An ANSI N13.1 Sampling Method for Portable Ventilation Units

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The Problem

- D&D project involves removal of buildings and therefore demolition of existing stacks
- Client desires to satisfy 40 CFR 61.93: “samples of the effluent stream shall be withdrawn continuously ... following the guidance presented in ANSIN13.1”
- Project scope requires stationary and portable ventilation units (PVUs)
- Did you say PORTABLE?

Of Course We Can Do It

(But I don't know exactly how just yet!)

- Fixed stacks have known precedents; compliance for portable units is not obvious!
- Review of known PVU effluent sampling methods does not uncover ANSI N13.1 compliant methods
- Known permitted methods are grandfathered and use alternative duct samplers or general area (GA) air sampling
- Client uses GA sampling for PVU exhausts

Not Found in Catalogues... So...

- Glissmeyer JA. 2011. *Principles for Sampling Airborne Radioactivity from Stacks*. In *Radioactive Air Sampling Methods*, ed. M Maiello, MD Hoover. CRC Press
- Chapter lists 15 methods for achieving uniform flow in ducts
  - Most compact method uses mixing vanes
  - Next is Andrew McFarland's generic mixer box

Generic Mixing System

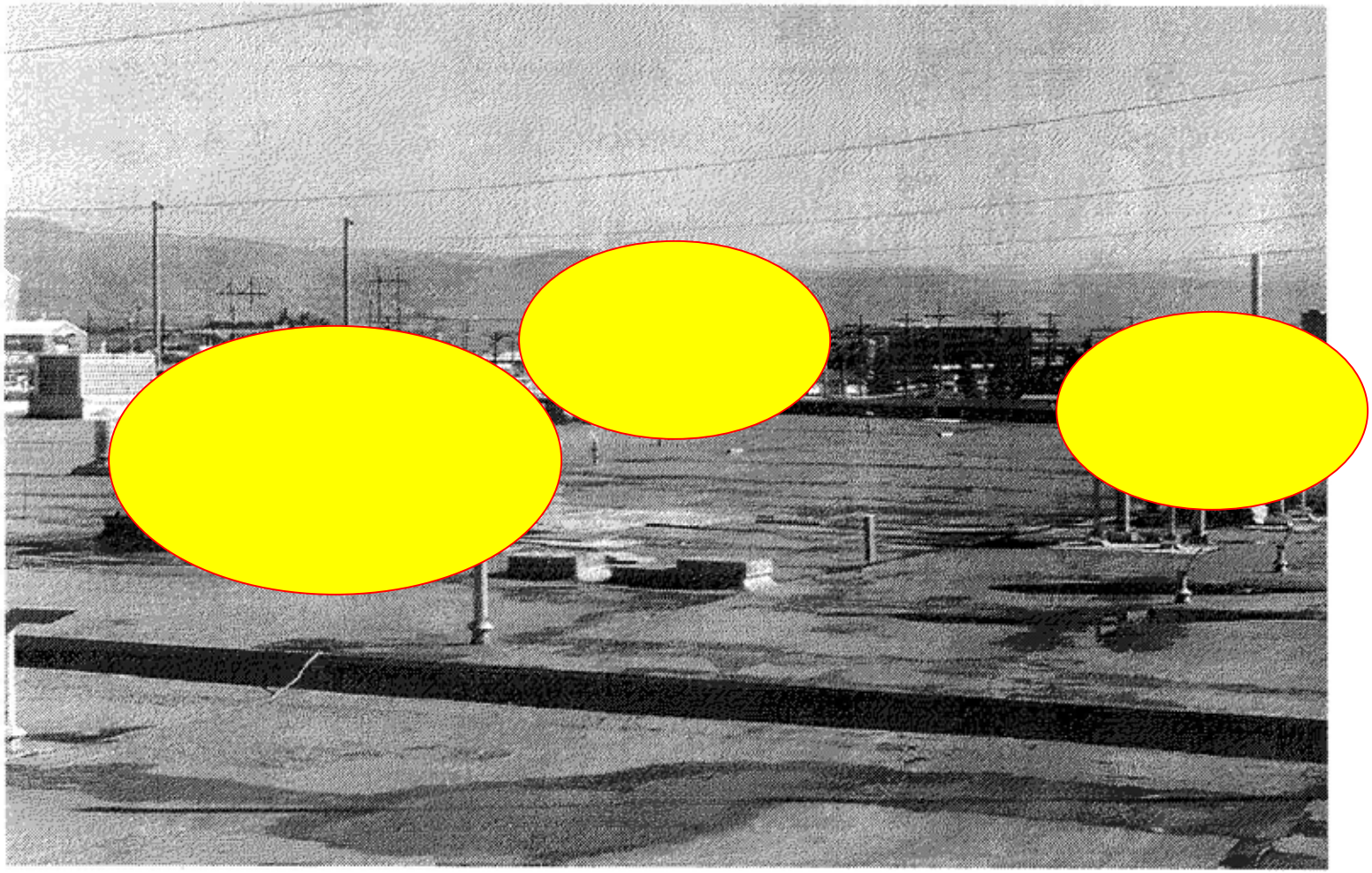


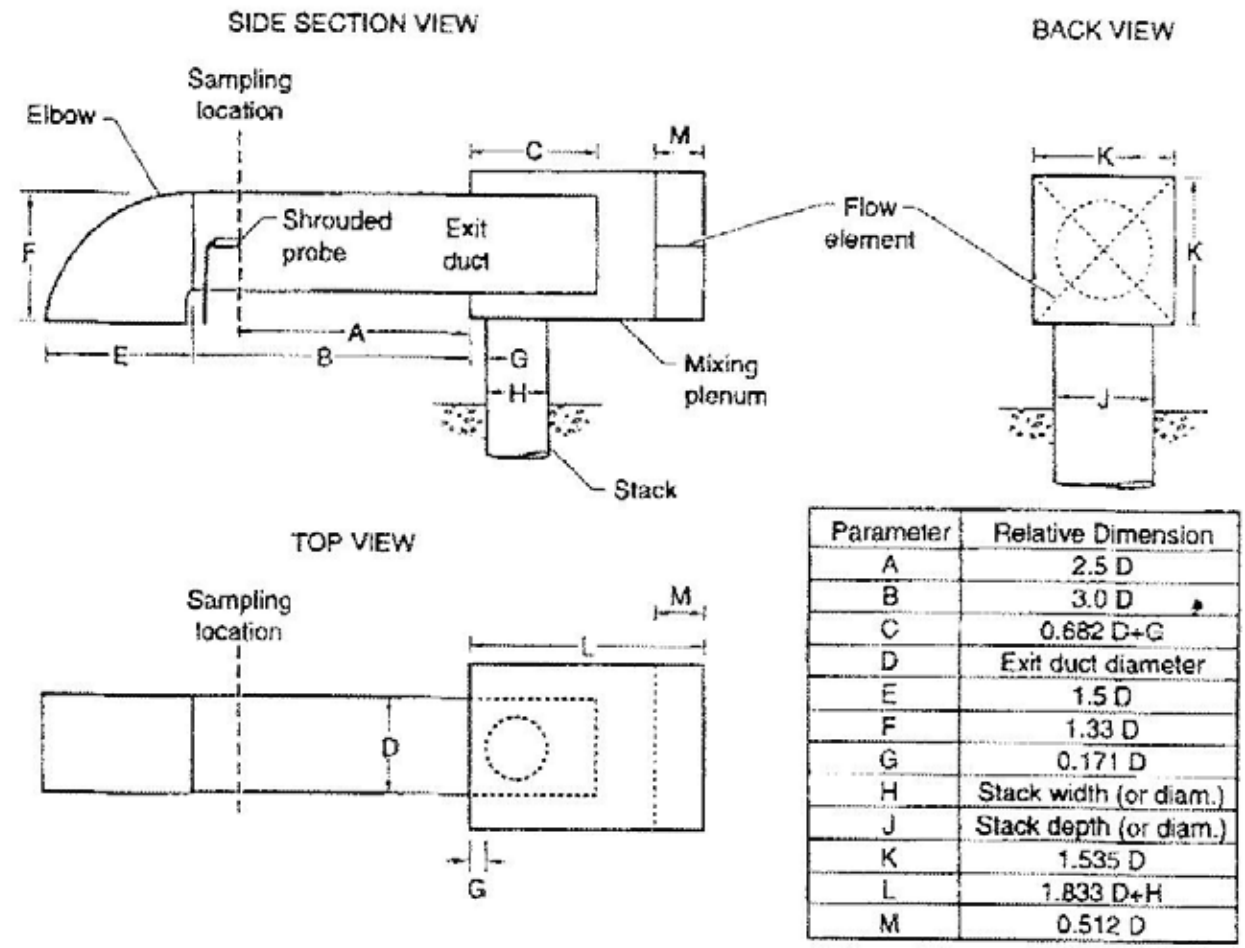
Figure A.15. Texas A&M University Developed Generic Mixers as Replacement Rooftop Exhausters

Generic Mixing System

- McFarland et. al. 1999, *A Generic Mixing System for Achieving Conditions Suitable for Single Point Representative Effluent Air Sampling*, Health Physics Vol. 76 No. 1 P. 17
- Published scaling parameters show total length 5.8 to 7.4 times duct diameter
  - 8” duct requires 4' to 5'
  - 10” duct requires 5' to 6'
- Sufficiently compact for portable applications

Generic Mixing System

Figure from McFarland et. al. (1999) showing scaling factors for "generic mixing system"

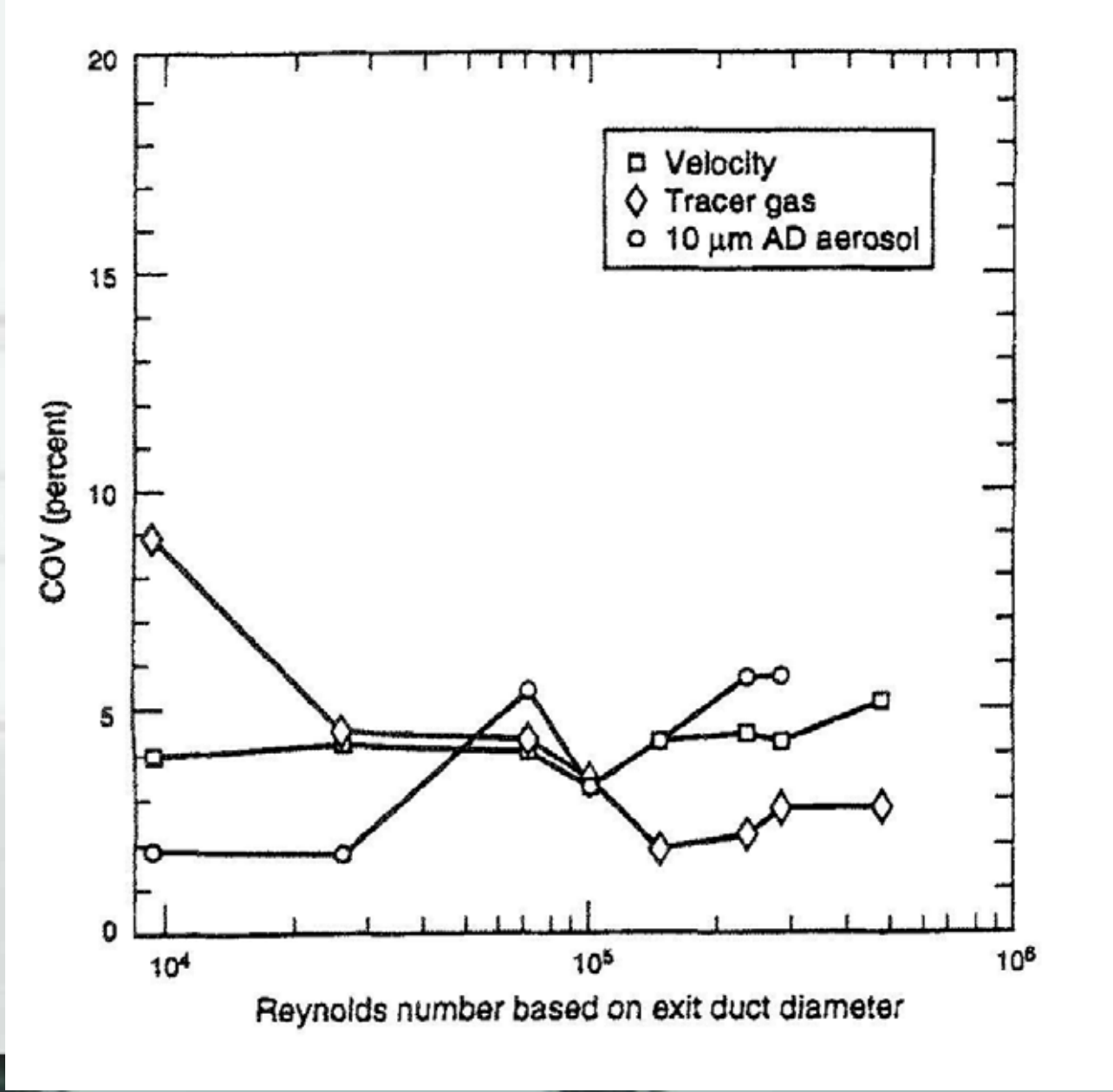


Parameter	Relative Dimension
A	2.5 D
B	3.0 D
C	0.682 D+G
D	Exit duct diameter
E	1.5 D
F	1.33 D
G	0.171 D
H	Stack width (or diam.)
J	Stack depth (or diam.)
K	1.535 D
L	1.833 D+H
M	0.512 D

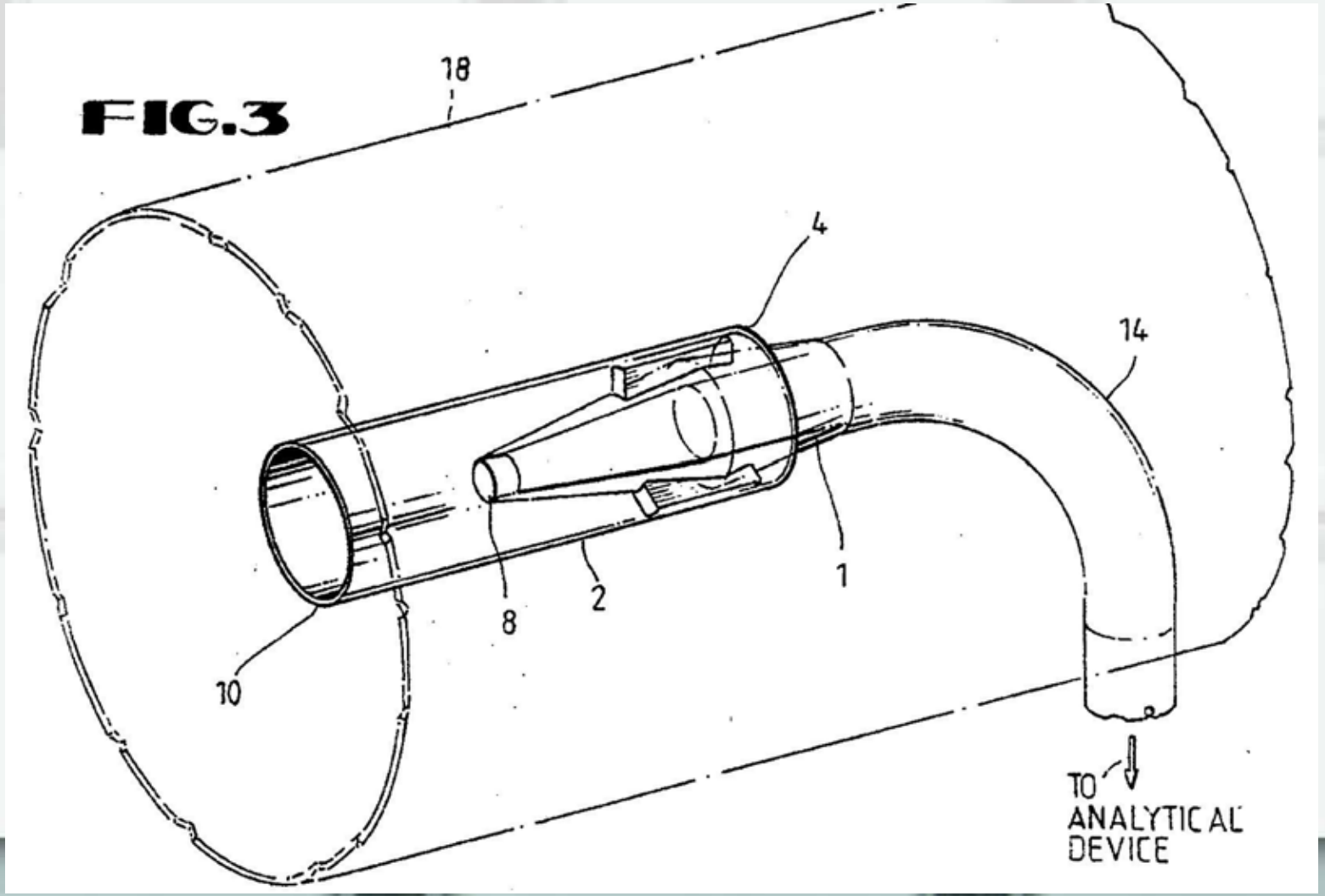
Fig. 2. Design dimensions of the generic mixing system. The dimensions are scaled to the diameter of the exit duct.

Velocity, Gas Particle COVs

Figure from McFarland et. Al. (1999) showing test results for generic mixing system



Shrouded Probe



ANSI N13.1 5.2.2.2 Acceptance Criteria

- Representative and stable sample location
- Short sample lines
- Flow angle less than 20%
- Scaling an existing design tested in lab or field
- Product V * D within factor of 6
- Reynolds Number greater than 10,000
- Velocity profile tested and COVs within 5%
- Reviewed with four ANSI N13.1 authors

Required Sample Flow Rate

- Standard method for tracking releases is to calculate sample concentration
- Apply minimum sensitivity if measurement less than minimum sensitivity
- Push for larger volumes
- Compliance engineer wants 60+ m
- But sample flow rate needs to change according to exhaust flow rate.

Example Case

- HEPA carts exhausted tunnel for 24 weeks
- 6000 cfm exhaust
- 3860 hours; 5E-15 μCi/cc average alpha MDA
- Sample average -8.E-16 gross alpha μCi/cc
- Use MDA as concentration for 22 of 24 weeks
- Calculate 0.02 μCi Pu-239 released
- Total net counts: 46 on 24 filters

Typical Data

α conc. uCi/cc	β–γ uCi/min	α uCi/min	Run time (min)	α Release μCi	Cts per filter
-2.E-15	5.E-06	1.E-06	7200	8.E-03	1
-4.E-16	6.E-06	1.E-06	5640	8.E-03	2
-8.E-15	9.E-05	3.E-05	265	8.E-03	2
-5.E-16	6.E-06	1.E-06	7085	8.E-03	2
7.E-15	5.E-06	1.E-06	9840	1.E-02	6
4.E-16	2.E-06	8.E-07	10290	8.E-03	3
-4.E-16	2.E-06	8.E-07	10290	8.E-03	2
7.E-15	3.E-06	1.E-06	10080	1.E-02	5
-1.E-15	5.E-06	1.E-06	8880	8.E-03	1
-1.E-15	2.E-06	8.E-07	10036	8.E-03	3

Calculated Release Comparison

Average net filter cpm = 0.19

Total sample (μCi) = 4.E-07

Exhaust flow/sample ratio = 4248

Total μCi exhausted = 0.00167

“Standard method” (μCi) = 0.205

Ratio = 191

Flow Rate Requirement Conclusion

- If the objective is to quantify an annual emission, base the sensitivity analysis on the annual data collected, not the weekly results.
- Radcon needs rightly revolve on concentration based surveys
- NESHAP compliance based on annual emission reported in curies per year
- Sample flow rate can be based on collection nozzle requirements for accurate sample

Questions?