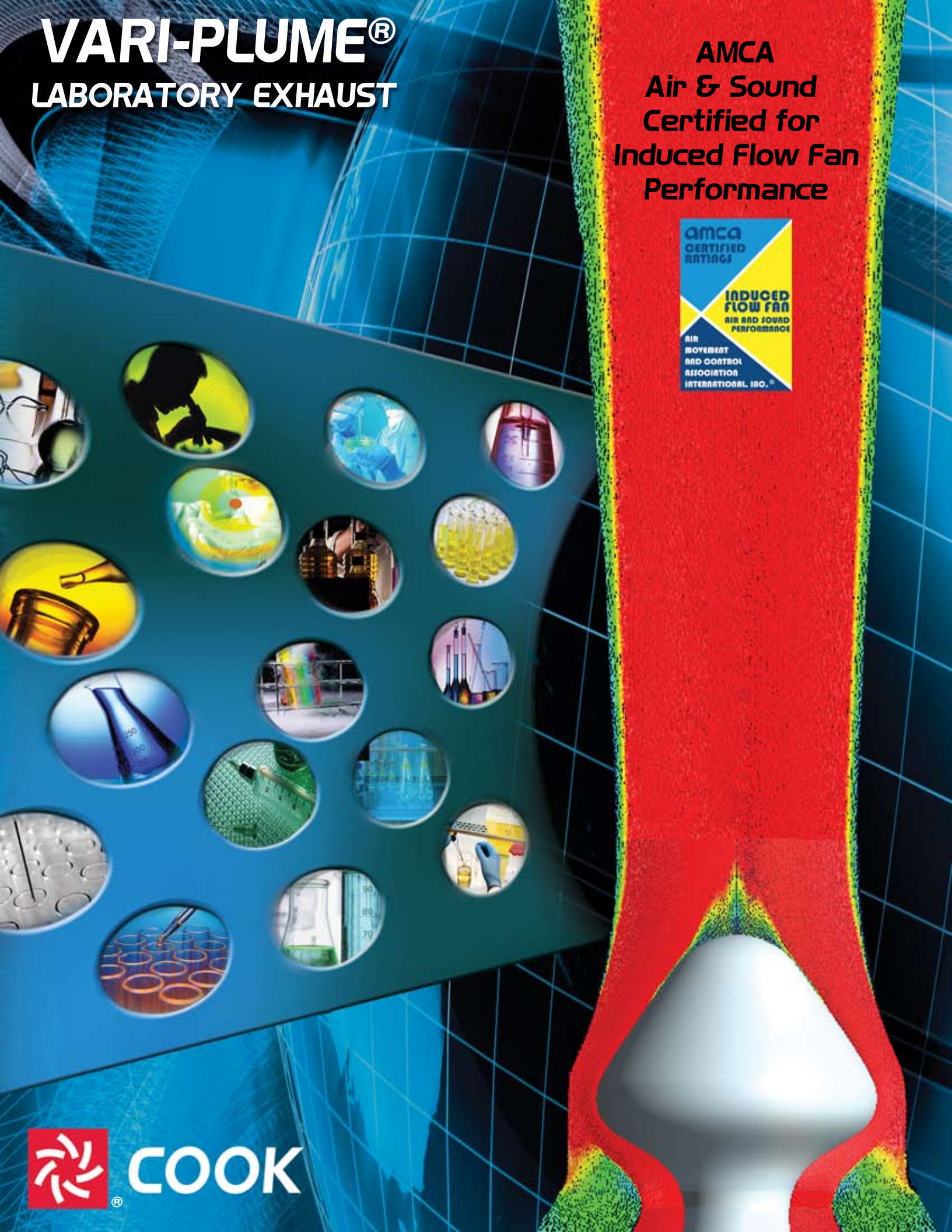
VARI-PLUME®
LABORATORY EXHAUST

AMCA
Air & Sound
Certified for
Induced Flow Fan
Performance

amca CERTIFIED RATINGS
INDUCED FLOW FAN
AIR AND SOUND PERFORMANCE
AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.®



COOK®

The **Vari-Plume®** high plume dilution fans were designed for safe and reliable displacement and dilution of laboratory exhaust.

Two common methods are utilized to obtain high plume heights above laboratories.

- ***Tall Exhaust Stacks***
  This method often requires guy wires and special structural designs for support and wind loads. Additionally, it is difficult to incorporate these stacks into a pleasing architectural design.

- ***High Plume Dilution Exhaust Systems***
  These systems induce fresh air thereby reducing hazardous exhaust concentrations. Additionally, these units are designed to have high discharge velocities. The combination of the air volume and velocity contributes to a high plume exhaust.

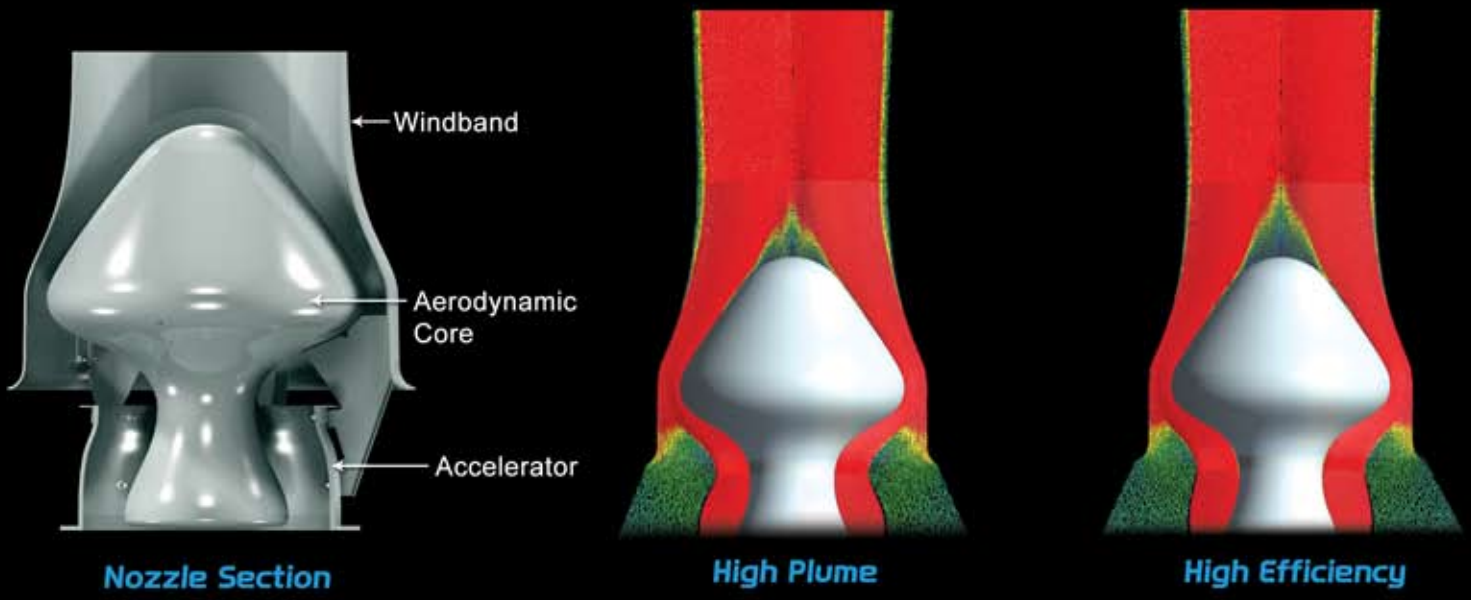
ASHRAE, ANSI, UL, NFPA and OSHA have each published regulations or design guidelines for laboratory exhaust. In addition, AMCA has developed a test method (AMCA Standard 260-07) as well as a Certified Ratings Program specifically for Induced Flow Fans.

Typical Laboratory Exhaust System

This schematic represents a typical lab exhaust system. Included are the lab hoods, modulating control valves, ductwork connecting to a manifold, a mixing box with bypass damper, a **QMX** mixed flow fan and a **Vari-Plume®** high plume dilution nozzle.

While this illustration shows a single fan/multiple hood arrangement, the **Vari-Plume®** is also available for other lab exhaust configurations. From a one fan/one hood system to more critical redundant system configurations, **Vari-Plume®** is your answer for laboratory exhaust. Multiple fan system options for both the **QMX** and **CA** are shown in this brochure. Additional layouts are also available.

Designed utilizing Computational Fluid Dynamics, the ***Vari-Plume®*** nozzle entrains air concentrically. The ***Vari-Plume®*** design provides smoother air entrainment for more uniform outlet airflow. The consistent ***Vari-Plume®*** outlet velocity reduces the harmful effects of cross winds, the major drawback of a typical bifurcated design.



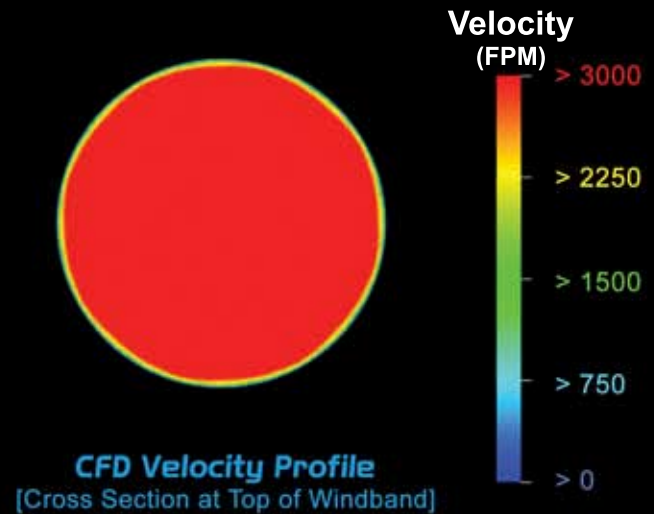
The CFD models above illustrate the lab exhaust air flow in the ***High Plume*** and ***High Efficiency Vari-Plume®*** nozzles. The ***High Plume*** accelerator compresses the exhaust air into a smaller area creating a higher velocity. This high velocity exhaust will entrain a greater amount of dilution air resulting in the maximum plume height. The ***High Efficiency*** accelerator provides a more gradual acceleration of the exhaust air, using less energy by creating less resistance around the accelerator.

As the air accelerates around the aerodynamic core, it creates low pressure, concentrically inducing outside air to encapsulate the contaminated exhaust. Both designs produce a consistent velocity resulting in an optimum plume pattern.

The velocity profile shown at right was modeled using CFD. This illustrates a near uniform outlet velocity above 3,000 FPM (see scale).

The ***Vari-Plume®*** design does not develop “hot” and “cold” outlet velocity levels typical of bifurcated nozzles. Outlet velocity in traditional bifurcated nozzles can vary wildly and will often drop below 500 FPM around the inside perimeter of the wind band.

ANSI/AIHA Z9.5 recommends "a minimum discharge velocity of 3000 FPM". In a typical 10 MPH cross wind, an outlet velocity below 3,000 FPM (at the top of the windband) will not allow the laboratory exhaust air to be ejected a safe distance above the roof. Low discharge velocities can also result in downdraft within the windband, causing contaminated air to be directed downwards.



How Cook Induced Flow Fans are Tested For AMCA Standard 260-07

Induced Flow Fan performance is determined using the two test configurations shown below. These test results provide dependable performance data for designing laboratory exhaust systems.

Setup #1 (AMCA Standard 210, Figure 15)

This test determines inlet airflow (CFM), inlet SP, RPM and HP.

Setup #2 (AMCA Standard 260, Figure 1)

This test determines the outlet airflow (CFM). Tested at the inlet SP conditions measured in test Setup #1.

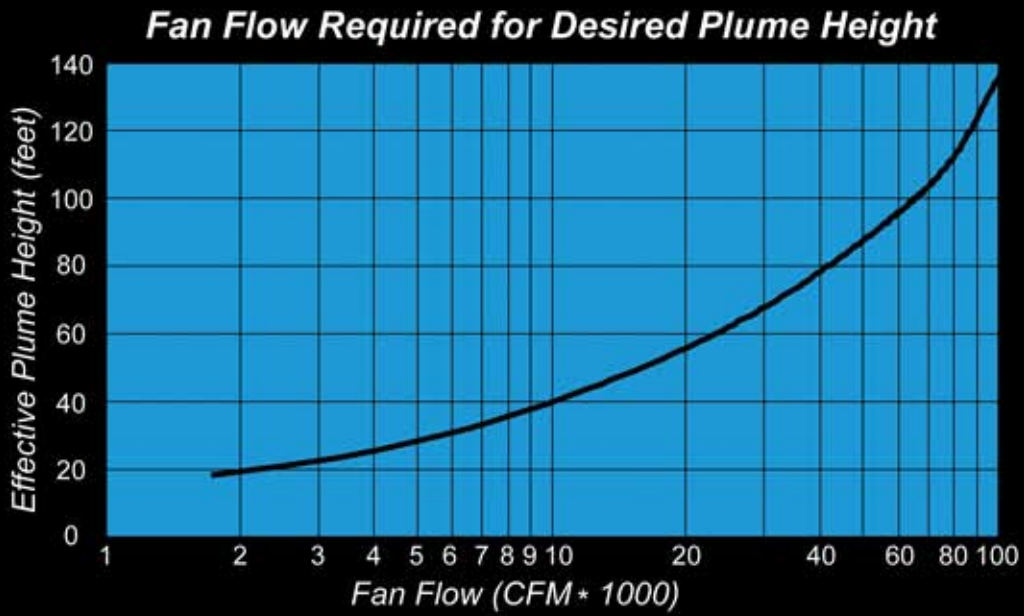
By dividing the outlet airflow from test Setup #2 by the inlet airflow from test Setup #1, the entrainment ratio can be calculated. Calculate the windband exhaust velocity for determining plume height by dividing the outlet airflow by the windband exit area.

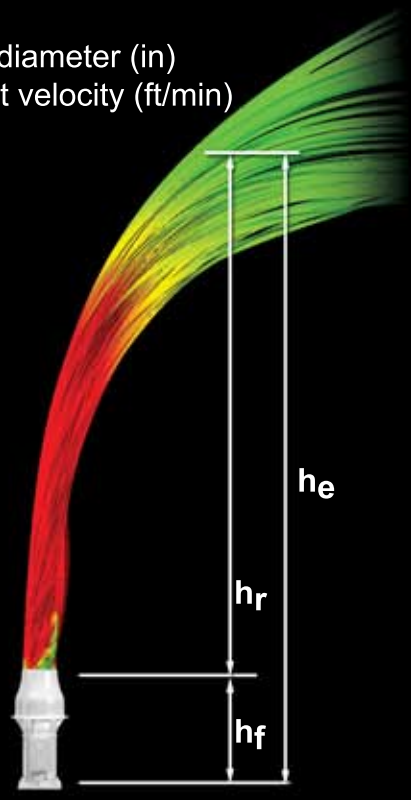
How Plume Height is Calculated

Effective plume height is calculated using the following formula:
Based on 2007 ASHRAE Applications Handbook, Chapter 44, Equation 7.

$h_e = h_r + h_f$ where:
- h_e = Effective plume height above roof (ft)
- h_r = Plume height above top of fan (ft)
- h_f = Total fan height above roof (ft)

$h_r = d\,(v/u) / 352$ where:
- d = Effective exhaust diameter (in)
- v = Windband exhaust velocity (ft/min)
- u = Windspeed (mph)



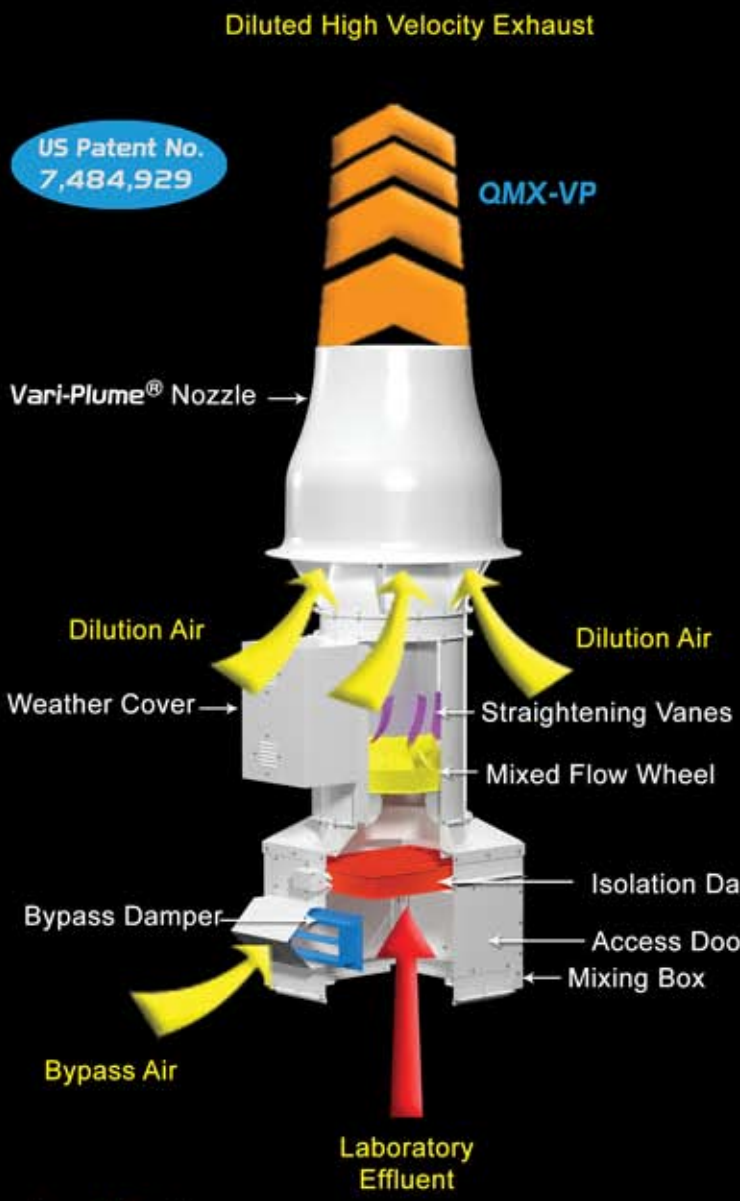


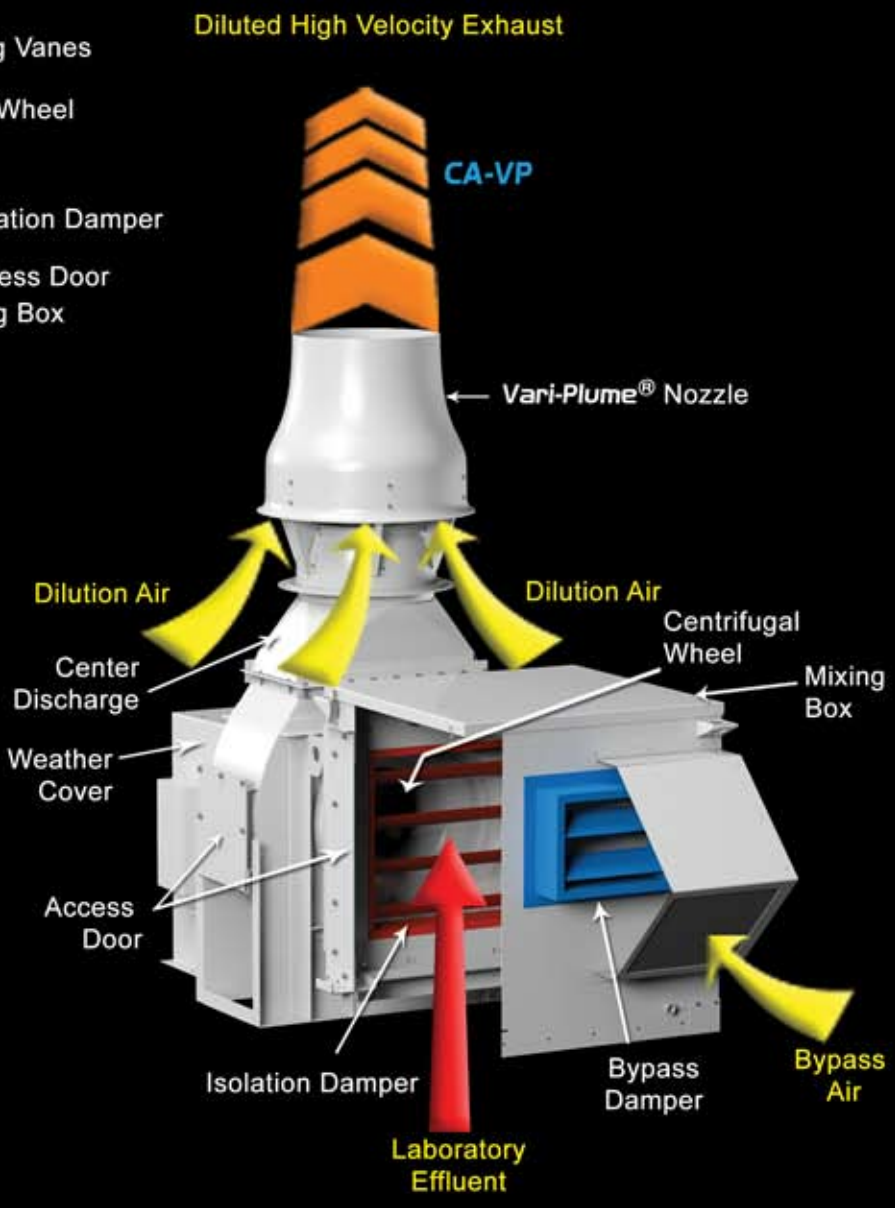
Nozzle Sizes

There are 10 different **Vari-Plume®** nozzle sizes that can be matched with the appropriate **COOK** model **QMX** mixed flow or **CA** centrifugal laboratory exhaust fan. Each nozzle size is available with two accelerator options. This allows for an optimized selection for your specific application.

How Vari-Plume® Works

The **QMX** mixed flow or **CA** centrifugal fan removes the contaminated air from the laboratory into the **Vari-Plume®** exhaust system. After the lab exhaust has been diluted with bypass air (optional), it travels through the fan into the **Vari-Plume®** nozzle. The air increases velocity in the accelerator and then passes around the aerodynamic core. The air reaches it's maximum speed around the perimeter of the core. This creates a low pressure area, inducing outside air concentrically around the bottom of the windband. This method of entrainment effectively encapsulates the laboratory exhaust, creating a near uniform outlet velocity at the discharge of the windband.





Laboratory Effluent:
Exhaust air from the laboratory system.

Mixing Box:
A plenum at the fan inlet used to mix laboratory effluent with bypass air.

Bypass Air:
Outside air drawn through the mixing box to increase dilution and plume height.

Bypass Damper:
A modulating damper utilized to control the volume of outside air into the mixing box.

Isolation Damper:
A damper used to isolate the laboratory exhaust fan from the ducted exhaust air system.

Dilution Air:
Entrained air drawn through the **Vari-Plume®** nozzle to dilute the laboratory effluent and increase plume height.

COOK QMX-VP

Size: 90-600
CFM: 1,500 - 94,500
SP: 1.0 - 6.0”

- Mixed Flow Wheel
- Concentric Dilution Nozzle
- Curb or Plenum Mounted
- Small Footprint

Shown With Optional Mixing Box

Standard Features:

- Lifting Lugs
- Fan Drain
- Access Door *(Bolted)*
- Phenolic Epoxy Powder Coating w/UV *(Light Gray)*
- Weather Cover
- Stainless Steel Shaft
- Stainless Steel Hardware
- Stainless Steel Lube Lines
- Concentric Lock Bearings
- Easy Access to Motor and Drives

Loren Cook Company certifies that the QMXVP shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

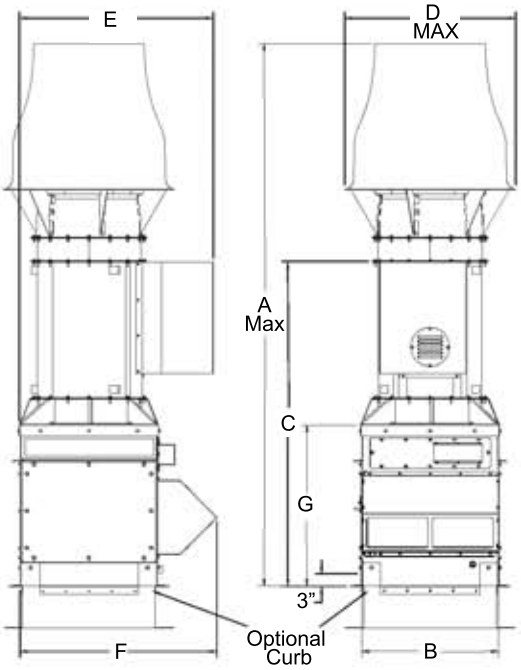
Performance Ranges *(Single Configuration)*

Size	Min Performance Inlet CFM	Min Performance Outlet CFM	Min Performance Plume Ht.*	Max Performance Inlet CFM	Max Performance Outlet CFM	Max Performance Plume Ht.*
90	1500	2506	15.3	2380	3235	18.2
120	1500	2487	15.8	4620	6946	26.0
135	1500	2476	16.2	5400	7893	28.8
150	1800	2876	18.3	6740	10149	30.9
165	1500	2525	17.5	8920	12796	37.2
180	3100	4602	20.9	11900	16966	41.1
202	3200	4784	22.1	14800	20950	44.7
225	2300	4464	22.0	16900	24149	50.9
245	5200	9068	31.2	20200	30276	53.8

Size	Min Performance Inlet CFM	Min Performance Outlet CFM	Min Performance Plume Ht.*	Max Performance Inlet CFM	Max Performance Outlet CFM	Max Performance Plume Ht.*
270	4700	6980	27.0	26100	35983	58.5
300	6200	10005	31.3	29700	42804	61.8
330	11000	17779	38.4	33900	49045	69.5
365	14700	21317	42.9	43700	61791	73.5
402	15800	21484	43.7	49400	70579	82.6
445	19400	28326	49.4	53000	74939	88.1
490	28100	45974	62.1	86200	118842	103
540	29000	47435	65.1	86500	118210	105
600	48300	78544	78.4	94500	129988	116

*Effective plume height referenced from base of unit. Calculated using Equation 7 from 2007 ASHRAE Application Handbook, Chapter 44, with 10 MPH wind.

For more information, including full performance data please visit www.LorenCook.com



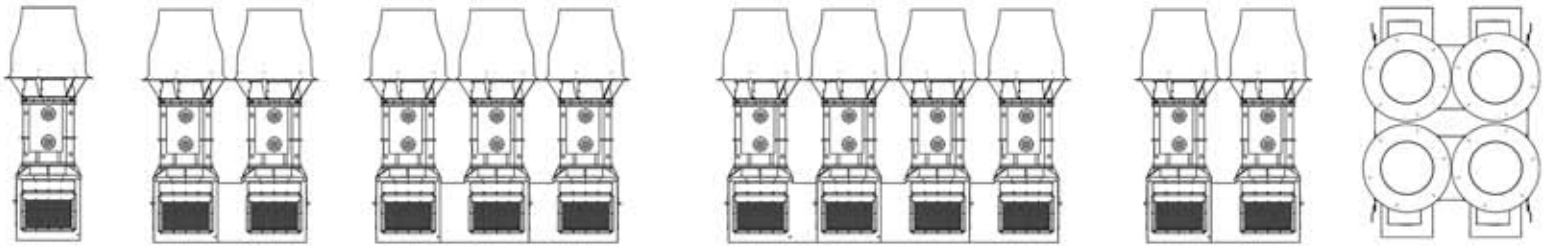
Shown With Optional Mixing Box & Curb

Dimensions

Size	A	B	C	D	E	F	G	Weight Fan Only	Weight Fan w/ Plenum
90	92	27	59	23	30	34	29	310	780
120	100	27	63	28	37	35	31	387	1050
135	108	27	67	28	39	36	33	464	1250
150	120	29	72	36	42	38	35	504	1380
165	124	31	76	36	44	41	37	586	1580
180	133	33	80	43	46	44	38	745	1830
202	143	37	85	43	50	49	41	875	1900
225	154	41	91	43	56	54	43	1033	2450
245	164	43	96	61	59	57	45	1230	2730
270	173	47	101	61	63	62	47	1377	3100
300	196	51	111	74	67	68	50	1862	3780
330	206	55	119	74	73	73	54	2177	4730
365	232	61	131	90	79	82	60	3294	5930
402	247	66	141	90	88	90	66	3781	6580
445	274	73	157	90	95	102	76	4320	7050
490	303	79	175	101	103	113	87	6798	11050
540	335	89	195	101	111	126	100	7467	12550
600	377	100	224	101	122	144	117	8692	14950

Dimensions in inches; weight in pounds (includes motor & drives for single configuration).

QMX Vari-Plume® Arrangements



Single Double Triple Quad (4x1) Quad (2x2)

COOK CA-VP

Size: 120-730
CFM: 1,500 -143,800
SP: 1.0 - 12.0”

- Centrifugal Wheel
- Concentric Dilution Nozzle
- Low Profile
- Higher Pressure Capabilities

Standard Features:

- Lifting Lugs
- Fan Drain
- Access Door *(Bolted)*
- Phenolic Epoxy Powder Coating w/UV *(Light Gray)*
- Weather Cover
- Stainless Steel Shaft
- Stainless Steel Hardware
- Aerodynamic Center Inlet/ Center Discharge Design
- Easy Access to Motor, Drives & Bearings

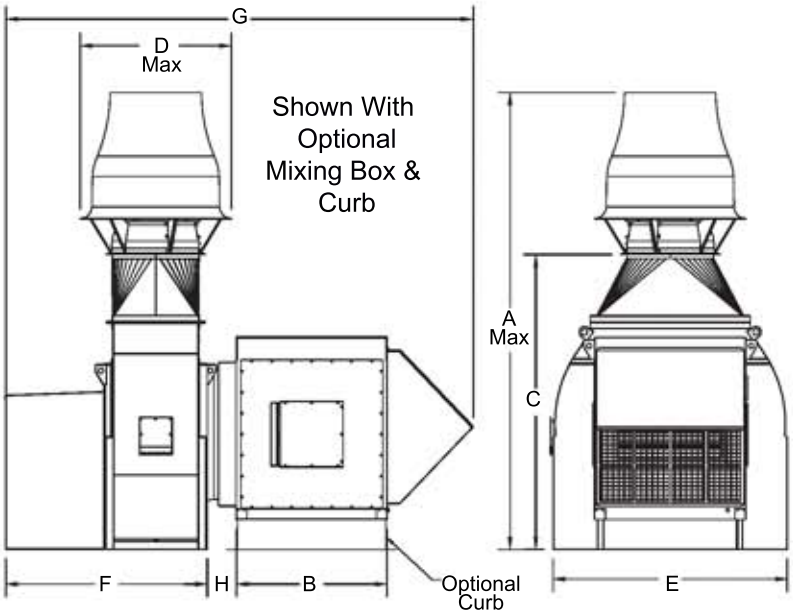
Loren Cook Company certifies that the CAVP shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

Performance Ranges *(Single Configuration)*

Size	Min Performance Inlet CFM	Min Performance Outlet CFM	Min Performance Plume Ht.*	Max Performance Inlet CFM	Max Performance Outlet CFM	Max Performance Plume Ht.*
120	1500	2463	15.7	3920	5419	27.3
135	1500	2503	16.1	4840	6609	32.3
150	1500	2529	16.2	6680	9743	34.7
165	1500	2514	16.5	7980	11823	41.1
180	1500	2509	16.7	7920	12449	43.1
195	1500	2441	16.5	11300	16496	46.6
210	2500	4534	20.5	12800	18368	51.2
225	2400	4564	20.8	12200	18226	44.4
245	2400	4544	21.2	15600	23215	54.6
270	2500	4469	21.3	21700	30055	61.9

Size	Min Performance Inlet CFM	Min Performance Outlet CFM	Min Performance Plume Ht.*	Max Performance Inlet CFM	Max Performance Outlet CFM	Max Performance Plume Ht.*
300	2500	4668	22.4	25100	36165	73.5
330	4100	6938	26.7	31900	47300	80.5
365	4000	6929	27.4	42500	55226	86.2
402	7000	9930	31.7	50700	70887	97.0
445	11100	18295	41.9	54300	75779	105
490	11500	19097	43.0	65400	90649	105
540	28600	46846	64.1	76100	109547	124
600	27900	45766	63.7	93000	132336	147
660	30100	45719	65.0	132700	172434	147
730	29100	45934	66.5	147800	199281	168

*Effective plume height referenced from base of unit. Calculated using Equation 7 from 2007 ASHRAE Application Handbook, Chapter 44, with 10 MPH wind.

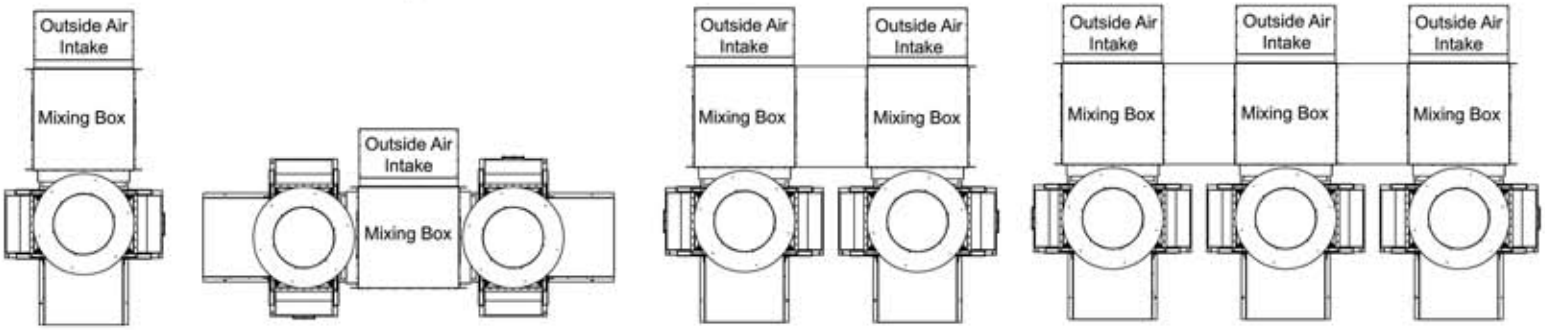


Dimensions

Size	A	B	C	D	E	F Cl 1	F Cl 2	G Cl 1	G Cl 2	H	Weight Fan Only	Weight Fan w/ Plenum
120	71	17	43	23	27	33	37	87	90	15	358	686
135	74	18	46	23	30	35	38	91	94	15	376	711
150	78	20	47	28	33	36	39	95	98	15	419	820
165	83	22	51	28	36	38	45	99	106	15	485	924
180	85	23	53	28	40	43	47	107	111	15	618	1102
195	97	25	55	36	43	44	48	110	114	15	790	1308
210	100	26	57	36	46	45	49	115	119	15	849	1401
225	107	28	60	43	49	47	51	118	122	15	913	1517
245	113	30	65	43	53	50	55	125	130	15	1045	1691
270	122	32	69	49	58	55	57	133	135	15	1213	1940
300	128	35	75	49	64	58	62	141	144	15	1457	2277
330	145	38	83	61	70	61	64	149	152	15	1808	2794
365	153	42	93	61	78	67	68	161	161	15	2091	3217
402	179	46	101	74	85	73	73	142	172	14	2937	4379
445	201	50	113	74	94	80	80	187	187	14	3361	5055
490	218	55	124	90	103	80	84	192	196	14	4242	6158
540	232	60	137	90	114	89	93	209	213	14	4803	7030
600	240	66	145	90	126	94	98	224	229	14	6077	8700
660	271	72	161	101	138	103	112	244	253	14	7878	10901
730	287	79	177	101	153	109	117	262	271	14	8792	12440

Dimensions in inches; weight in pounds (includes motor & drives for single configuration).

CA Vari-Plume® Arrangements



Single | Double Opposed | Double | Triple

Additional Laboratory Exhaust Products

COOK POWER-PLUME®

Patent Pending

- Constant plume height with VAV lab exhaust
- No bypass air required
- Delivers constant 50 foot minimum plume height in 10 MPH wind
- Mixed-flow, non-overloading welded aluminum wheel
- Fiberglass reinforced (FRP) windband with UV protection

COOK CPS-LE

Size: 100-245
CFM: 450-12,550
SP: 0.25-5.0"

- Curb Mounted
- Adjustable Outlet Velocity
- 10 ft. Discharge Available

COOK TCN-LE

Size: 100-490
CFM: 330-49,500
SP: 0.5 - 4.0"

- Curb or Plenum Mounted
- Small Footprint
- 10 ft. Discharge Standard

LOREN COOK COMPANY

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U.S. GREEN BUILDING COUNCIL MEMBER

ISO 9001 CERTIFIED

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