Fume Exhaust Systems

By:

Andy Bosscher
Product Sales Manager

Purpose

- Fume exhaust systems are designed to exhaust hazardous fumes in a way that prevents concentrated exposure to humans.

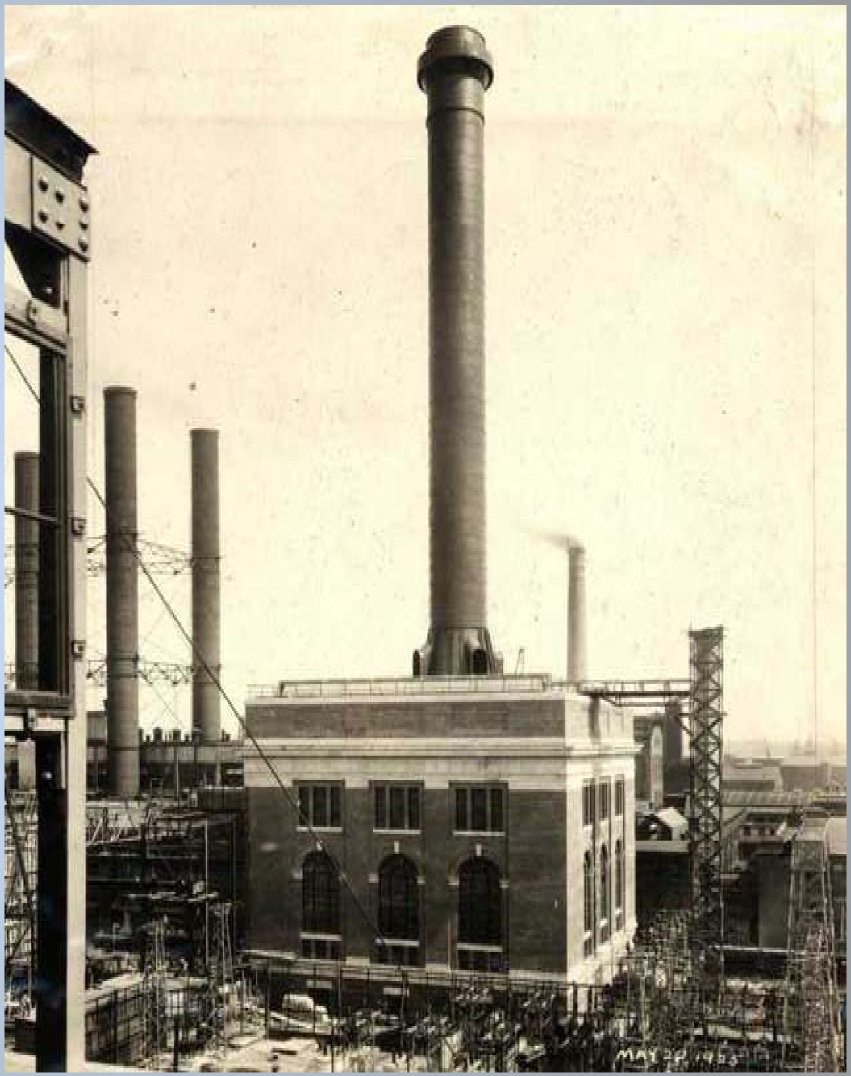
- The fumes are exhausted in a way where they are not able to re-enter the building.

History of Fume Exhaust

- The long time practice for exhausting hazardous fumes is to use tall stacks mounted on the top of the building to exhaust the fumes a safe distance away.

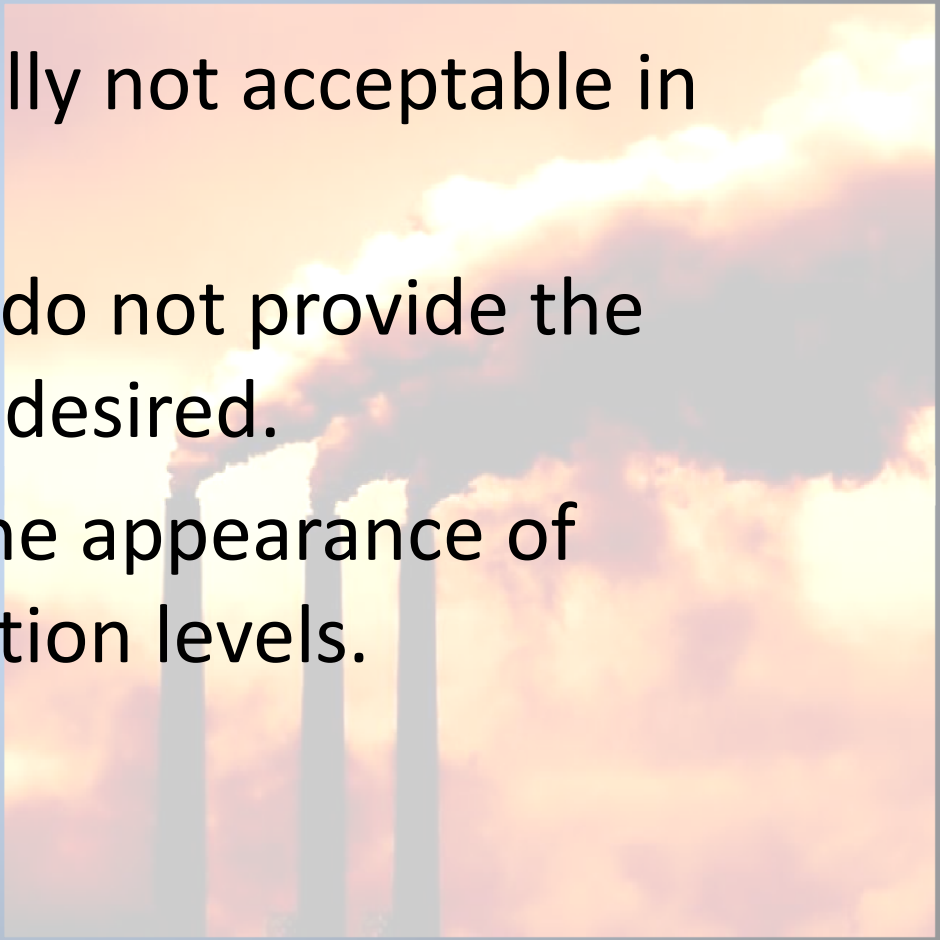
History of Fume Exhaust

- The original standards for fume exhaust required the stack to be at least 2 to 3 times the height of the building being exhausted.



History of Fume Exhaust

- These stacks are generally not acceptable in today's world.
- Tall, low velocity stacks do not provide the clean rooflines that are desired.
- They can also give off the appearance of excess/dangerous pollution levels.



httpzombiestories.wordpress.com20090505smoke-stack

History of Fume Exhaust

- There are options to hide the tall stacks with screens and covering walls, but these are often as obtrusive as the stacks themselves.

However…

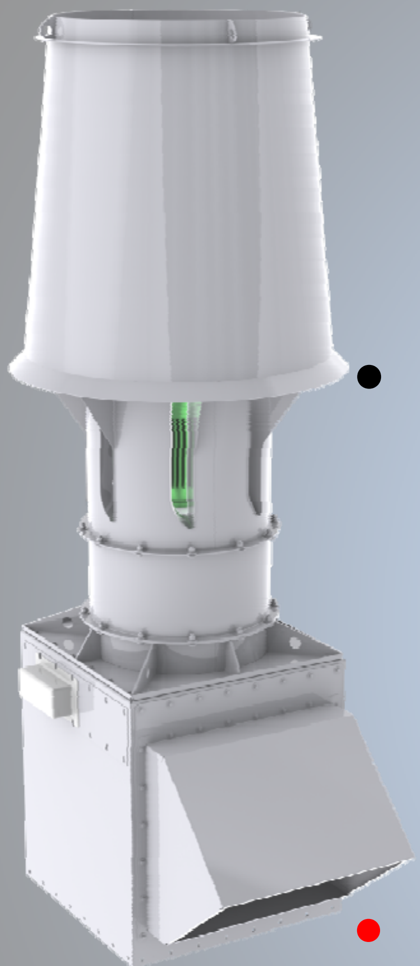
There is a another way!

The High Plume – High Dilution Exhaust System

- The purpose of these systems is also to exhaust hazardous/caustic chemicals in a safe manner.

- The lab effluent is exhausted from the building in a way that it is not re-entrained into the building nor neighboring buildings in unsafe or high concentrations.

High Plume – High Dilution Exhaust System



- With high plume/high dilution exhaust systems the fans are designed to reduce the need for unsightly tall stacks and provide customers with a "clean roofline"

- The solution to pollution is dilution, measurable at a reasonable height

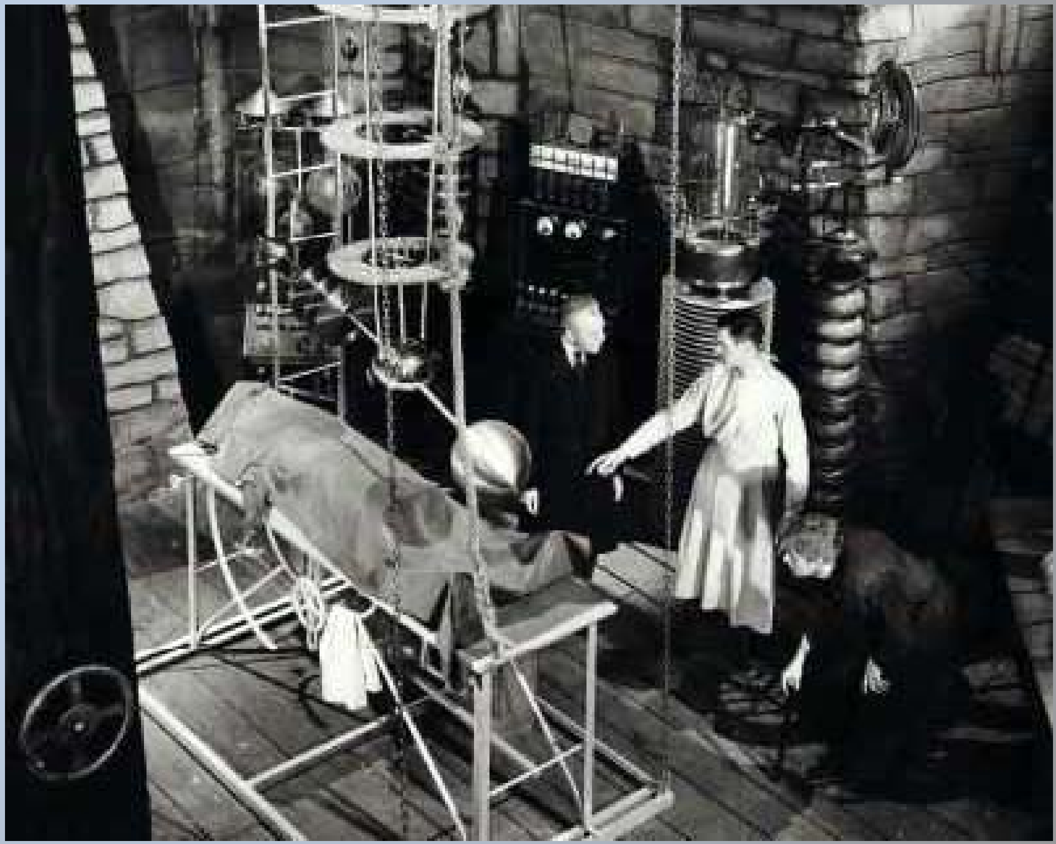
Applications for High-Plume-High Dilution Exhaust System

- Universities
- Schools
- Hospitals

http://www.ofm.gov.on.ca/english/Publications/Messenger/2003/images/MayAugust/Fume_hoo.GIF

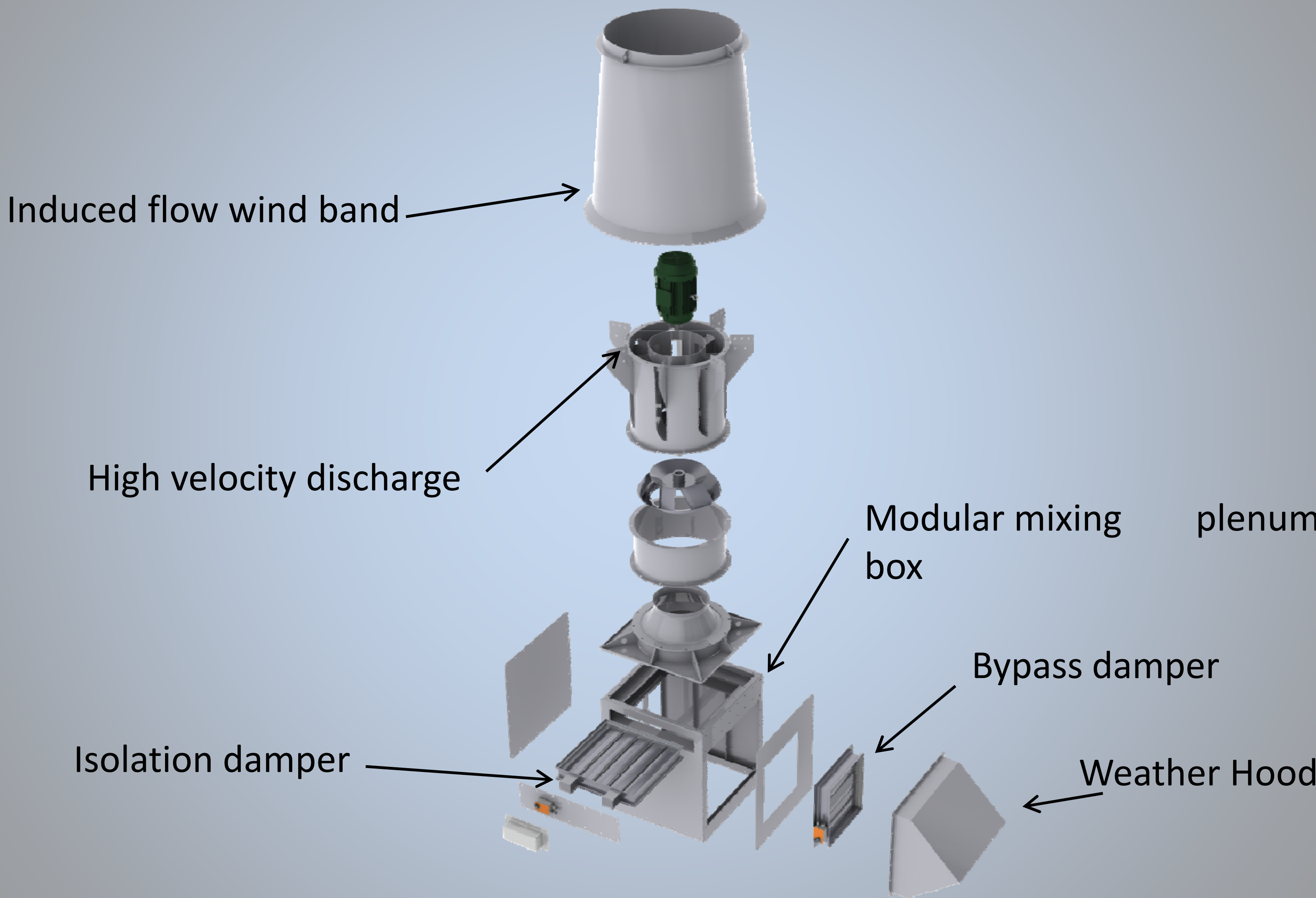
Applications for
High-Plume-High Dilution Exhaust System

- Research Facilities
- Laboratories
- Anywhere that caustic or noxious fumes are being exhausted



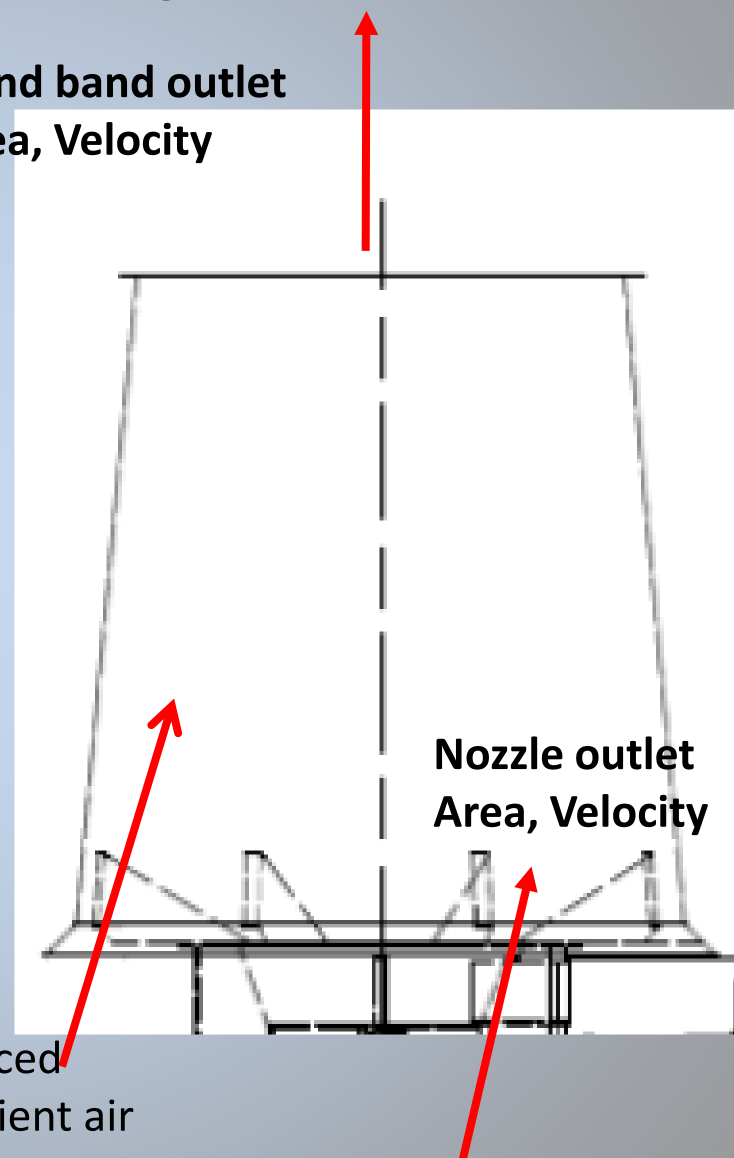
http://www.nd.edu/~druccio/images/frankenstein_lab.jpg

Equipment Terminology

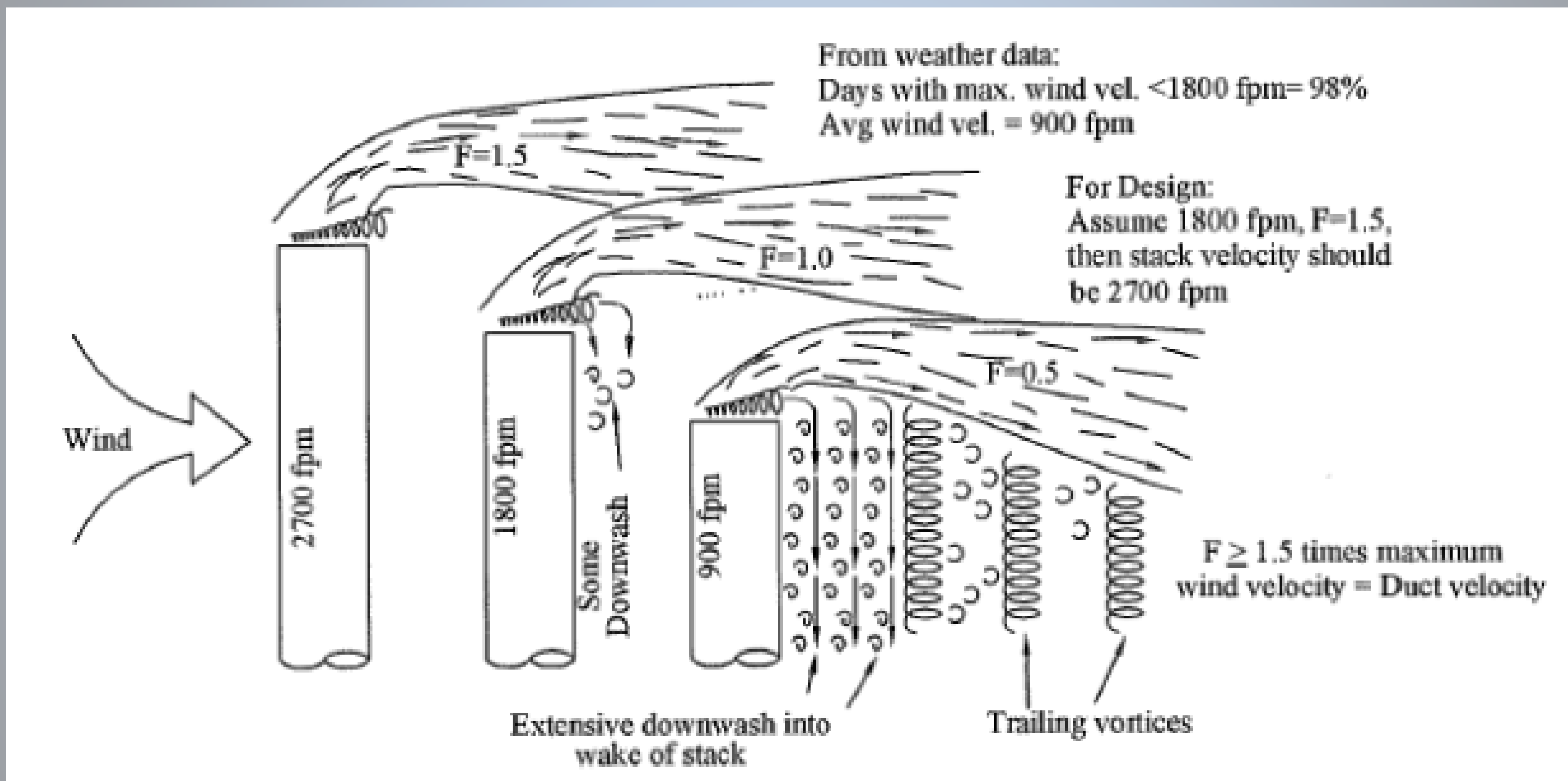


Outlet Velocity

- Achieved by Constricting the Outlet Air stream.
- V=Q/A
  - V=Outlet Velocity at Nozzle or wind band (fpm)
  - Q=Flow Rate (cfm)
  - A=Outlet Area of Nozzle or wind band (sq ft)

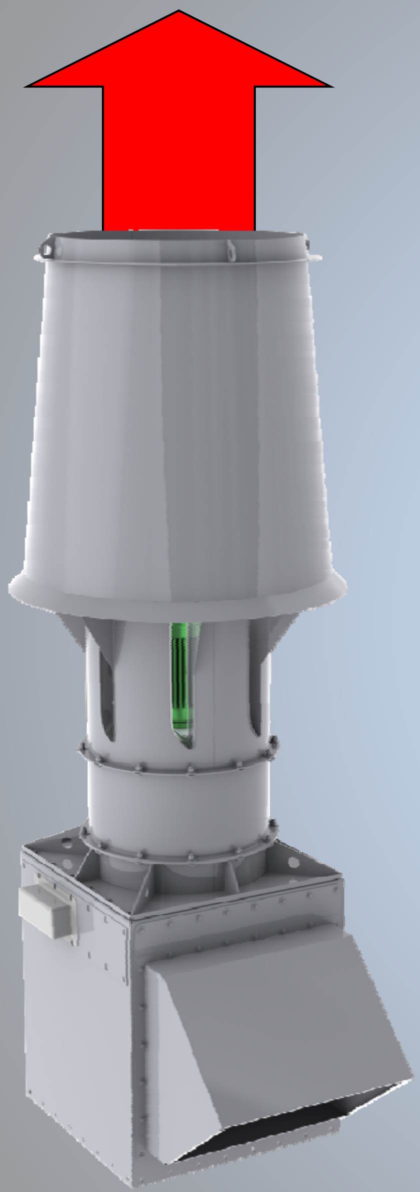


Why Outlet Velocity Is Important



Industrial Ventilation – A manual of recommended Practice for Design, 26th edition

Outlet Velocity



- Minimum Outlet Velocity Recommendations
  3000 fpm – ANSI Z9.5

Plume Rise

- Outlet Velocity is used to obtain your desired "plume rise".
- By exhausting the air at a higher outlet velocity you can exhaust the air to a safe distance from your building without the need for stacks.

Effective Plume Rise

- Plume Rise needs to be great enough to avoid re-entrainment of fumes into buildings.
- Briggs Equation:

$h_e = (3 \times \{V \times d/U\}) + h_s$

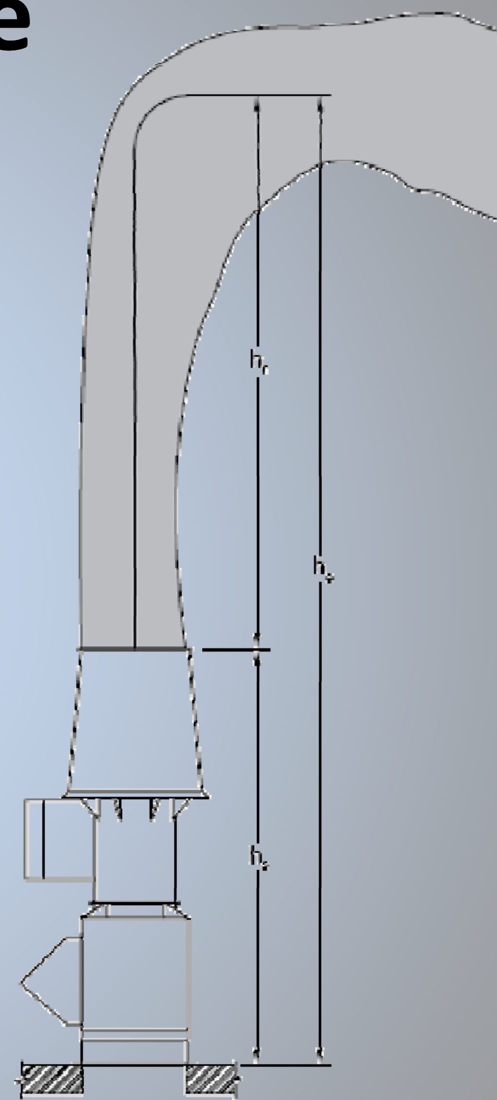
h_s = fan height (ft)

h_r = plume rise (ft)

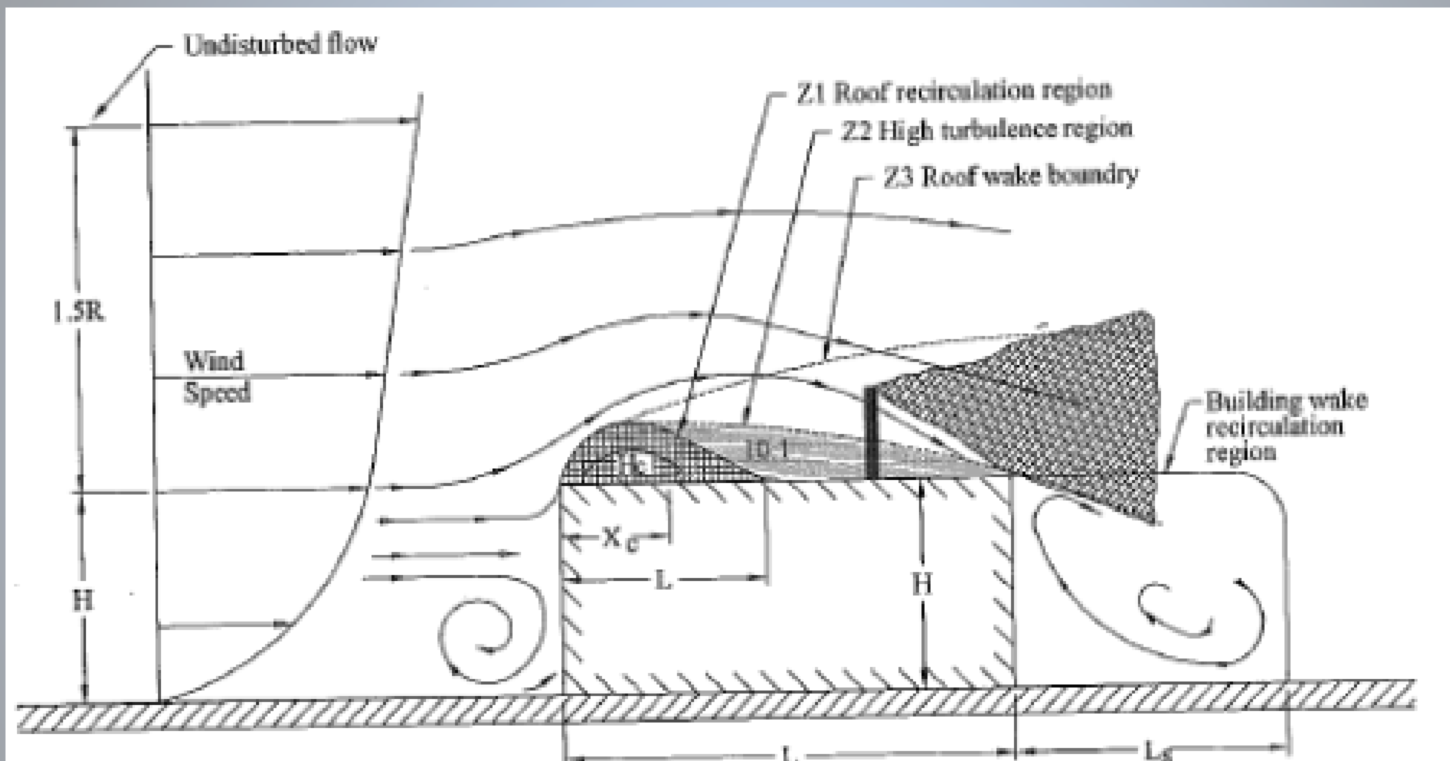
V = exit velocity at wind band (fpm)

d = outlet diameter at wind band (ft)

U = cross wind velocity (fpm)



Stack Location



Industrial Ventilation – A manual of recommended Practice for Design, 26th edition

Stack Location

- It is also important to consider how other buildings or objects on your roof can effect wind flow across your building.

- Turbulence and swirl can negatively affect the plume rise coming out of your fan

Definitions

- An induced flow fan is defined by AMCA as:

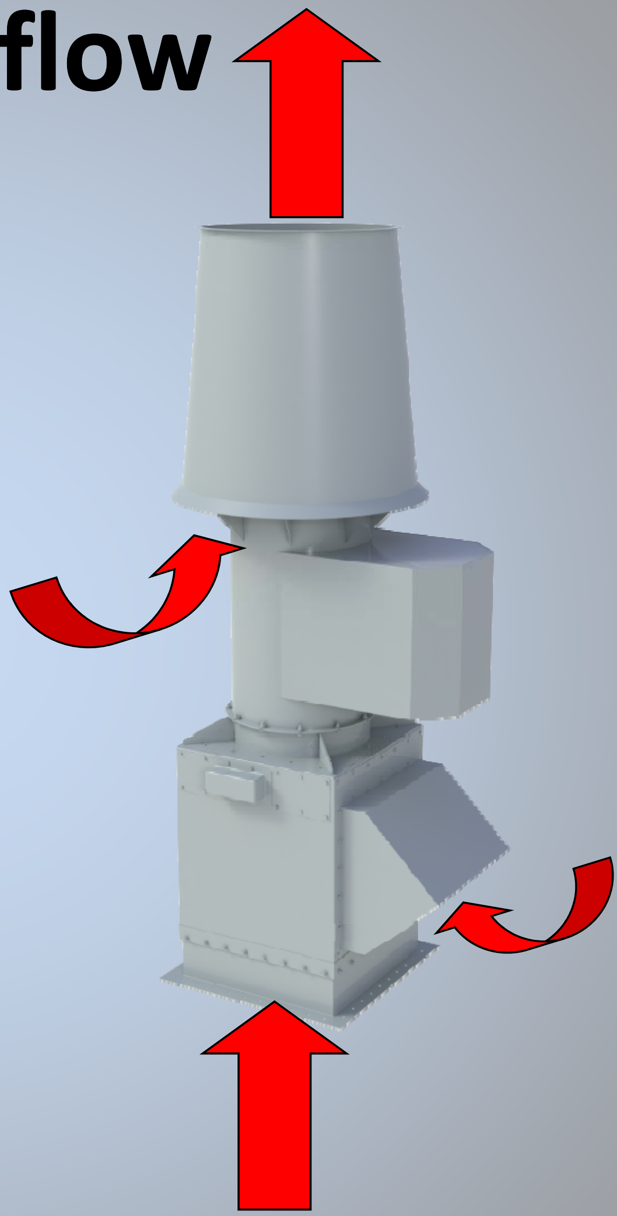
  "a housed fan whose outlet airflow is greater than its inlet airflow due to induced airflow"

Airflow

- A standard exhaust fan has an inlet flow and an outlet flow.
- An induced flow fan has 4 types of airflow that need to be considered.

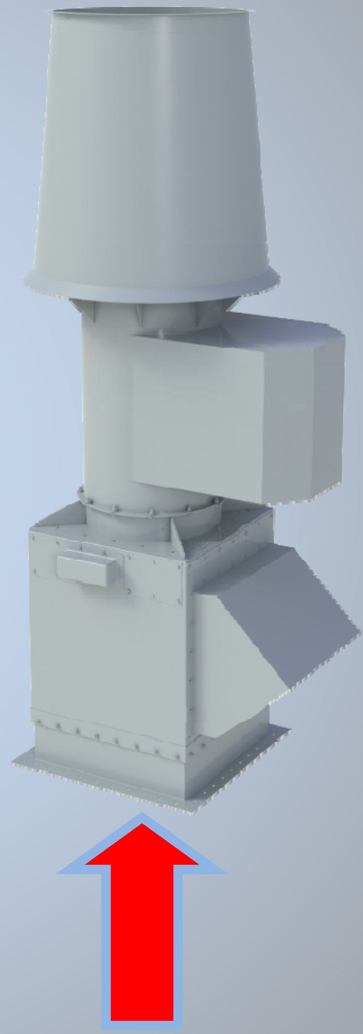
Types of Airflow

- Total Discharge Flow
- Entrained/Induced Air
- Bypass Air
- Laboratory Effluent/Exhaust



Laboratory Effluent/Exhaust

- Caustic or noxious air that is being exhausted from the laboratory or fume hood within the building.

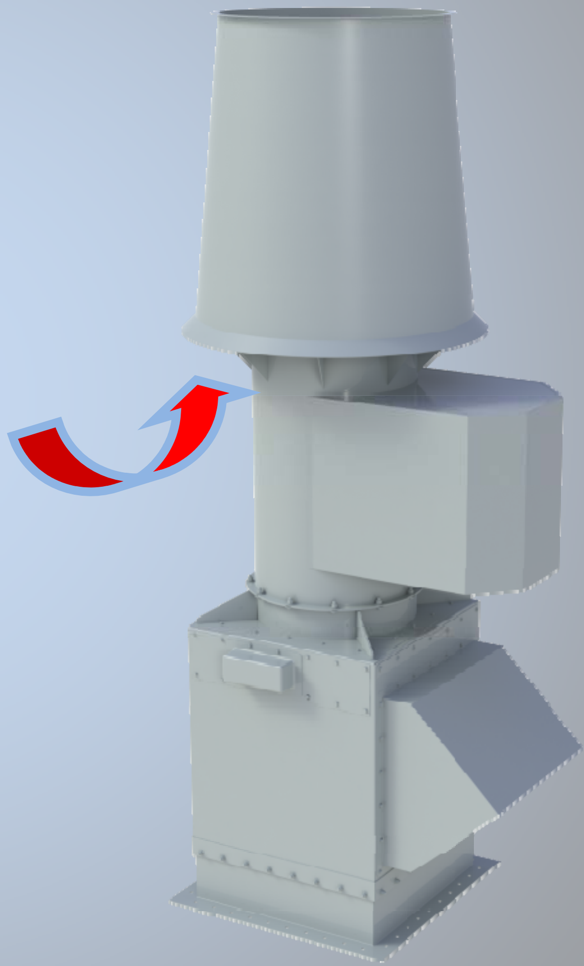


Bypass Air

- Ambient air that is drawn through the bypass air plenum and mixed with the lab exhaust to maintain plume height. Primarily used in variable volume applications to maintain a constant discharge volume.

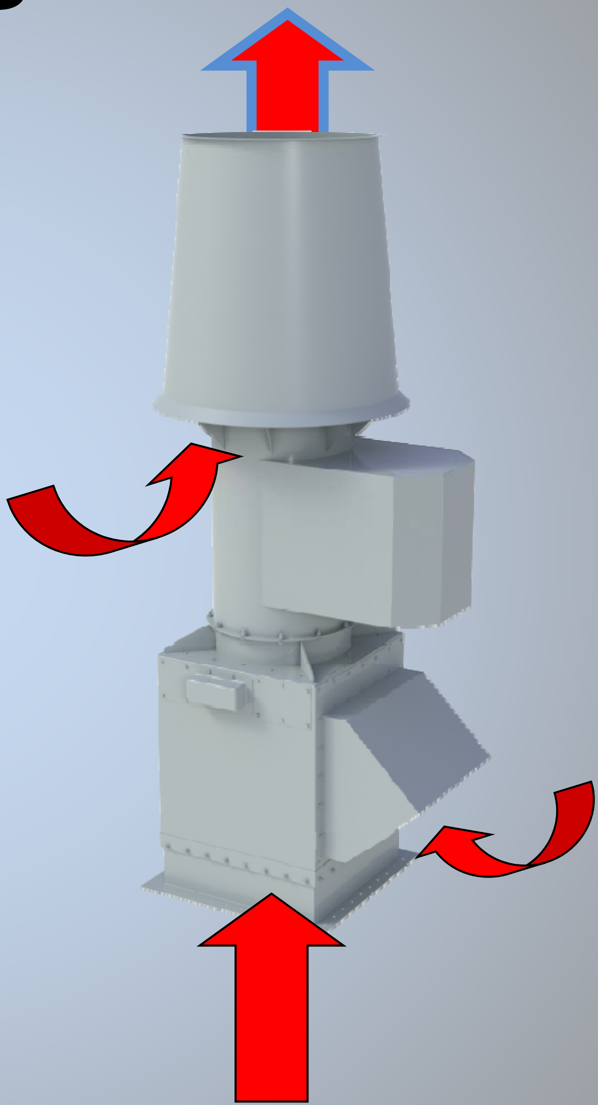
Entrained/Induced Airflow

- Air that is entrained/induced through the wind band and mixed with the lab exhaust to increase dilution ratio.



Total Discharge Flow

- Total Discharge Flow =
  laboratory exhaust +
  bypass air + induced air



Dilution

- Dilution is another important part of the fume exhaust puzzle.

- By mixing clean air with the contaminated air you reduce the concentration of pollutants to a safe level.

Dilution Ratio

- The ratio of Total Discharge Flow volume divided by the Laboratory Exhaust Flow volume.

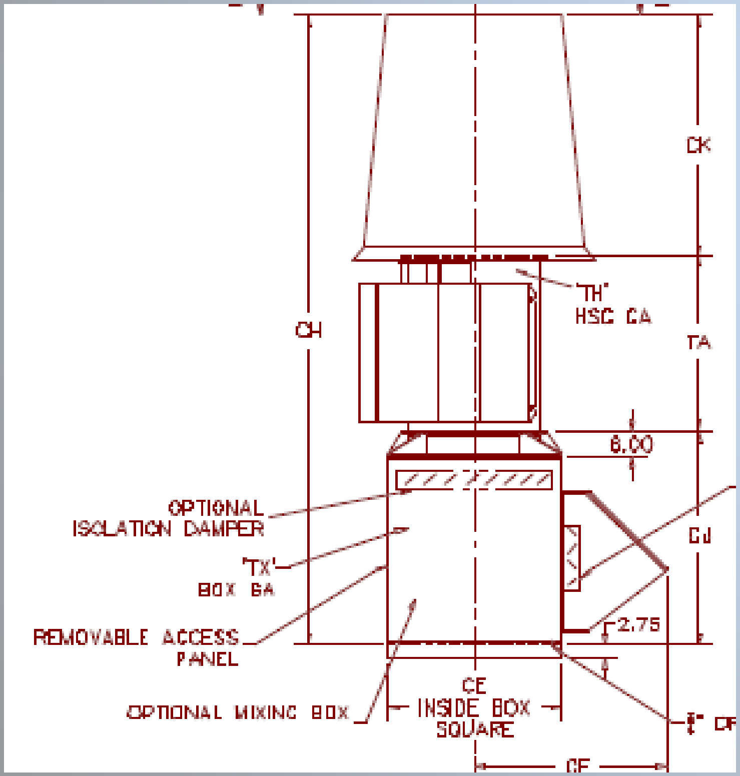
$$\frac{\text{Total Discharge Flow}}{\text{Laboratory Exhaust Flow}} = \text{Dilution Ratio}$$

Exhaust Systems

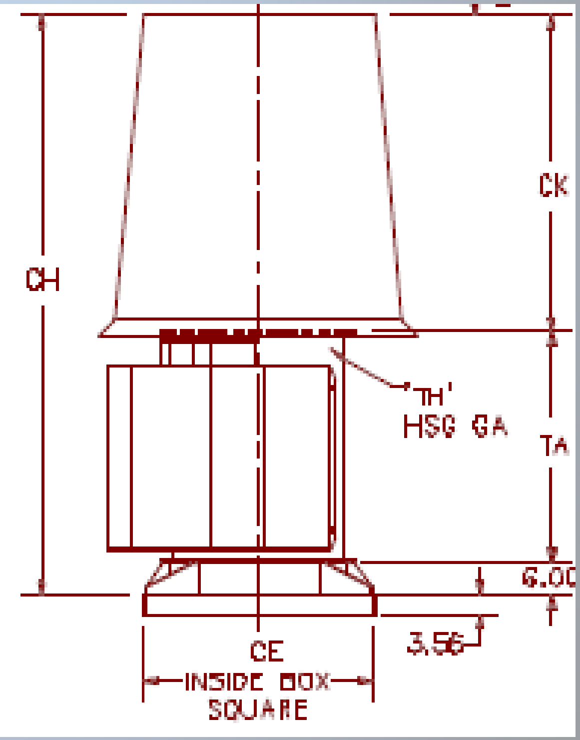
- In order to maintain the appropriate plume height and dilution ratio there must be a constant volume of air coming into the inlet of the fan.

2 Main Types of Exhaust Systems

- Variable Volume



- Constant Volume

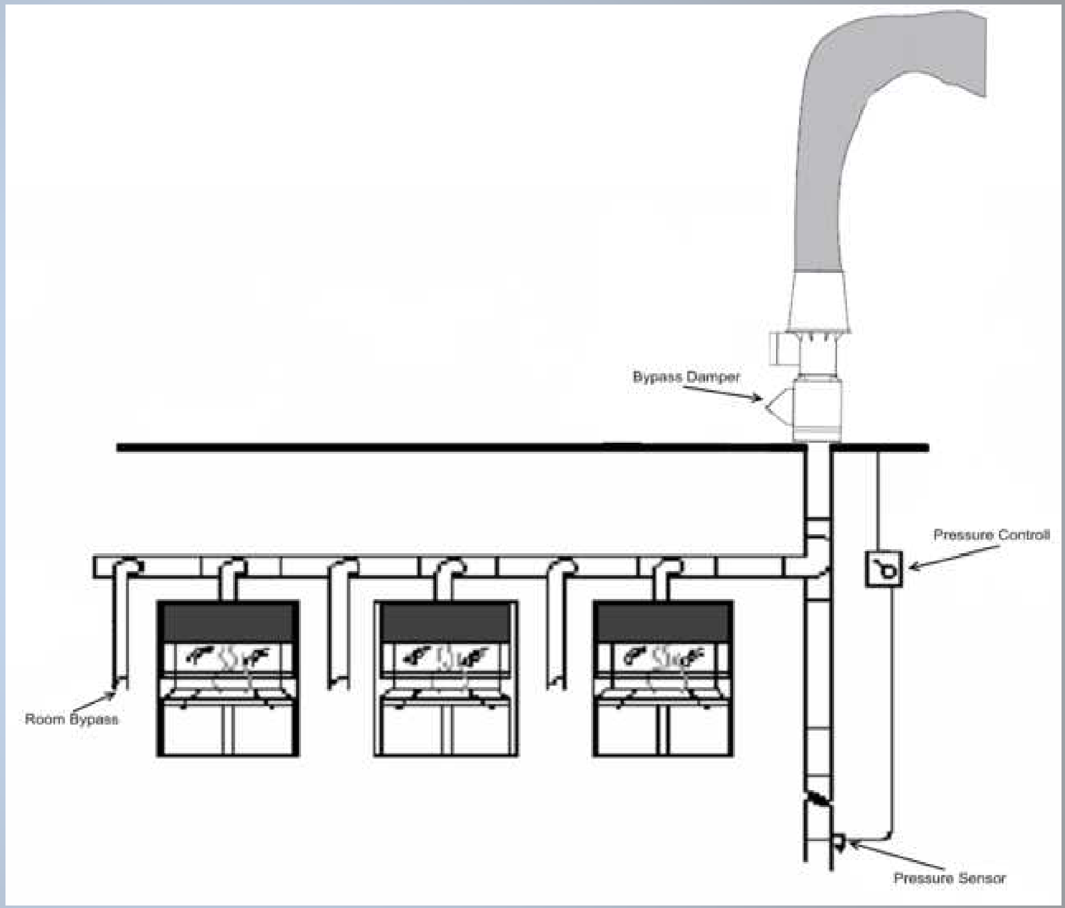


Variable Volume Exhaust System

- Laboratory effluent is variable
- Discharge velocity must remain constant to maintain a constant plume height
- Reduces energy use by reducing laboratory airflow

Variable Volume Exhaust System

- Constant discharge velocity is maintained through the use of Bypass Air
- Different Methods
  - Mixing Plenum
  - Hood Bypass
  - Room Bypass



United States Environmental Protection Agency

Variable Volume Exhaust System

- The bypass damper generally receives it input signal from:
- A manual or timed switch
- A sash position sensor
- A pressure sensor
- A velocity sensor

Constant Volume Exhaust System

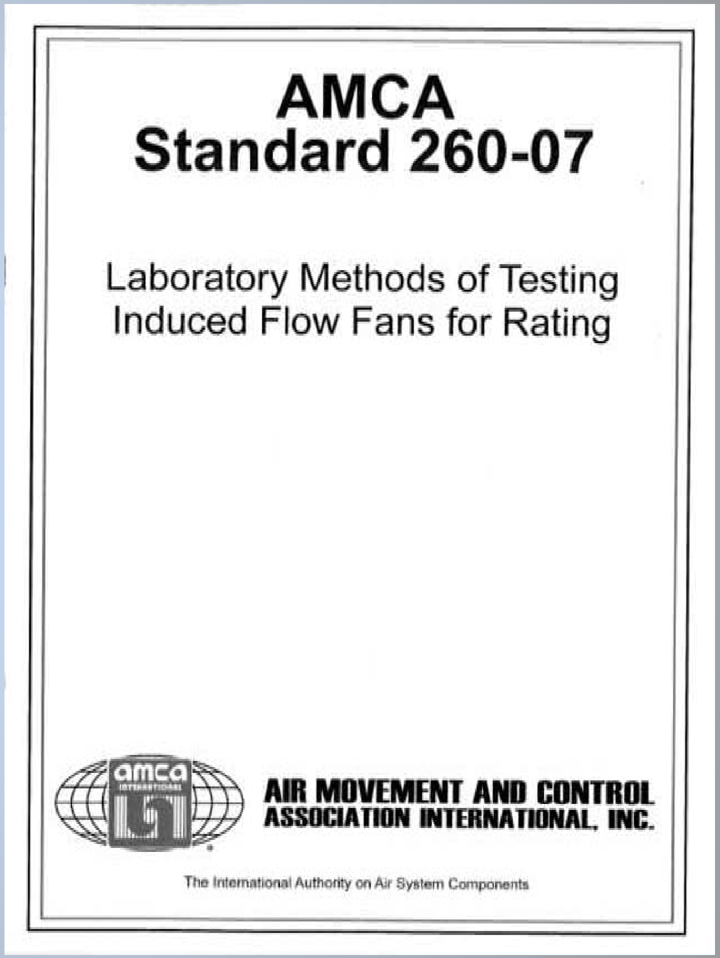
- Fan sees a constant laboratory effluent at all times.
- Bypass air *is not* needed to balance the exhaust system.
- Bypass air *is* still used on occasion to add additional air to the system for low volume exhaust applications.

AMCA std 260-07

- Developed to level the playing field between different manufacturers

- Consistent definitions of fan outlet flow (at wind band discharge), fan inlet flow, inlet and discharge noise

- Performance ratings cataloged are based on AMCA stds 210, 260, 300.



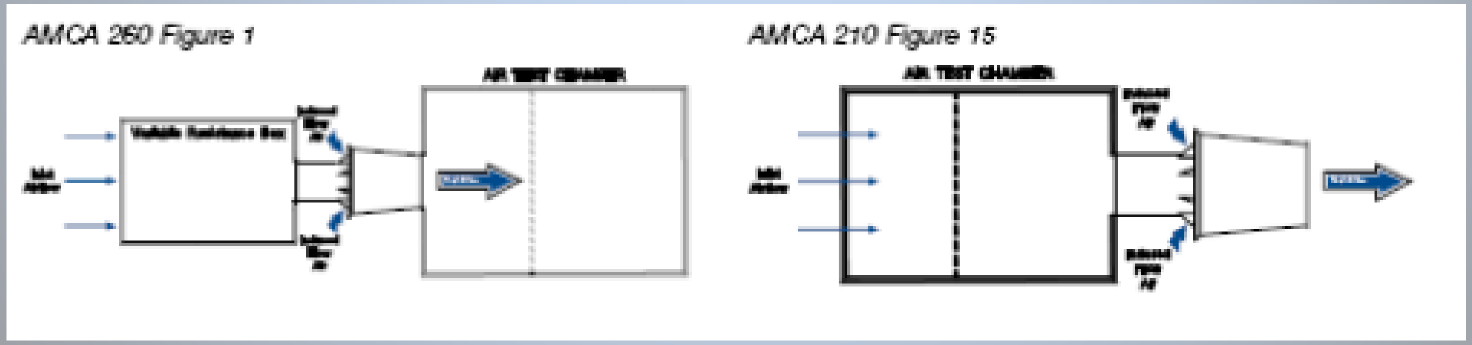
AMCA 260 Certification

- AMCA Standard 260 establishes a uniform method of laboratory testing of induced flow fans in order to determine their aerodynamic performance in terms of inlet and outlet airflow rate, pressure developed, power consumption, air density, speed of rotation, and efficiency. This standard is an adjunct to AMCA 210 in order to accommodate the induced flow fan’s unique characteristics.
- The AMCA CRP (Certified Ratings Program) ensures that all data is cataloged and verified per the relevant standards.

http://www.amca.org/store/item.aspx?ItemId=40

AMCA 260 Test Procedure

- The total discharge flow is the sum of the inlet airflow and the entrained airflow.
- The AMCA 260 Test is based on the variable resistance box simulating inlet suction pressure while discharging the flow to atmosphere at all points along the fan curve.



AMCA 260 Test Procedure

Knowing Your Laboratory

- There are 4 general types that laboratories can be divided into
  - Biological laboratories
  - Chemical laboratories
  - Animal laboratories
  - Physical laboratories

- Knowing the type of laboratory can help you design a safer, more efficient system.

ASHRAE Handbook, chapter 14 on Laboratories

Biological Laboratories

- This type of lab contains biologically active materials and could involve the chemical manipulation of these materials.
- Services fields such as biology, bio-chemistry, toxicology and many others.
- Lab will commonly have both chemical fumehoods and bio-safety cabinets

ASHRAE Handbook, chapter 14 on Laboratories

Chemical Laboratories

- This type of lab generally supports research in organic *and* non-organic synthesis.
- Commonly has multiple fumehoods.

ASHRAE Handbook, chapter 14 on Laboratories

Animal Laboratories

- This type of lab contains areas for animal research.
- Commonly contains fumehoods but also exhaust for animal waste and potentially contagious diseases.
- In some cases treated similar to a clean room as most research animals are very susceptible to bacteria.

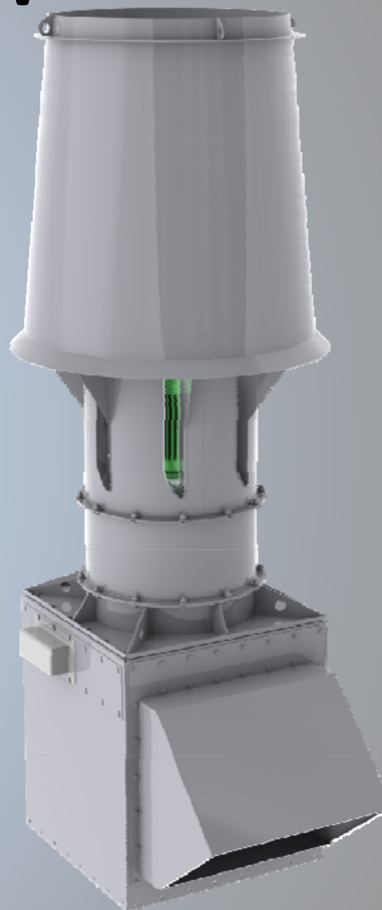
ASHRAE Handbook, chapter 14 on Laboratories

Physical Laboratories

- This type of lab contains equipment for the research of physics. Could contain lasers, optics, nuclear, and electronic material.
- Generally low dust environment with hazardous gases that need to be exhausted safely.
- Could contain chemical fumehoods and/or bio-safety cabinets.

ASHRAE Handbook, chapter 14 on Laboratories

Fan Types
Induced Flow - Mixed Flow



Commonly available in both Belt & Direct Drive

Fan Types
Induced Flow - Centrifugal

Commonly available in both Belt & Direct Drive

Fan Types
Inline Centrifugal

Generally available in Belt Drive only

Selecting Your Fan Type

- What are your airflow and pressure requirements?
- What are the vibration requirements?
- What are your space requirements?
- What are you sound & noise requirements?
- What is the temperature and humidity of your surroundings and your airstream?

Common Features & Accessories

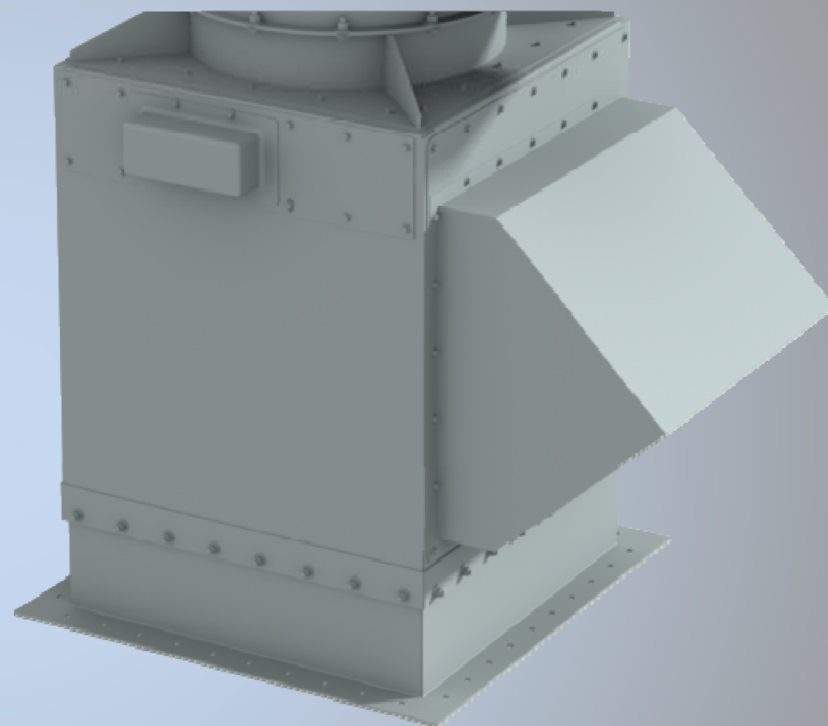
- Sealed Belt Tube (belt drive only)
- 125 mph Wind Rating
- Shaft Seals
- Wheel backplate fins
- Extended Lube Lines
- Airfoil/Centrifugal wheel designs
- Induced Flow Windband
- Bolted access door
- Weather cover
- SS Hardware

Common Features & Accessories

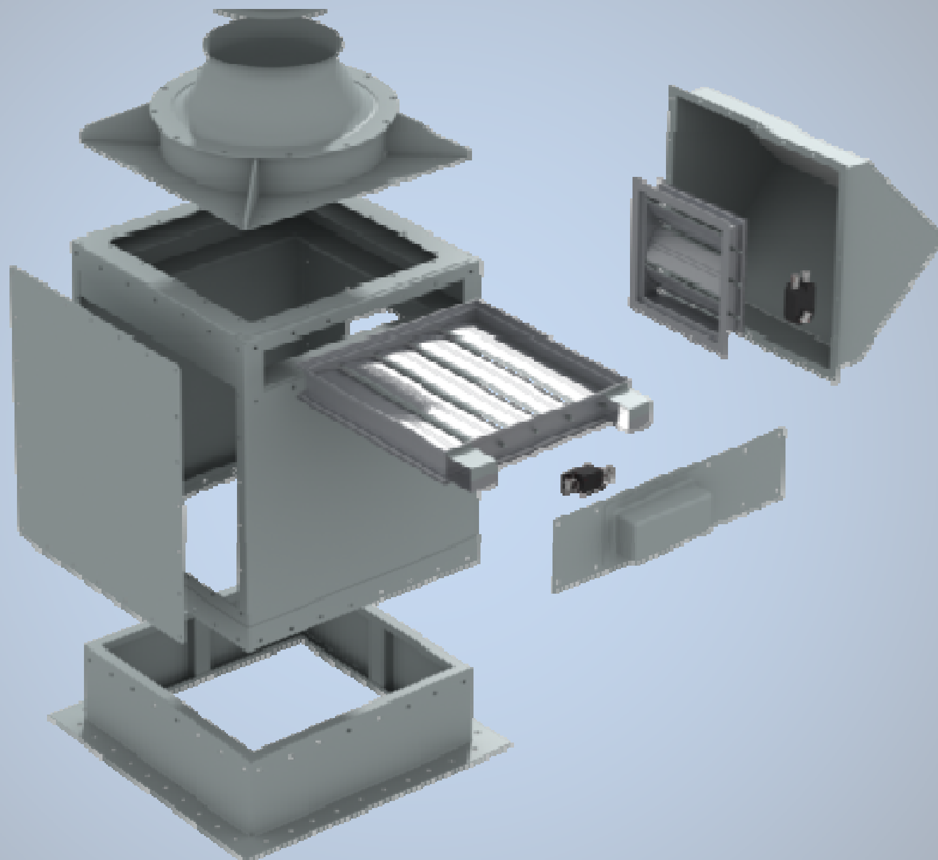
- Acoustically Attenuated Windband
  - Generally lowers sound by ~3 dba in each octive band
- Acoustically Attenuated Housing
- Jib Crane
- SS Shaft
- Roof Curb (standard is 12” high)
  - Generally supplied by manufacturer to ensure wind-load rating

Common Features & Accessories

- Mixing Plenum Box
  - Opposed Blade Bypass Damper
  - Parallel Blade Isolation Damper
  - Actuators
  - Vortex Breaker
  - Side Intake (Bottom Standard)
  - Access Door
  - Drain
  - Double wall construction (optional)

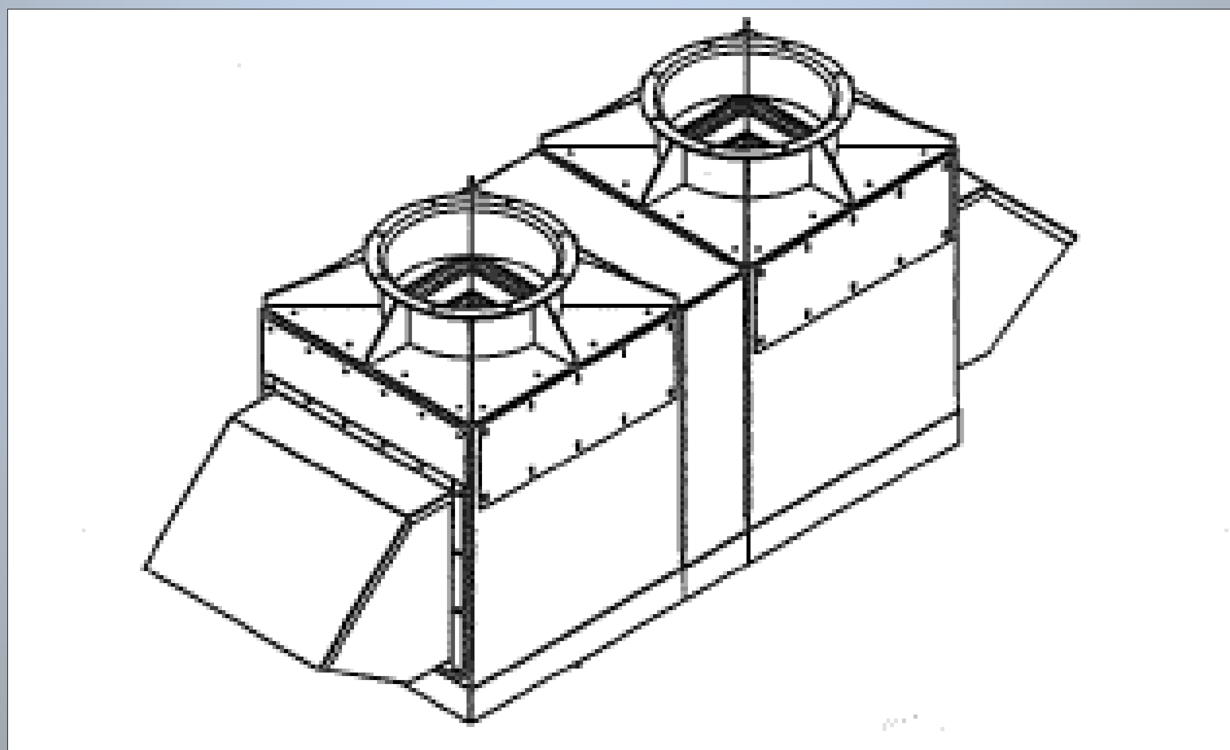


Mixing Box Design



Mixing Box Design

- Modular Construction makes for easier installation and shipping, as well as retro-fit situations

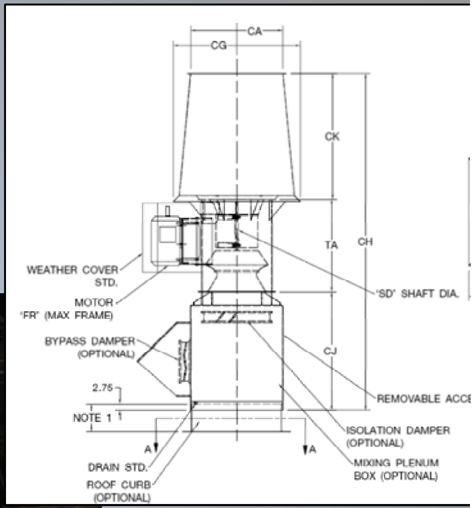


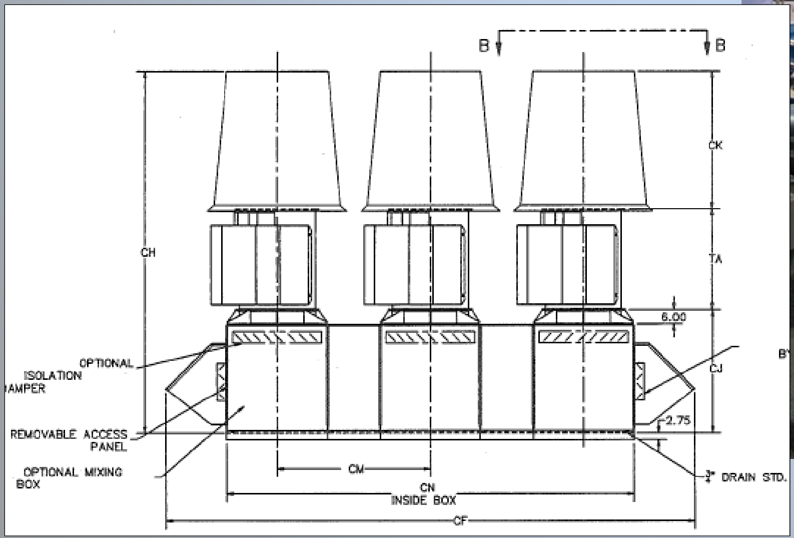
Common Plenum

- Why use a common plenum mixing box?
  – Complete fan redundancy
  – Multiple smaller fans vs. one large fan
  – Better control of energy use
  – Ability to manifold your exhaust system

Common Plenum

- Standard Configurations
  - Single
  - Double
  - Triple
  - Quad





Common Plenum

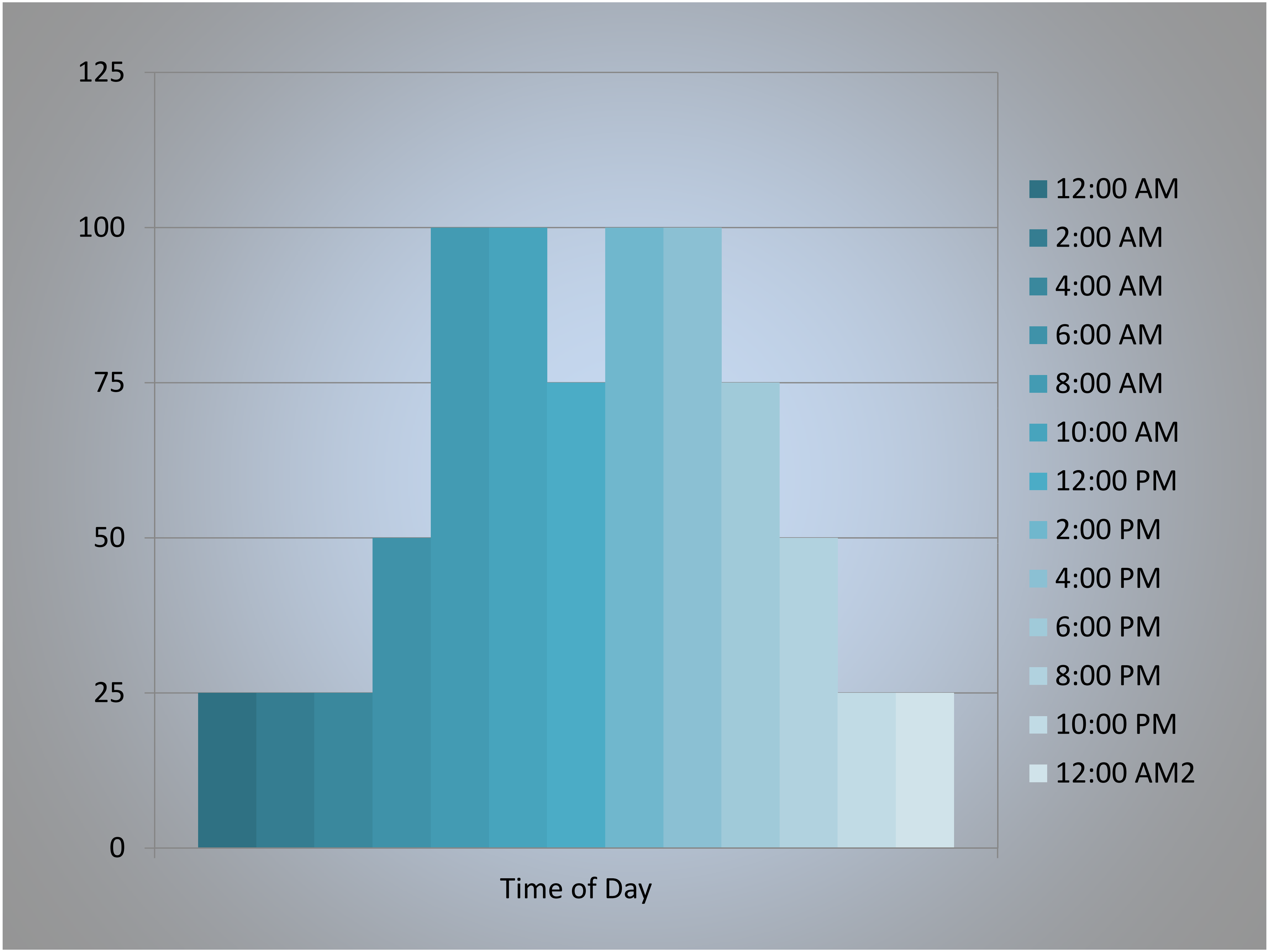
- Having more smaller fans on a common plenum gives your greater incremental control of overall system exhaust.

- This gives you better energy usage and a more efficient building.

Common Plenum

- As the exhaust requirements of the lab vary during occupied and non-occupied hours multiple smaller fans give you greater control of your overall exhaust

- Having 4 fans on a common plenum can give you greater energy control than having 2 fans on a common plenum



125
100
75
50
25
0
Time of Day
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM2

Chemical Resistance

- Material and coating selection can depend on a number of factors including, but not limited to:
- Nature, composition, and concentration of chemicals in the exhaust airstream
- Temperature of the exhaust airstream and fumes
- Humidity of the exhaust airstream and fumes
- Constant or intermittent flow
- There is no coating or material that will perfectly handle every fume exhaust condition

ASHRAE Handbook, chapter 14 on Laboratories

Chemical Resistance

- Common Coatings
  - Air-Dried Phenolic
  - Air-Dried Epoxy
  - Baked Powder
  - Baked Epoxy

- Common Materials
  - Steel
  - Fiberglass
  - Stainless Steel
  - Aluminum

Chemical Resistance

CORROSIVE REAGENT				ACIDS																			ACID SALTS, NEUTRAL SALTS ALKALINE SALTS, ALKALIES, ETC.												
CORROSION RESISTANT: • METALS • PAINTS • COATINGS	GROUP NO.*	NUMBER OF COATS	TEMP. RANGE (°F)	ASCETIC	BORIC	CARBOLIC	CARBONIC	CHROMIC	CITRIC	FLUOROBIC	FORMIC	HYDROBROMIC	HYDROCHLORIC	HYDROFLUORIC	HYDROCHLOROUS	LACTIC	NITRIC	PERCHLORIC	PHOSPHORIC	PICRIC	SULPHURIC ACID	SULPHUROUS ACID	ALUMINUM CHLORIDE	ALUMINUM NITRATE	ALUMINUM SULPHATE	AMMONIUM CHLORIDE	AMMONIUM HYDROXIDE	AMMONIUM NITRATE	AMMONIUM SULPHATE	BRINE	BROMINE	CALCIUM CHLORIDE	CALCIUM CARBONATE	CALCIUM HYDROIXIDE	CALCIUM DISULPHIDE
METALS																																			
LOW CARBON STEEL		—	600	U	F	F	F	F	U	X	U	U	U	U	U	U	U	U	U	X	U	U	U	U	U	U	E	F	U	X	U	F	X	F	F
ALUMINUM		—	250	G	G	G	G	F	G	U	U	U	U	U	U	G	U	F	U	E	U	G	F	G	F	F	E	E	F	G	U	G	E	F	E
304 S.S.		—	1000	G	E	F	G	G	G	C	G	U	U	U	U	F	E	G	G	E	U	F	F	E	F	F	E	E	U	E	U	F	E	E	E
316 S.S		—	1000	E	E	F	E	E	E	X	G	E	U	U	U	G	E	E	E	E	F	G	F	E	G	E	E	E	F	E	U	F	E	E	G
PAINTS — TCF&B STANDARD SURFACE PREPARATION																																			
ASPHALTUM (Not Recom-mended For Fans)	I	2	100 to 140	F	E	F	F	F	G	X	F	X	G	F	F	F	F	U	F	F	F	X	G	F	G	F	E	E	G	X	U	E	E	E	F
VINYL (PVC)	II	2	140 to 175	F	G	U	G	G	G	G	G	X	G	F	X	G	G	F	G	X	F	G	G	F	G	G	G	E	G	X	U	E	E	E	G
ZINC	III-Z	2	200 to 400	U	E	U	E	U	U	U	X	U	U	X	X	U	U	U	U	X	U	U	X	X	E	G	G	E	G	X	U	G	X	G	E
EPOXY	III-E	2	150 to 220	G	G	G	E	F	G	X	G	X	G	G	F	G	G	F	G	U	G	G	G	X	G	G	G	E	G	G	X	F	E	E	G
SYNTHETIC RESIN	III-S	3	300 to 400	E	E	U	E	G	G	X	G	G	E	U	E	E	E	U	E	E	G	G	E	E	E	G	E	X	E	E	X	E	E	E	U
AIR-DRIED PHENOLIC	IV	4	140 to 200	G	G	G	G	U	G	G	E	U	G	U	X	E	G	F	G	X	G	G	G	F	G	G	U	G	F	G	U	G	G	E	G
COATINGS — SURFACE PREPARATION INCLUDES STEELBLASTING																																			
EPOXY	VII-S	2	180 to 220	G	E	G	E	U	G	X	E	X	G	G	F	E	F	U	G	X	U	G	E	X	E	G	F	E	G	G	U	E	E	E	E
PHENOLIC EPOXY	VII-P	2	X	E	E	E	E	U	E	X	E	X	G	E	G	E	X	U	E	X	G	E	E	F	E	U	U	G	G	E	U	G	E	E	E
BAKED PHENOLIC	VIII	2	200	E	E	E	E	F	E	X	E	U	E	U	F	E	F	G	E	X	E	E	E	G	E	F	E	G	E	E	U	E	E	E	E
HI-BAKE EPOXY	IX	2	X	E	E	E	E	G	E	X	E	U	E	E	G	E	X	G	E	X	G	E	E	X	E	E	E	E	E	E	U	E	E	E	E

*Please refer to page 4 for descriptions.

SELECTION INSTRUCTIONS

Coatings with E or G ratings should be selected, if possible, for best results throughout.

E = Satisfactory from 15% to 85% (depending upon coating) of concentration of fumes and for continuous operation. Also suitable for splash or condensation.

G = Good for up to 5% to 15% of concentration of fumes. Not recommended for applications involving splash or condensation.

F = Fair. Recommended for low (maximum 5%) concentration application. Should not be specified unless detailed application is available.

U = Unsatisfactory and hence not recommended.

X = Sufficient data not available at present. User comments would be appreciaated.

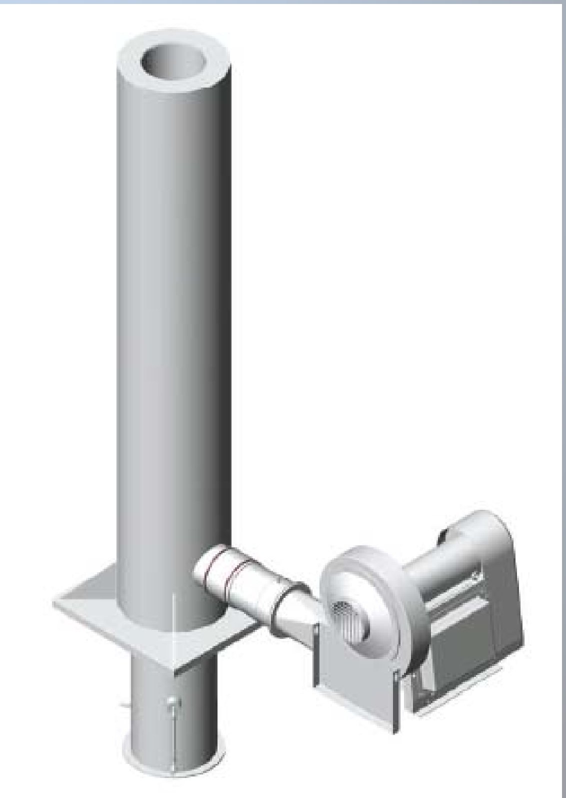
Perchloric Acid Exhaust

- **Very dangerous!!**
- Can cause build-up that is explosive if hit hard enough
- Highly corrosive
- Requires a minimum of 316 SS or PVC construction
- Ductwork and stack should be smooth with no crevices for build-up
- Perchloric exhaust systems should not be shared with other types of exhaust

ASHRAE Handbook, chapter 14 on Laboratories

Perchloric Acid Exhaust

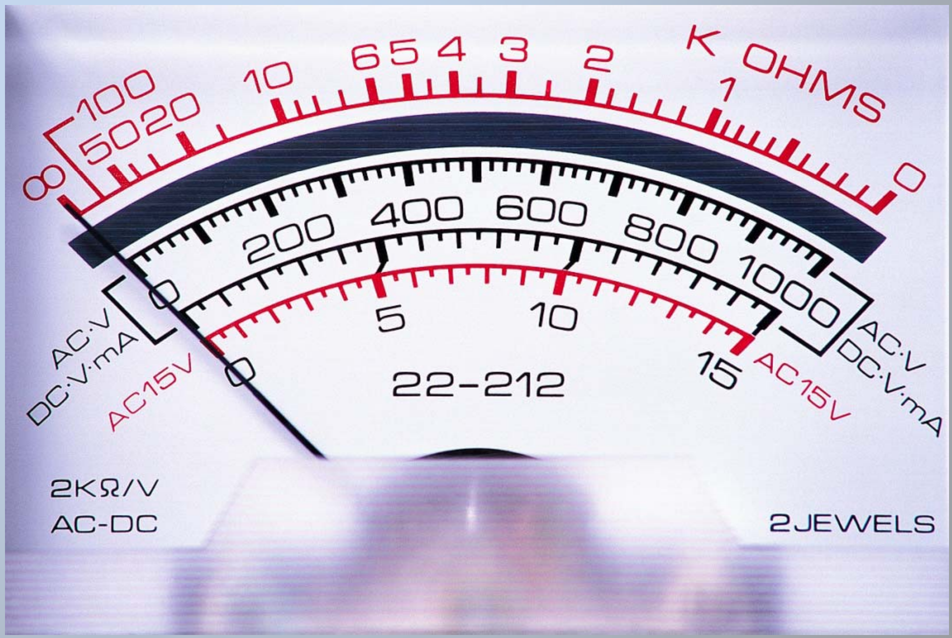
- Requires internal wash down nozzles to prevent chemical build-up
- Best to avoid moving parts in the airstream with and induced flow side mounted stack
- Must contain full drainage system



ASHRAE Handbook, chapter 14 on Laboratories
http://www.mkplastics.com/documents/literature/Venturi_Catalog_50-01_FEBRUARY_2009.pdf

Low-Energy Design

- Laboratories can use 5 to 10 times more energy than a standard office building

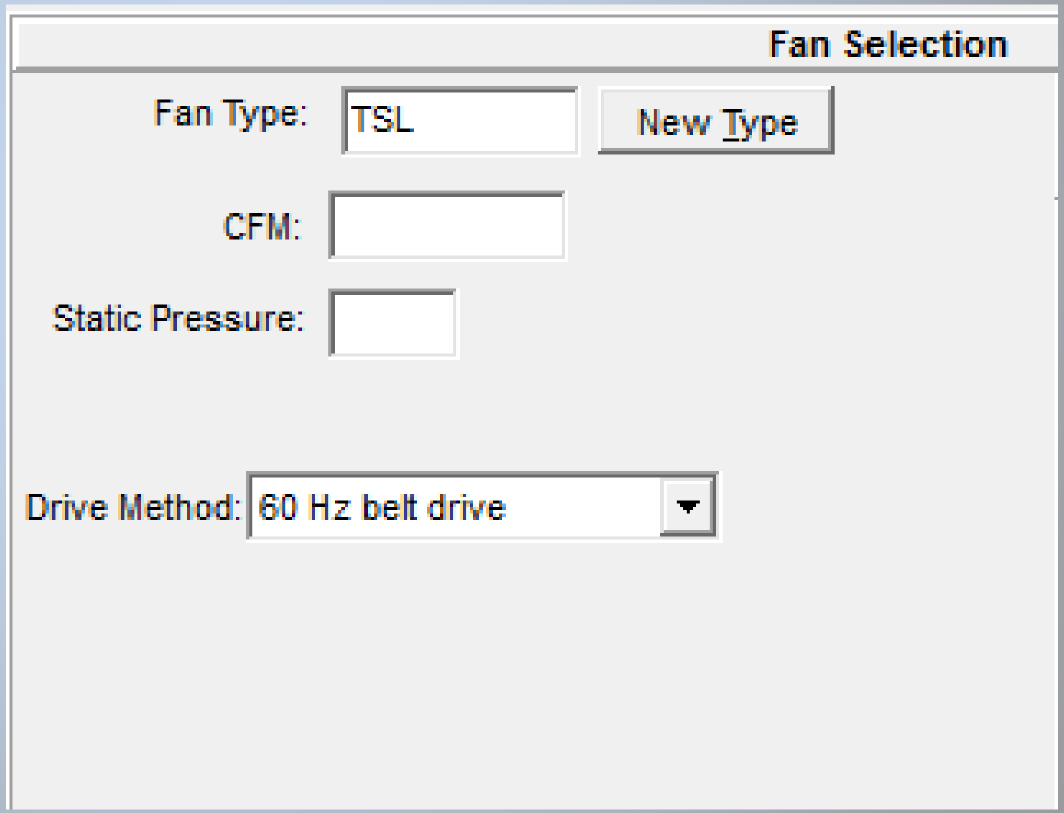


Ventilation

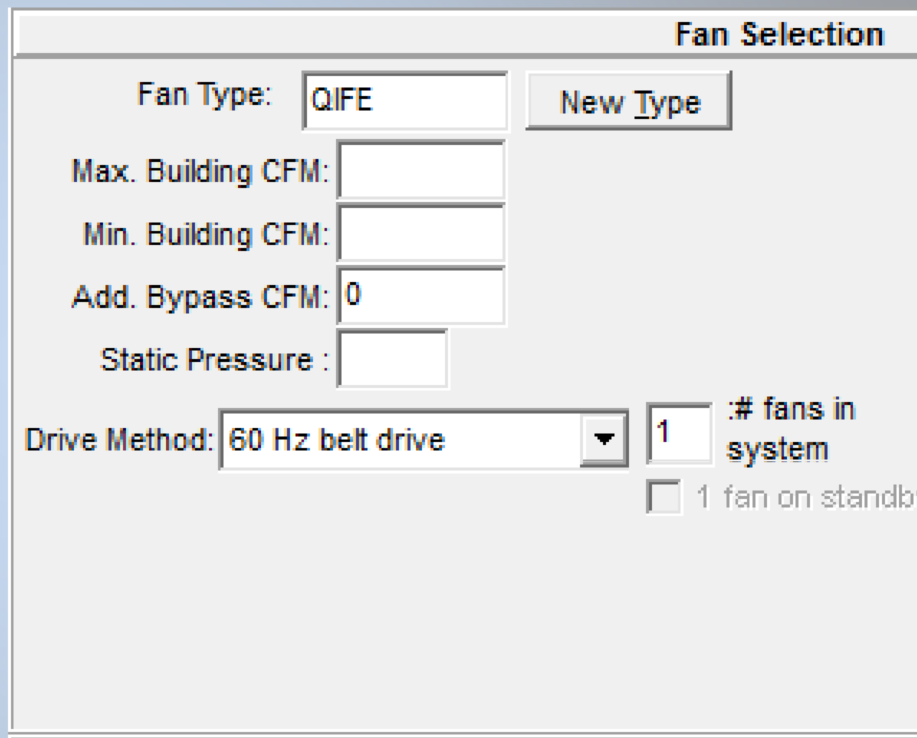
- The common rule of thumb is 6 to 10 air changes per hour when the space is occupied
- New studies to reduce this for specific applications to reduce energy usage in laboratories
- Animal housing laboratories could require more, up to 15 or more air changes per hour

Making Fan Selections

- Standard fan selections are based on 2 main criteria and a single fans performance
  - CFM
  - Static Pressure

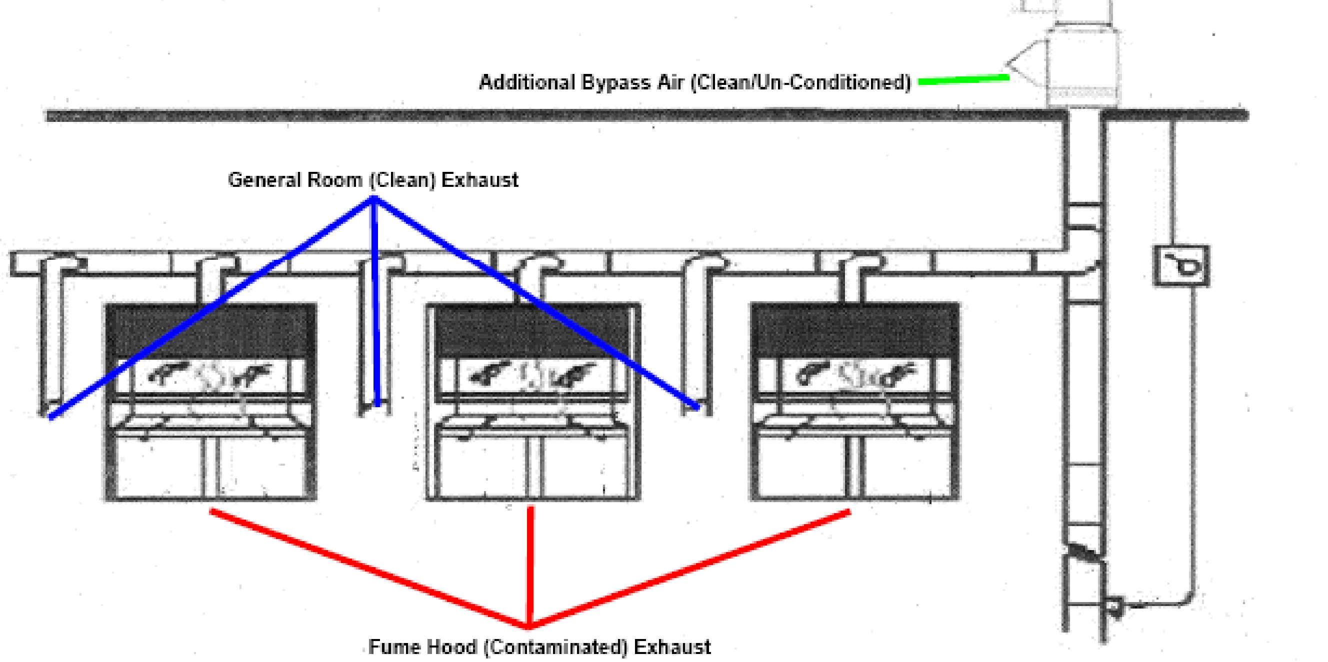


- With Induced Flow fans there are ***4*** main selection criteria to consider, and the performance is for an *entire system*.
  - Maximum Building Flow
  - Minimum Building Flow
  - Additional Bypass Air
  - Static Pressure



Air Types

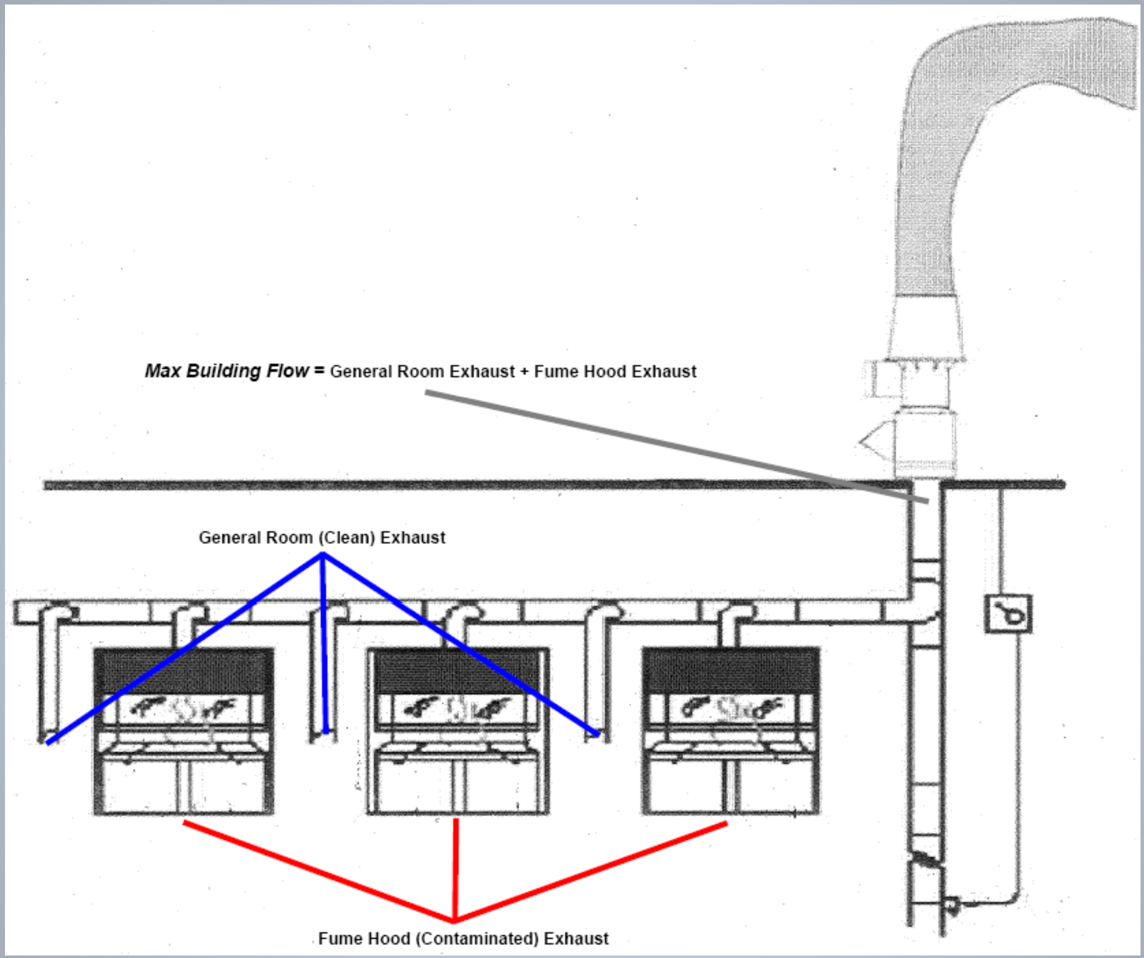
- There are 3 air types that could potentially affect the selection of fumehood exhaust fan.



Maximum Building Flow

- Max Building Flow is a combination of the contaminated fumehood exhaust and the clean general room exhaust.
- It is the total amount of air that is being exhausted from inside the building. If the selection is for a multiple fans mounted on a common mixing box then the airflow is generally for the entire, multi-fan system, not the airflow per fan.

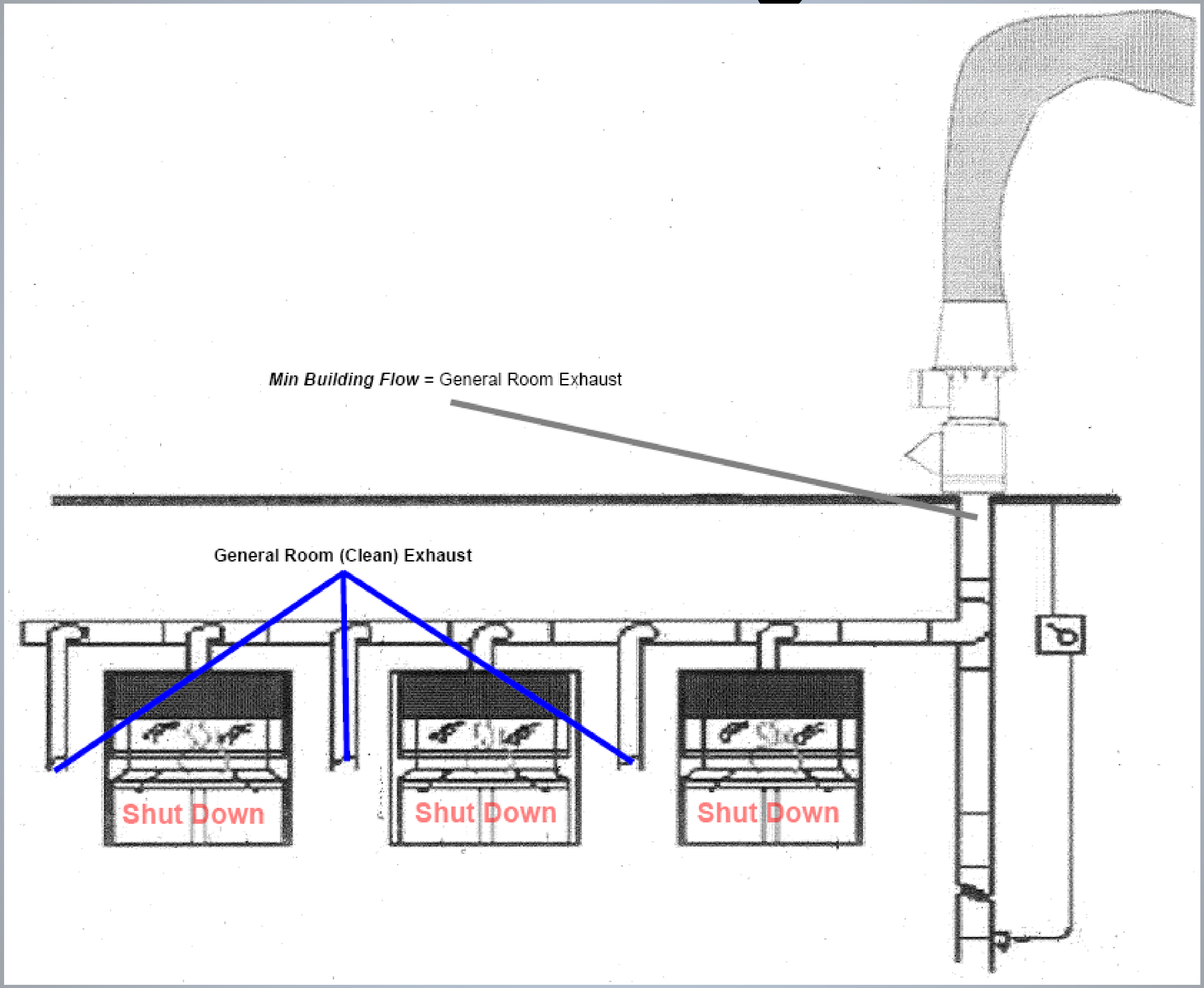
Maximum Building Flow



Minimum Building Flow

- Min Building Flow is the minimum amount of air required to be exhausted from a room for safe occupation, again entered as the entire system, not by individual fan.
- It is the clean air, general room exhaust
- The min building flow level is reached when all of the fumehoods are shut down/not in use
- In a variable volume system the additional air required to keep a constant discharge would be brought in through the bypass dampers on the roof

Minimum Building Flow



Additional Bypass Air

- There are times when the laboratory exhaust is not sufficient to reach the desired plume height or dilution ratio.
- There are also times when the exhaust flow is *so* low that a selection can not be made.
- You can add additional bypass air to bring up the flow going through the fan and solve either of these problems.

Initial Selection Tip

- If your schedule only lists one type of air flow it is generally understood that this is the Maximum Building Flow volume.
- If you are selecting a direct drive fan you may have to additional bypass air to reach to correct motor RPM, or use a variable frequency drive to change the speed of your motor.

Static Pressure

- Static pressure is at the inlet to the mixing box
- Most programs automatically account for losses due to fan/plenum box assembly and dampers

What To Watch Out For

Type	Size	Cl.	% dia	% wid	% peak	Drive	RPM	Max RPM	Std. BHP/fan	Tot. Std. BHP	Op. BHP/fan	Tot. Op. BHP	Nozzle OV	Windband OV	Plume Height	Dil.Ratio	Ent.Ratio	S.E.	T.E.	FEG	In.LwA/Fan	Tot.Pkg.In.LwA	Out.LwA/Fan	Tot.Pkg.Out.LwA	$$
TVIFE	150HV	I	100	100	40.76	DD	1920	2721	1.22	2.45	1.22	2.45	4323	1486	22	237%	216%	35.32	76.47	FEG85	78	81	80	83	1.00
TVIFE	165HV	I	100	100	51.94	DD	1552	2483	1.02	2.05	1.02	2.05	3600	1239	22	237%	216%	42.27	76.42	FEG80	76	79	77	80	1.05
TVIFE	150MV	I	100	100	45.47	DD	1721	2721	0.92	1.85	0.92	1.85	3088	1292	20	206%	187%	46.82	74.65	FEG80	80	83	81	84	1.00
TVIFE	122HV	I	100	100	25.04	DD	3017	3450	2.13	4.26	2.13	4.26	6400	2132	24	230%	209%	20.28	72.08	FEG80	91	94	91	94	0.90
TVIFE	135HV	I	100	100	33.73	DD	2363	3137	1.65	3.30	1.65	3.30	5289	1760	24	230%	209%	26.19	71.86	FEG80	88	91	88	91	0.95
TVIFE	150XV	I	100	100	31.59	DD	2246	2721	1.94	3.87	1.94	3.87	5945	1803	24	288%	262%	22.32	71.50	FEG75	82	85	84	87	1.00
TVIFE	165XV	I	100	100	41.23	DD	1794	2483	1.54	3.09	1.54	3.09	4950	1501	24	288%	262%	27.98	70.73	FEG75	79	82	81	84	1.05
TVIFE	135MV	I	100	100	61.72	DD	2011	3137	1.09	2.17	1.09	2.17	3445	1458	21	190%	173%	39.82	69.29	FEG75	86	89	86	89	0.95
TVIFE	182XV	I	100	100	53.93	DD	1410	2232	1.25	2.50	1.25	2.50	3999	1216	24	288%	262%	34.54	68.97	FEG75	76	79	77	80	1.09
TVIFE	122MV	I	100	100	46.82	DD	2540	3450	1.33	2.66	1.33	2.66	4169	1770	22	191%	174%	32.54	67.80	FEG80	89	92	88	91	0.90
TVIFE	200XV	I	100	100	66.06	DD	1157	2027	1.09	2.17	1.09	2.17	3299	1002	23	288%	262%	39.81	66.82	FEG75	74	77	74	77	1.18
TVIFE	165XV7	I	100	100	32.24	DD	1967	2483	1.67	3.33	1.67	3.33	4950	1538	24	295%	268%	25.95	65.58	FEG71	90	93	89	92	1.05
TVIFE	150XV7	I	100	100	24.54	DD	2483	2721	2.12	4.23	2.12	4.23	5945	1854	25	296%	269%	20.43	65.45	FEG71	93	96	92	95	1.00
TVIFE	182XV7	I	100	100	43.23	DD	1527	2232	1.33	2.65	1.33	2.65	3999	1243	24	295%	268%	32.61	65.13	FEG71	88	91	86	89	1.09
TVIFE	165HV7	I	100	100	37.29	DD	1779	2483	1.20	2.40	1.20	2.40	3600	1296	22	248%	226%	35.95	65.00	FEG71	87	90	85	88	1.05
TVIFE	200XV7	I	100	100	54.42	DD	1236	2027	1.13	2.26	1.13	2.26	3299	1022	24	294%	267%	38.32	64.31	FEG67	85	88	82	85	1.18
TVIFE	150HV7	I	100	100	28.58	DD	2227	2721	1.47	2.94	1.47	2.94	4323	1556	22	248%	226%	29.42	63.70	FEG71	89	92	88	91	1.00
TVIFE	135XV	I	100	100	24.84	DD	2880	3137	2.94	5.88	2.94	5.88	7273	2190	27	286%	260%	14.71	63.21	FEG75	92	95	92	95	0.95
TVIFE	200XV5	I	100	100	45.17	DD	1340	2027	1.15	2.31	1.15	2.31	3299	1006	23	289%	263%	37.45	62.85	FEG67	74	77	76	79	1.18
TVIFE	182XV5	I	100	100	34.88	DD	1679	2232	1.40	2.79	1.40	2.79	3999	1214	24	288%	262%	30.97	61.85	FEG67	77	80	78	81	1.09
TVIFE	150MV7	I	100	100	33.78	DD	2019	2721	1.12	2.24	1.12	2.24	3088	1364	21	218%	198%	38.56	61.49	FEG71	92	95	89	92	1.00
TVIFE	165XV5	I	100	100	25.31	DD	2193	2483	1.81	3.62	1.81	3.62	4950	1498	24	287%	261%	23.88	60.37	FEG67	80	83	81	84	1.05
TVIFE	135HV7	I	100	100	24.54	DD	2755	3137	2.01	4.02	2.01	4.02	5289	1846	24	241%	219%	21.52	59.06	FEG67	92	95	91	94	0.95
TVIFE	150XV5	II	100	100	18.72	DD	2794	3558	2.35	4.70	2.35	4.70	5945	1802	24	288%	261%	18.40	58.93	FEG67	82	85	85	88	1.05
TVIFE	135MV7	I	100	100	34.66	DD	2370	3137	1.33	2.67	1.33	2.67	3445	1543	22	202%	183%	32.39	56.36	FEG63	91	94	89	92	0.95
TVIFE	122MV7	I	100	100	25.75	DD	3025	3450	1.67	3.34	1.67	3.34	4169	1869	22	202%	183%	25.88	53.93	FEG67	94	97	90	93	0.90
TVIFE	165HV5	I	100	100	26.23	DD	2102	2483	1.54	3.08	1.54	3.08	3600	1281	22	245%	223%	28.07	50.76	FEG63	77	80	78	81	1.05
TVIFE	150HV5	I	100	100	19.55	DD	2668	2721	1.95	3.91	1.95	3.91	4323	1543	22	246%	224%	22.12	47.90	FEG63	79	82	81	84	1.00
TVIFE	150MV5	I	100	100	23.16	DD	2462	2721	1.53	3.07	1.53	3.07	3088	1358	21	217%	197%	28.17	44.92	FEG63	81	84	83	86	1.00
TVIFE	135MV5	I	100	100	22.66	DD	2908	3137	1.87	3.75	1.87	3.75	3445	1543	22	202%	183%	23.06	40.13	FEG56	95	98	92	95	0.95

Additional Bypass Air

- Try to minimize the amount of excess bypass air included in your system.
- The more bypass air you add in the more energy your system will require.
- Additional bypass air could cause you to use a larger HP motor.

Fan Selection - Plume Height

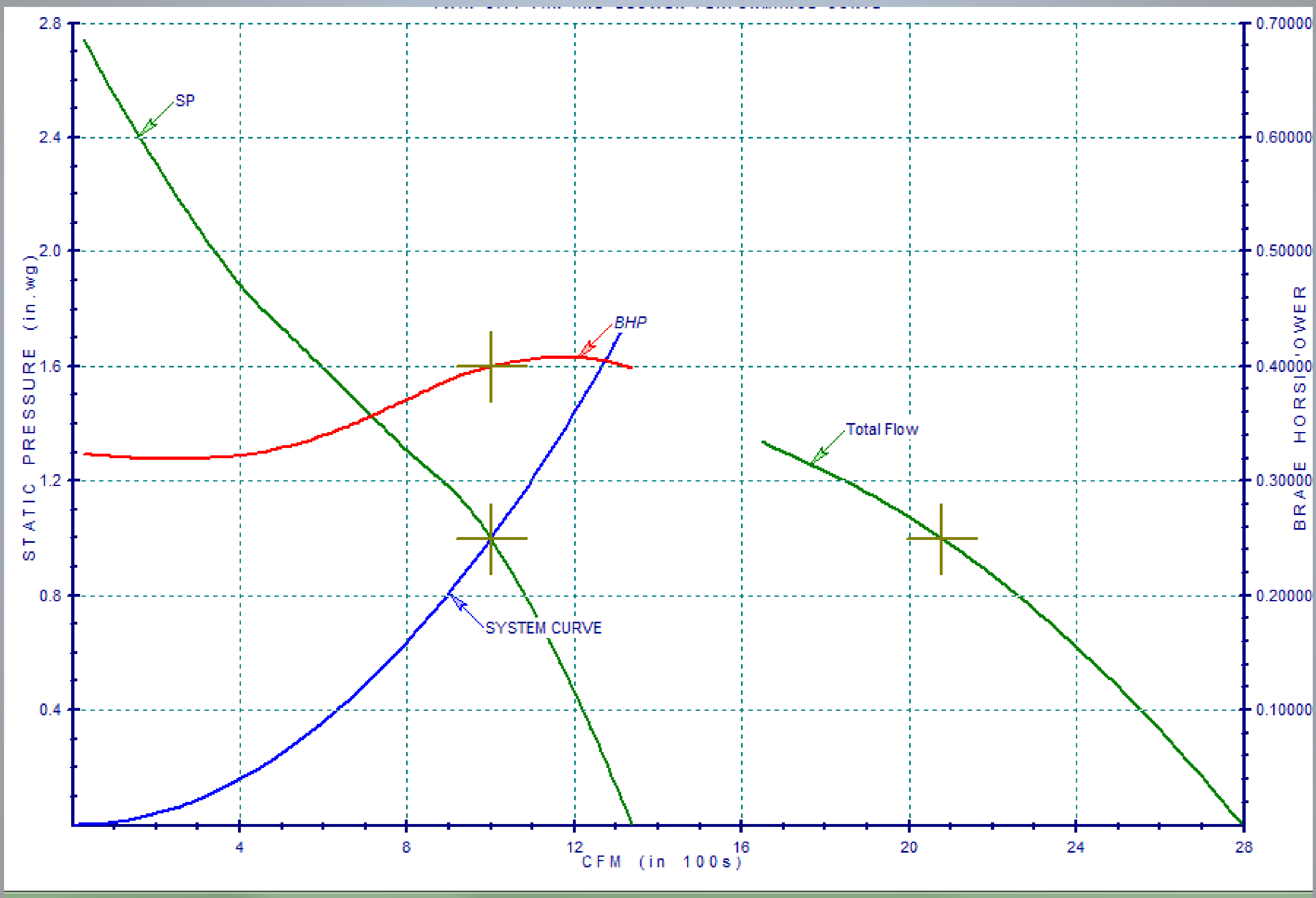
- When selecting these fans watch plume height and outlet velocity closely.
- Select a fan with a plume height that will allow you to exhaust contaminants away safely.

Fan Selection - Plume Height

- Don’t automatically select the fan with the highest plume height and outlet velocity.

- A detailed study of the surround area will help determine a safe height to exhaust to without wasting energy.

Reading Induced Flow Fan Curves



Fan Quantities

- When specifying be sure to clearly state how many fans you need per plenum and if any of the fans are on standby.
- It is also important to be clear if the performance called out is per system or per fan.
- This can help ensure that you really get what you need from the fan manufacturer.

Conclusion

- Role of fume exhaust fans in modern laboratories
- Equipment & flow terminology
- AMCA 260 standard
- Know your laboratory
- Chemical resistance
- Selecting the correct fan & accessories for your application
- Saving energy on your laboratory

Thank You!

Questions?