of choice by commercial analytical labs.
 - Some labs want to receive the whole sampler. Others want to receive just the filter.
- In general, commercial analytical laboratories are not prepared for large-scale analysis of beryllium samples collected using inhalable samplers.
- For this report it is assumed that LANL will handle and process samplers and send filters only to analytical lab.

Cleaning of Samplers

- Sampler cleaning must meet high QA standards.
- Samplers have a lot of parts and places to carry contamination to the next sample.



Proposed Cleaning Method

- General procedure:
 - Tap water rinse.
 - 1st stage warm ultrasonic bath, soap solution, 15 min.
 - 2nd stage warm ultrasonic bath, soap solution, 15 min.
 - 3rd stage warm ultrasonic bath, water, 15 min.
 - Distilled water rinse.
 - Dry at room temperature.
- Clean in separate batches for heavier sampler housings and delicate filter cassettes/supports.
- Sample ultrasonic baths and replace or filter solutions when needed.

Cleaning Process Concerns

- Exposure concerns for cleaning solutions:
 - Dermal exposure: Wear gloves and lab coat.
 - Misting during ultrasonic cleaning: Cover baths and perform air monitoring. Work in hood if necessary.
- Contamination concerns for splashes and spills:
 - Containment trays.
 - Adsorbent paper cover on countertops.
 - Wet wipe areas.
 - Collect surface wipe samples to confirm clean.
- Cleaning solutions may create a waste stream issue.
- QA procedure and sampling required to confirm samplers have been adequately cleaned.

LANL Costs for Inhalable Samplers

- Number required may equal number of samples/month.
 - Average weekly use (25) must be prepared and ready.
 - Assume one week in field and one week in lab.
 - Assume use at multiple locations.
- Approximate cost for 100 samplers:

– IOM (plastic)	\$ 104.00		
– IOM (extra cassettes)	\$ 20.00	\$	12,400
– CIS	\$ 82.50		
– CIS (extra cassette)	\$ 8.25	\$	9,075
– Button	\$ 213.00	\$	21,300
- Upgrading personal sampling pumps.

– 41 NiMH batteries	\$ 150.00	\$	6,150
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LANL Costs for Inhalable Samplers

- Additional equipment and materials.
 - Ultrasonic cleaners \$ 1500\$ 4,500
 - Other miscellaneous \$ 2,500
- Consumables/QA per year.
 - General supplies \$ 1,200
 - QA and IH sampling (estimated) \$ 8,300
 - Filter and sample tube \$ 1.45 ea \$ 1,740
- Technician time to handle and process samplers.
 - Estimated 20% FTE per year. \$ 32,600
- Professional time to develop and maintain.
 - Estimated 80 hours to establish programs. \$ 9,600
 - Estimated 24 hours per year to maintain. \$ 2,880

LANL Cost Summary for Inhalable Samplers

- Initial set-up costs:

– Samplers	\$ 9,075	to	\$
	21,300		
– General Equipment	\$13,150		
– Professional T&E	\$ 9,600		

- Annual costs:

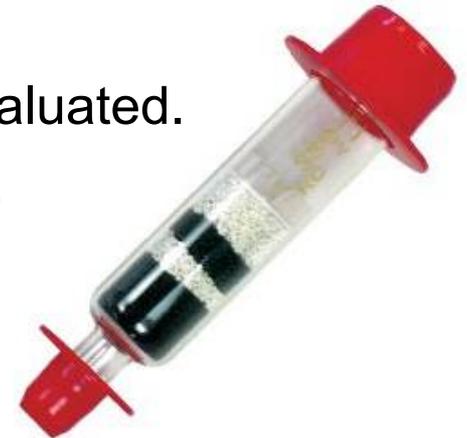
– Consumables/QA	\$11,240		
– Sampler Replacement	\$ 500	to	\$
	1,500		
– Technician T&E	\$ 32,600		
– Professional T&E	\$ 2,880		

- Overall costs:

– First year	\$ 79,045	to	\$
	91,270		
– Subsequent years	\$ 47,220	to	\$
	48,220		

It's Not Just Beryllium

- From: *ACGIH Statement of Position Regarding the TLVs® and BEIs®*:
 - “*ACGIH® TLVs® and BEIs® are based solely on health factors; there is no consideration given to economic or technical feasibility. Regulatory agencies should not assume that it is economically or technically feasible to meet established TLVs®.*”
- 2009 ACGIH booklet lists 78 inhalable or inhalable and vapor TLVs.
 - 15 were randomly selected and methods evaluated.
 - None could be ensured to meet ISO criteria.
 - OVS-2 sampler has been validated, but not characterized for particle fraction.



Requested Actions

- Establish a working group within the Sampling and Analysis Subcommittee to perform a **critical** review of the literature on inhalable samplers and methods.
 - Working group members should include aerosol scientists and industrial hygienist. (Also health physicists?)
 - Develop bibliography and summary.
 - Report to BH&SC at Spring 2011 meeting.
- Request DOE interpretation of 10 CFR 850.24(e).
 - Would accuracy requirement ($\pm 25\%$ with 95% confidence) now apply at the TLV rather than the action level?
 - Are analytical results between LOD and RL usable?

Questions



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