

**APPLICABILITY OF KURZ SAMPLING NOZZLES AND SAMPLING SYSTEMS
TO THE ANSI N13.1-1999 GUIDELINES**



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INTRODUCTION:

The ANSI N13.1-1969 guideline for sampling has been updated to the ANSI N13.1-1999 as of 1-12-1999. The basic difference is that the 1999 revision is based upon performance criteria for sample nozzles and associated equipment, and requires extensive particle, mixing and velocity profile measurements to qualify the sampling location, rather than selection of the sampling location by engineering principles and the use of several sampling nozzles placed at equal areas within the duct/stack to increase the probability of detecting particulate emissions due to a failure of the HEPA filter due to water damage, physical damage or a bad gasket, etc. These problems make up a fair number of the subjects discussed at the annual DOE/NRC Air Cleaning Conference, so we know that such failures occur. The new 1999 criteria, apparently has ruled out such problems, as it directs the user to map out the particle, mixing and velocity profiles, such that a single nozzle may be used, apparently assuming that these measurements are sufficient to cover all possibilities. The revised guideline is primarily written around a single-point shrouded nozzle as developed at Texas A & M, although efficient single-point and multi-point sampling rakes are allowable, provided they meet the Transmission Ratio criteria, but are clearly discouraged without appropriate technical justification, in our opinion.

Based upon our many years of experience and working with the top "Gurus" of sampling technology at Du Pont and later Westinghouse at the Savannah River Site, we believe that the new standard is flawed for the following reasons:

- 1) The test program for particle trajectories, gaseous mixing and velocity profile is very expensive, time consuming and may have little to do with abnormal or accident conditions, since it uses a single nozzle and is based on the assumption that its location will work over the full range of possible conditions. Changes to the duct work, flow rates, etc., will require new tests. This can be a never ending, expensive situation which clearly benefits the consultants and testing agencies. In other words, this approach is not very compliant with changes nor accidents. There is little chance that a leak of large particles will be detected by a single sample probe, no matter where placed. Finding this "Sweet Spot" for a single-point sample nozzle can be an elusive challenge, and easily remedied by using an efficient multi-point sample rake, as we have developed.
- 2) The shrouded probe is large, difficult to install, has a sole supplier and does not appear to have a well understood theoretical basis over the wide range of nozzle sizes, flow rates, etc. It appears to be most effective for large ducts and nozzle diameters as it was originally designed for the 14' diameter exhaust at the Waste Isolation Pilot Plant at Carlsbad, New Mexico.

About 12 years ago Kurz developed a new sample nozzle (AXF) that has a demonstrated transmission ratio of about thirty (30) times (for 15 micron particles) more than the "ANSI" nozzle having a 90° bend

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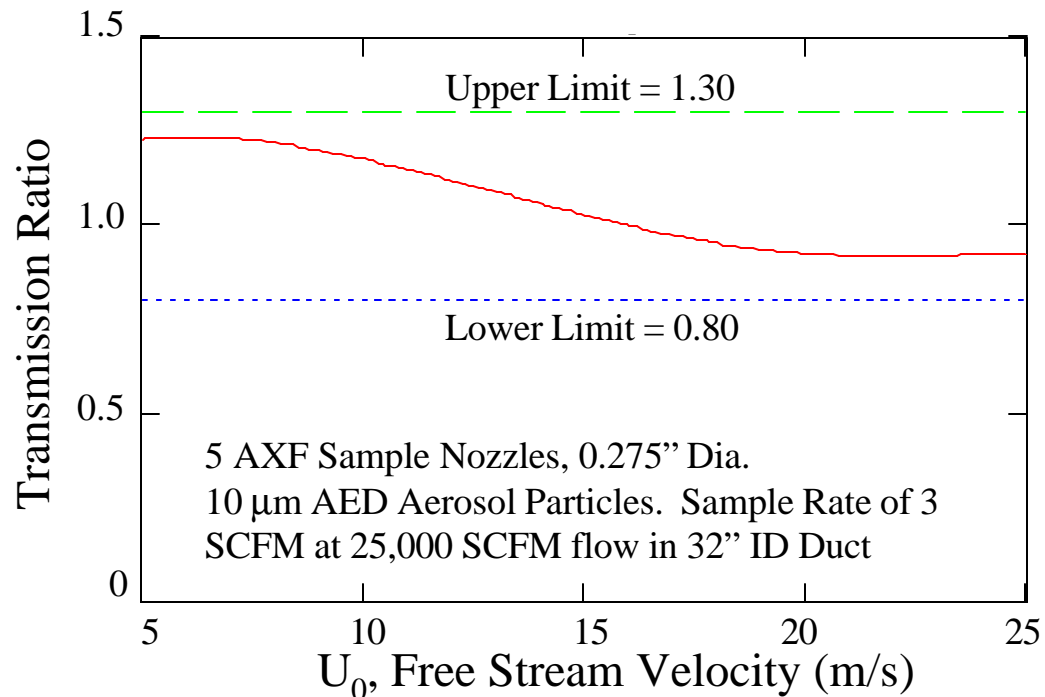
with a 5:1 radius, and a constant diameter (see Test Report attached). This nozzle has been used successfully at SRP and many other facilities in over 100 locations. Kurz Sampling Systems meet the ANSI N13.1-1969 guidelines including the number of sample point criteria for various sized stacks. We believe that having an array of sample nozzles offers an order-of-magnitude improvement in the ability to detect an accident or abnormal event compared to a single-point nozzle no matter how well the sample location is qualified. The cost of a multiple point array is not much more than the shrouded probe (which is quite expensive and only available from Andersen Instruments). Our K-BAR Multi-Point Thermal Mass Velocity Sensors are installed along-side the nozzle rake with a simple flanged installation and is inserted as one assembly. The Kurz system accurately measures and controls the sample rate, and measures the stack flow rate and its velocity profile accurately, with sensor redundancy. Our Series 155 Mass Flow Computer/Controller can be operated at isokinetic, sub-isokinetic, constant flow or under manual flow control. (Please see the attached system outline drawing).

We believe that the concept of using a well designed multi-point sample rake having the performance criteria of ANSI N13.1-1999 by using sub-isokinetic sampling to offset the losses for large particles is the best overall solution to having an accurate, repeatable, reliable, and redundant emission sampling system that will tolerate HEPA filter failures, gasket leaks and changing conditions. Because of our multi-point velocity sensors and multi-point nozzle arrays it is much more compliant and reliable than single point systems.

CONCLUSION:

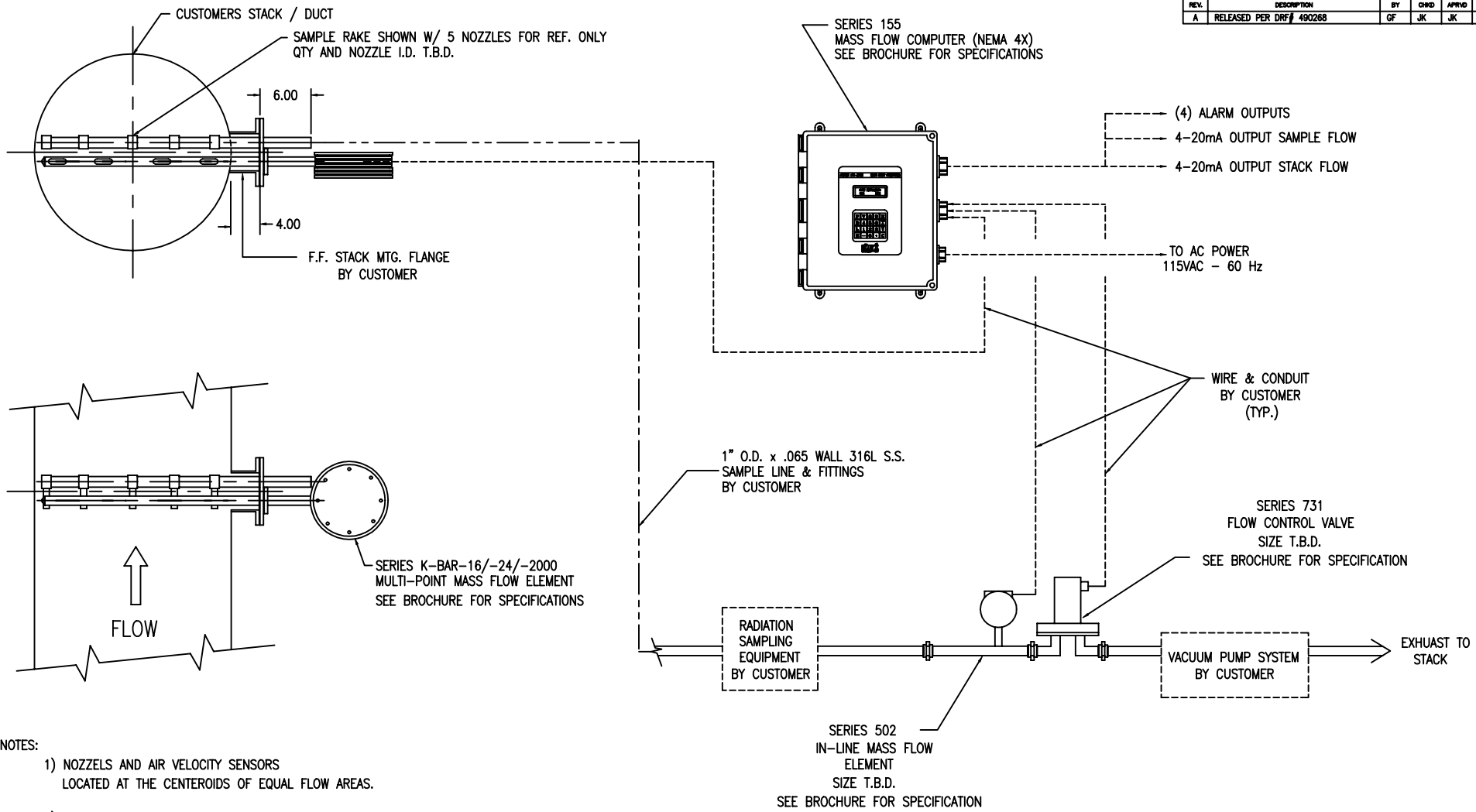
Kurz Instruments can meet the requirements of the new ANSI N13.1-1999 guidelines using our "AXF" a single-point non-shrouded nozzle or multi-point non-shrouded nozzles by simply changing the sampling method from isokinetic to sub-isokinetic. Our Low-Loss Axial Flow (AXF) nozzle that we developed for SRP will easily provide the Transmission Ratio range of .8 to 1.3 for 10 micron particles as required in Paragraph 6.3.2 of N13.1-1999 (see attached graph). For existing systems one can simply change the thread-on AXF sample nozzles to a larger size. The attached graph shows the Transmission Ratio for a typical sampling system using the Kurz AXF nozzles for a stack flow rate of 0 to 25,000 SCFM, with five sample nozzles on a Series 220 Multi-Point Sample Rake, a sample flow rate of 0-3 SCFM which is controlled to be flow proportional to the stack flow rate and sub-isokinetic. Sub-isokinetic sampling, as shown by Professor Dale Lundgren in 1980, increases the concentration ratio of the larger particles and therefore offsets the sampling losses of the sample nozzles and sample transport piping. We have a much simpler nozzle design than the shrouded probe, and meet the same performance criteria, and most importantly—greatly improves the ability of measuring the correct emission rates in the event of abnormal or accident conditions. Our approach is much more versatile than the single-point shrouded nozzle and includes all the flow measurement control and computational equipment as an integrated, easy-to-install system and has a much larger flow rate turn-down ratio than competitive systems.

Kurz Sampling System Compliance with ANSI N13.1-1999 Requirements



Particle Transmission Ratio of the Kurz Low Loss Axial Flow (AXF) nozzles at a sub-isokinetic ratio of 3:1. Reference: D000270-01 Flow Proportional Air Sampling System Outline Drawing.

REVISIONS					
REV.	DESCRIPTION	BY	CHKD	APRVD	DATE
A	RELEASED PER DRP# 490268	GF	JK	JK	11.12.99



- NOTES:
- 1) NOZZELS AND AIR VELOCITY SENSORS LOCATED AT THE CENTROIDS OF EQUAL FLOW AREAS.
 - 2) NOZZLE SIZE FOR ISOKINETIC SAMPLING IS DETERMINED BY USING AN EQUAL VELOCITY INSIDE THE NOZZLE TIP AS IN FREE STEAM. NOZZLE SIZE TO MEET ANSI - 13.1 1999 HAS NOZZLE AREA (3) THREE TIMES ISOKINETIC NOZZLE AREA.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		TOLERANCES ARE		APPROVALS		KURZ INSTRUMENTS, INC.	
FRACTIONS ± 1/16		DECIMALS ± .01		DESIGNED BY	DATE	FLOW PROPORTIONAL AIR SAMPLING SYSTEM OUTLINE	
ANGLES ± 1°-0'		DECIMALS ± .001		CHECKED BY	DATE	DWG. NO. 000220-01	
X .001 ± 0.001		DECIMALS ± 0.001		APPROVED BY	DATE	SCALE NONE SHEET 1/1	
NEXT ASSEMBLY		ORIG. RELEASE DATE		J.FOSTER	11.12.99	REV. A	
				J.KURZ	11.12.99		
				J.KURZ	11.12.99		



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Test Data On Kurz Axial Flow Sampling Nozzles And ANSI Standard Nozzles

The test procedure was the standard procedure used by most aerosol researchers. Kurz supplied an isokinetic wind tunnel that adapted to a Whitby-Liu Vibrating Orifice aerosol generator at the Industrial Hygiene Laboratory at UCLA (Professor William Hinds). Kurz flow instruments were used to measure and control the sample flow into the aerosol generator and the sample probes. The aerosol was generated at a known particle size and contained a small amount of fluorescent dye. The ratio of the material collected in a downstream filter to the mass of material collected in the sample nozzle, plus the filter, represents the particle penetration efficiency. Various nozzle geometries were tried and the data represents our present proprietary design. Test data was also taken for the traditional nozzle design described in ANSI N13.1-1969. It is quite evident that the use of the standard ANSI Nozzle design is extremely detrimental to defensible particulate measurements and that our axial flow nozzle is far superior. Below 5 microns, the results are similar. The ANSI Nozzle is not even a candidate for acceptable performance at 10 microns.

TEST SERIES A (12-22-87) Nozzle Type: Kurz Axial Flow (AXF)

Flow Rates (SLPM)		Penetration (%)		
Nozzle Flow	Upstream Manifold Flow	5µm	10µm	15µm
10	10	91	51	34
15	15	87	40	30
20	20	72	42	30

TEST SERIES B (12-22-87) Nozzle Type: ANSI Design Nozzle

Nozzle Flow (SLPM)	Penetration (%)		
	5µm	10µm	15µm
10	88	13	1.5
15	82	3	0.4
20	72	2	0.2