Tipe / Jenis Ventilasi Industri

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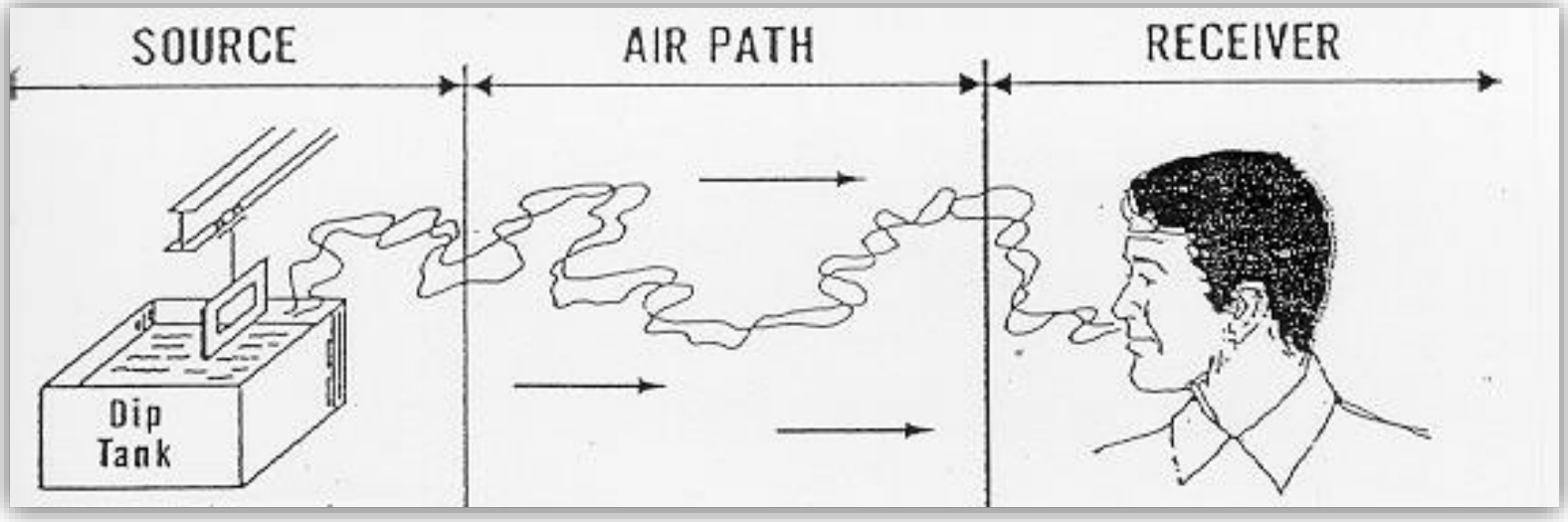
AGENDA PEMBAHASAN

- Tipe / Jenis Ventilasi Industri
- *General dilution ventilation*
- *Local exhaust ventilation*
- *Heating,ventilation and air conditioning system (HVAC)*

Pendahuluan

Generalized Diagram:-- Methods of Control



Desired control priority for chemical hazards

1. **Source control**
2. **Pathway control**
3. **Receiver control**

Definisi

Industrial Ventilation

- Ventilation is a primary engineering control available to eliminate or reduce the concentration of gases, dusts, vapors, smoke, and fumes present in the work environment .
- Ventilation is defined as the process of supplying air to, or removing air from, any space by **natural** or **mechanical** means.

Types of Ventilation

1. General Dilution Ventilation (Pathway control)
   - Mechanical Ventilation (involves Fans)
   - Natural Ventilation (with natural air movement caused by thermal gradient or any other)
2. Local Exhaust Ventilation (Source control)
3. Heating Ventilation and Air conditioning System (to control temp. & humidity)

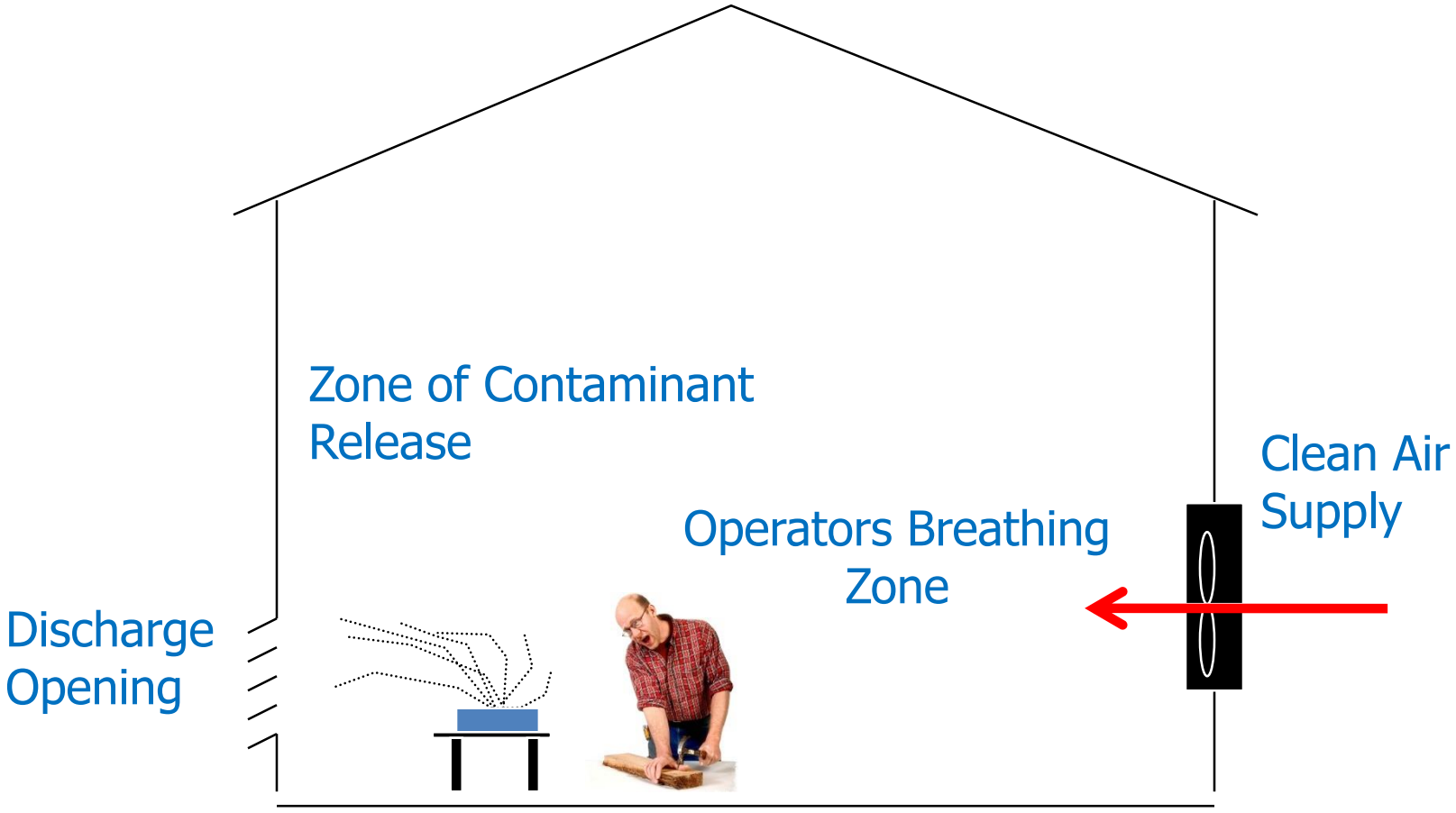
ADA TIGA JENIS VENTILASI DI TEMPAT KERJA

1. "Dilution (general) ventilation/Ventilasi Pengenceran Udara", pengenceran terhadap udara yang terkontaminasi di dalam bangunan atau ruangan, dengan bertiup udara bersih (tidak tercemar) yang bertujuan untuk mengendalikan bahaya di tempat kerja.
2. "Local exhaust ventilation/Ventilasi pengeluaran setempat" , adalah proses pengisapan dan pengeluaran udara terkontominasi secara serentak dari sumber pencemaran sebelum udara berkontominasi berda pada ketinggian zona pernapasan dan menyebar keseluruh ruang kerja, umummnya ventilasi jenis ini di temapatkan sangat dekat dengan sumber emisi
3. "Indoor air quality ventilation" digunakan terutama untuk memberikan udara segar, atau didinginkan / udara dipanaskan untuk bangunan sebagai bagian dari pemanasan, ventilasi dan sistem pendingin udara,

1. DILUTION (general) VENTILATION/ Ventilasi Pengenceran Udara

- Dilusi ventilasi biasanya dicapai dengan cara mengencerkan udara yang terkontaminasi atau mengandung gas yang mudah terbakar dengan meniupkan udara ketempat kerja dan mengeluarkan kembali.
- Aliran udara harus diperhitungkan dalam desain gedung

Principle of General Ventilation



Direction of air flow must remove contaminants from workers breathing zone

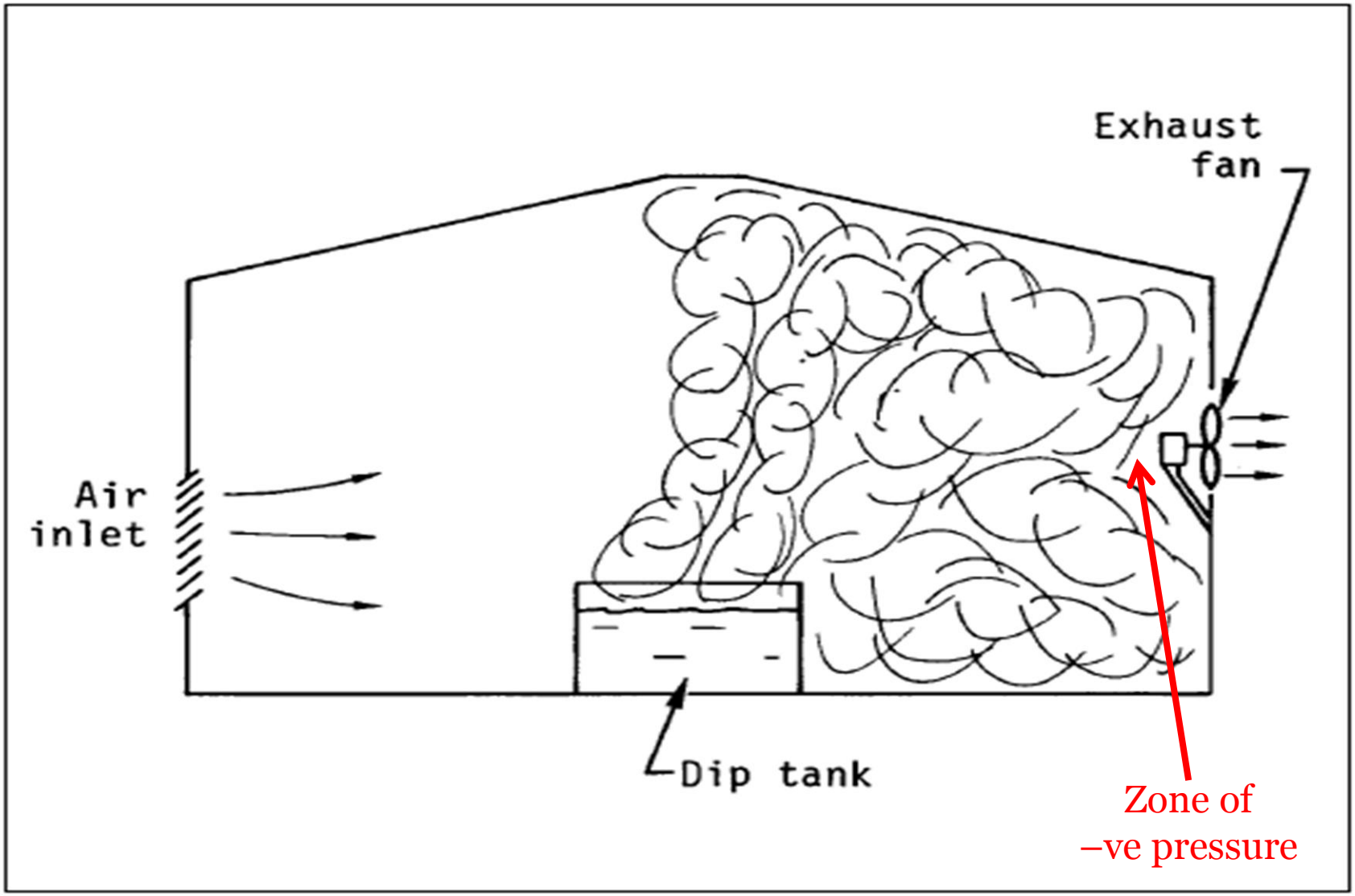
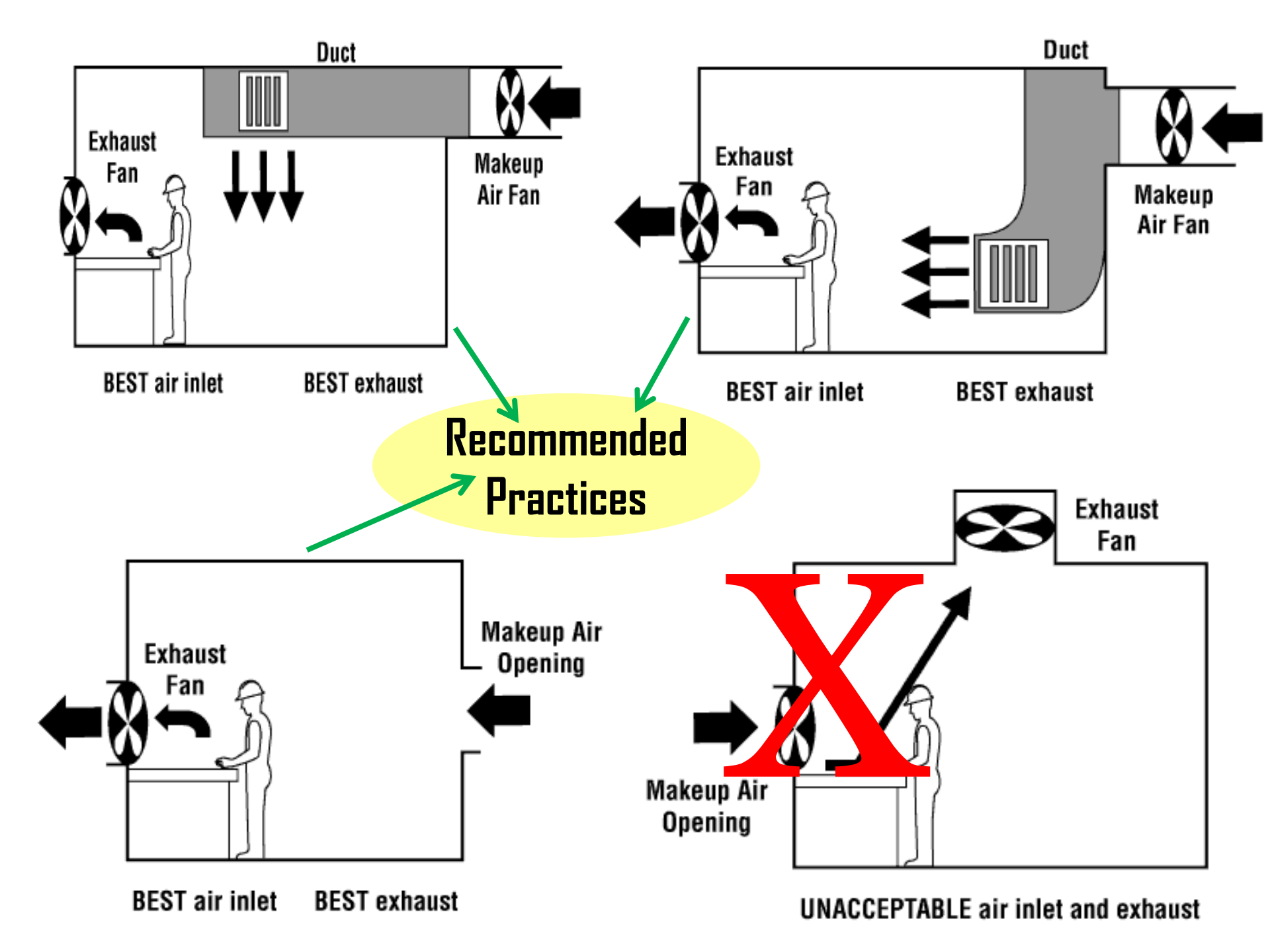


Figure 20–1. Dilution ventilation gradually removes contaminants dispersed in the workroom air.


Duct
Exhaust Fan
Makeup Air Fan
BEST air inlet
BEST exhaust
Duct
Exhaust Fan
Makeup Air Fan
BEST air inlet
BEST exhaust
Recommended Practices
Exhaust Fan
Makeup Air Opening
BEST air inlet
BEST exhaust
Exhaust Fan
Makeup Air Opening
UNACCEPTABLE air inlet and exhaust

Example of General Dilution Ventilation?

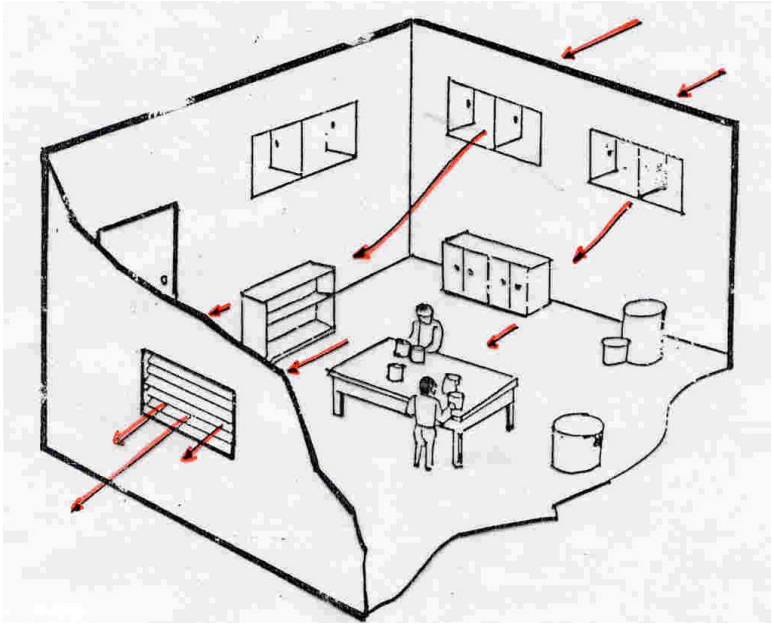
General Dilution Ventilation

- If (TLV <100ppm)- not recommended
- Only suitable for contaminant with low & uniform generation rate
- Not completely remove the contaminant
- Some general ventilation devices:---

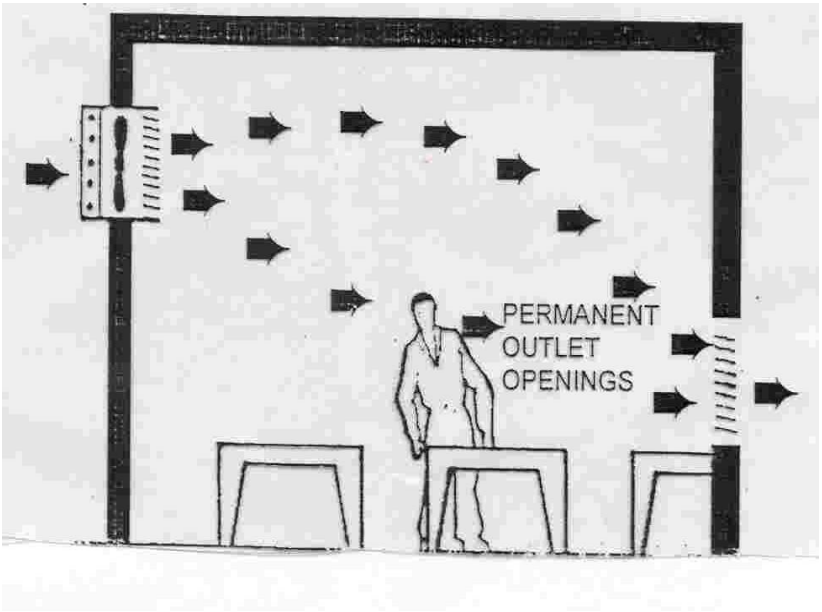
Roof-mounted exhaust fans

Industrial exhaust fans

General or Dilution Ventilation Type



Natural Ventilation



Mechanical Ventilation

Preferred if significant health hazards exist

SYSTEM OF VENTILATION –**Natural**

- Definition - the process of supplying and removing air through an indoor space **without using mechanical systems**. It refers to the flow of external air to an indoor space as a **result of pressure or temperature differences**
- The benefits of natural ventilation include:-

1. Improved Indoor air quality (IAQ)
2. Energy savings
3. Reduction of greenhouse gas emissions
4. Reduction in occupant illness associated **with Sick Building Syndrome**
5. Increased worker productivity

- How can you relate the natural ventilation with this criteria :

1- Indoor Air Quality

2- Energy saving

3- Sick Building Syndrome

DURATION : 10 minutes

DISCUSSION 1

SYSTEM OF VENTILATION - Natural

- Recommendations from design guidelines from various building regulations suggest the following:

1. **Building orientation** and **location**.
2. **Building form** and **dimensions**.
3. **Window** typologies and operations;
4. **Types, shape and size of openings**;
5. **Construction methods and detailing**;
6. **Urban planning consideration**

SYSTEM OF VENTILATION - **Mechanical**

- Definition - mechanical ventilation systems circulate fresh air using **ducts and fans** rather than relying on airflow through small holes or crack's in a home's wall, roof or windows. Homeowners can breath easier knowing their home has a good ventilation.
- Benefits of using mechanical ventilation:-

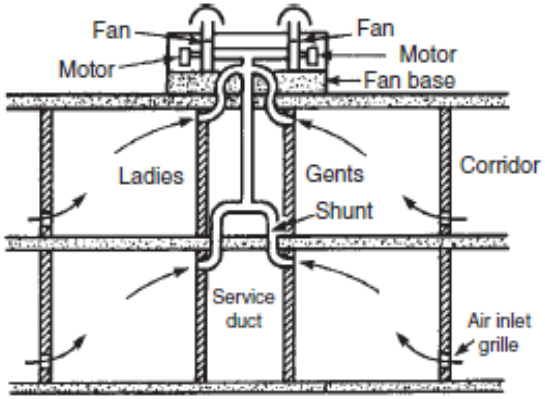
1. **Better indoor air quality** –can remove pollutants, allergens, and moisture that can cause mold problems
2. More control – **provide proper fresh air flow** along with appropriate locations for intake and exhaust
3. Improved **comfort** – allow a constant flow of outside air into the home and can also provide filtration, dehumidification, and conditioning of the incoming outside air.

SYSTEM OF VENTILATION - **Mechanical**

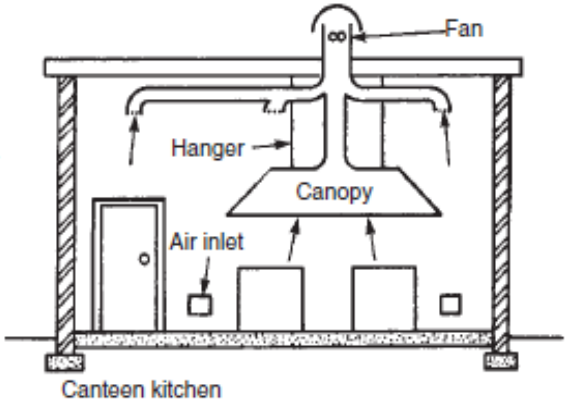
- These systems employ an electrically driven fan or fans to provide the necessary air movement;
- They also ensure a specified air change and the air under fan pressure can be forced through filters. There are three types of mechanical ventilation systems:
  1. Natural inlet and mechanical extract (exhaust system).
  2. Mechanical inlet and natural extract
  3. Mechanical inlet and extract

NATURAL INLET & MECHANICAL EXTRACT

- This is the most **common type** of system and is used for **kitchens, workshops, laboratories, internal sanitary apartments, garages and assembly halls**.
- The **fan creates negative pressure on its inlet side**, and this causes the air inside the room to move towards the fan, and the room air is displaced by the fresh air from outside the room.



Internal sanitary accommodation

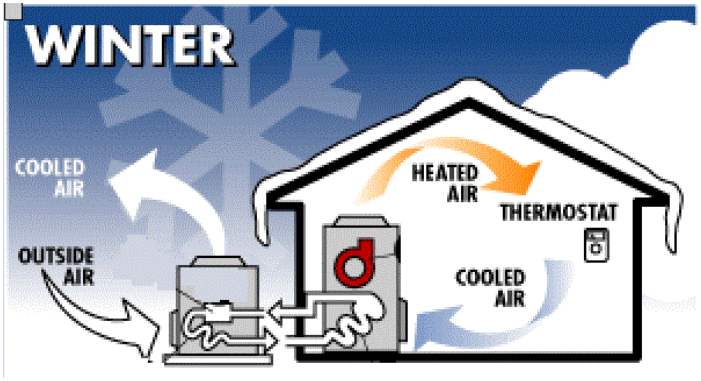


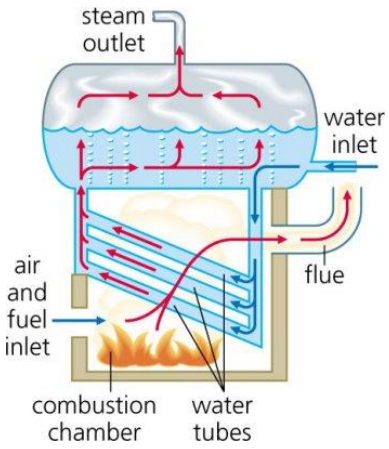
Canteen kitchen

SYSTEM OF VENTILATION -Mechanical

MECHANICAL INLET & NATURAL EXTRACT

- It is essential with this system that the air is heated before it is forced into the building.
- The system may be used for boiler rooms, offices and certain types of factories.
- The air may be heated in a central plant and ducted to the various rooms, or a unit fan convector may be used.

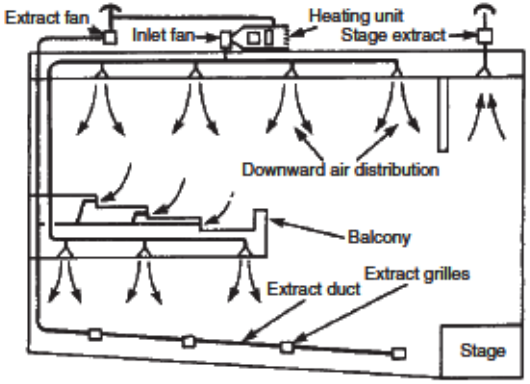




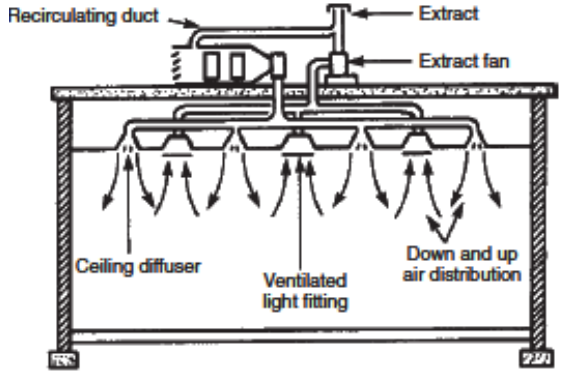
SYSTEM OF VENTILATION -Mechanical

MECHANICAL INLET & EXTRACT

- This provides the best possible system of ventilation, but it is also the most expensive and is used for many types of buildings including cinemas, theatres, offices, lecture theatres, dance halls, restaurants, departmental stores and sports centers. The system is essential for operating theatres and sterilizing rooms.



Mechanical inlet and mechanical extract for a theatre



Mechanical inlet and mechanical extract for an open plan office or supermarket

SYSTEM OF VENTILATION -Mechanical

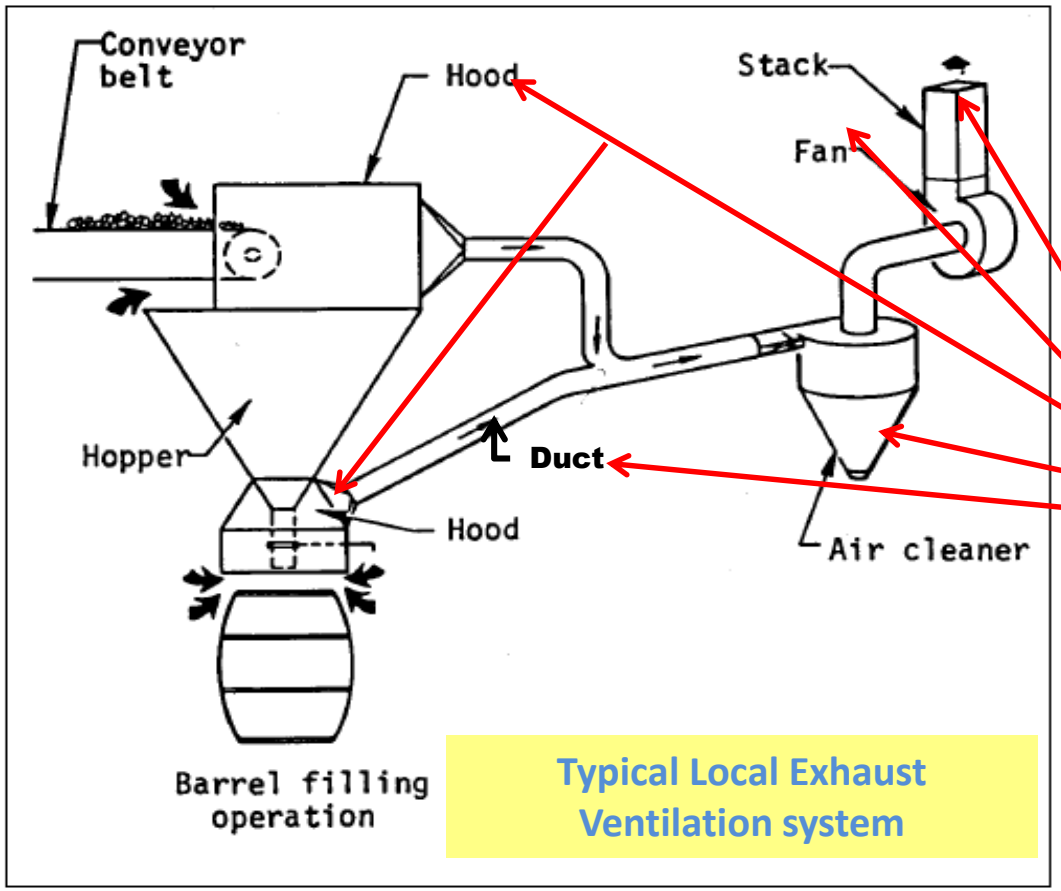
Keterbatasan Dilution (general) ventilation/Ventilasi Pengenceran Udara

- Tidak sepenuhnya menghapus kontaminan.
- Tidak bisa digunakan untuk bahan kimia sangat beracun.
- Tidak efektif untuk debu atau uap logam atau sejumlah besar gas atau uap.
- Memerlukan jumlah besar makeup udara yang akan dipanaskan atau didinginkan.
- Apakah tidak efektif untuk menangani uap atau emisi tidak teratur

2. LOCAL EXHAUST VENTILATION / Ventilasi Pengeluaran Setempat (Source Control)

Tujuan dari sistem ini adalah mengeluarakan udara kontaminan bahan kimia dari sumber tanpa memberikan kesempatan kontaminan mengalami difusi dengan udara di tempat kerja.

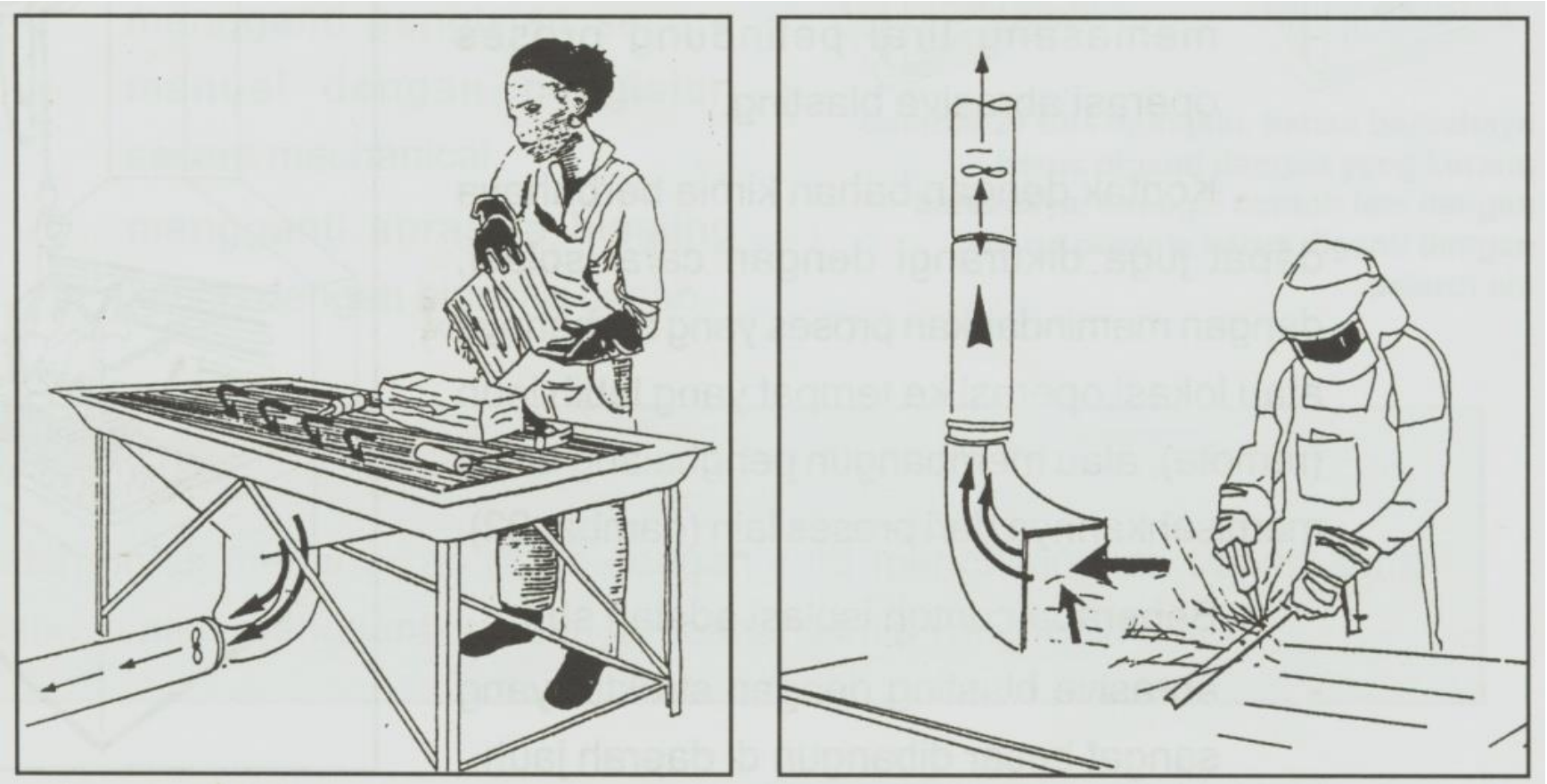
- Capture or contain contaminants at their source



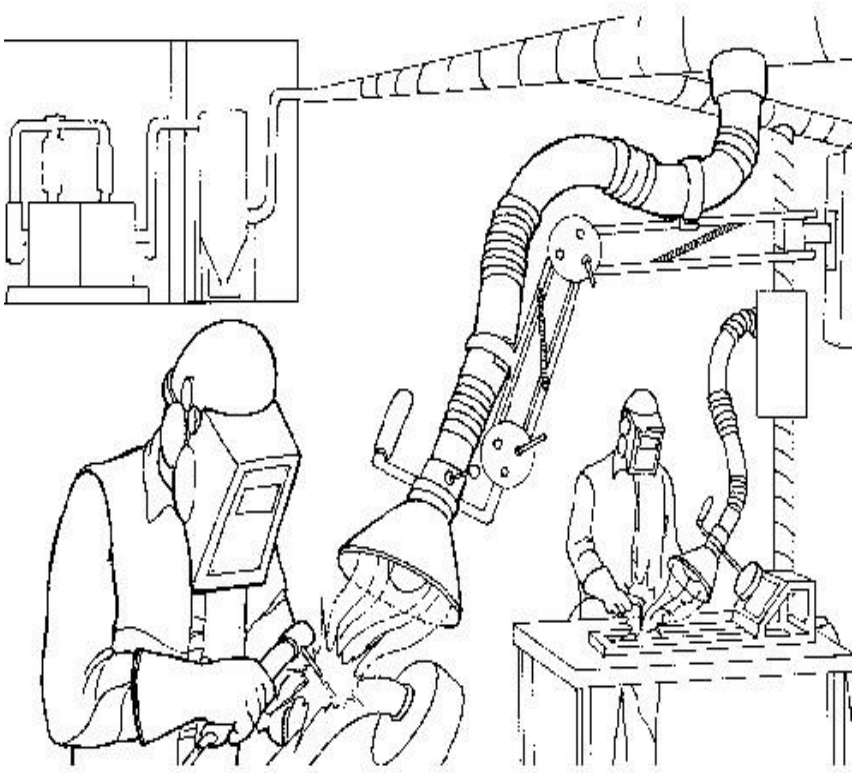
Typical Local Exhaust Ventilation system

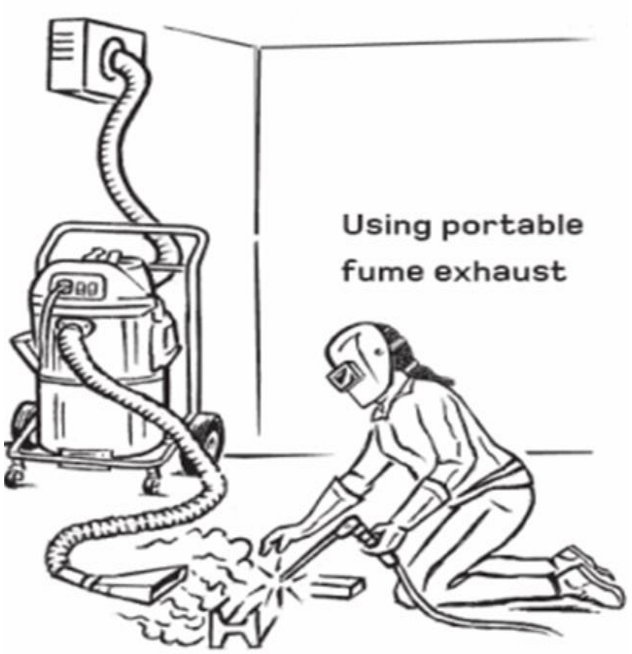
Components of Local Exhaust System

- **Hoods -** any point where air is drawn into the ventilation system to **capture** or control **contaminants**.
- **Ducts -** *the **network of piping** that connects the hoods and other system components.*
- **Fan -** *air-moving device that **provides the energy** to draw air and contaminants into the exhaust system & through the ducts and other components.*
- **Air Cleaner -** *a device to **remove airborne materials** that may be needed before the exhaust air is discharged into the community environment.*



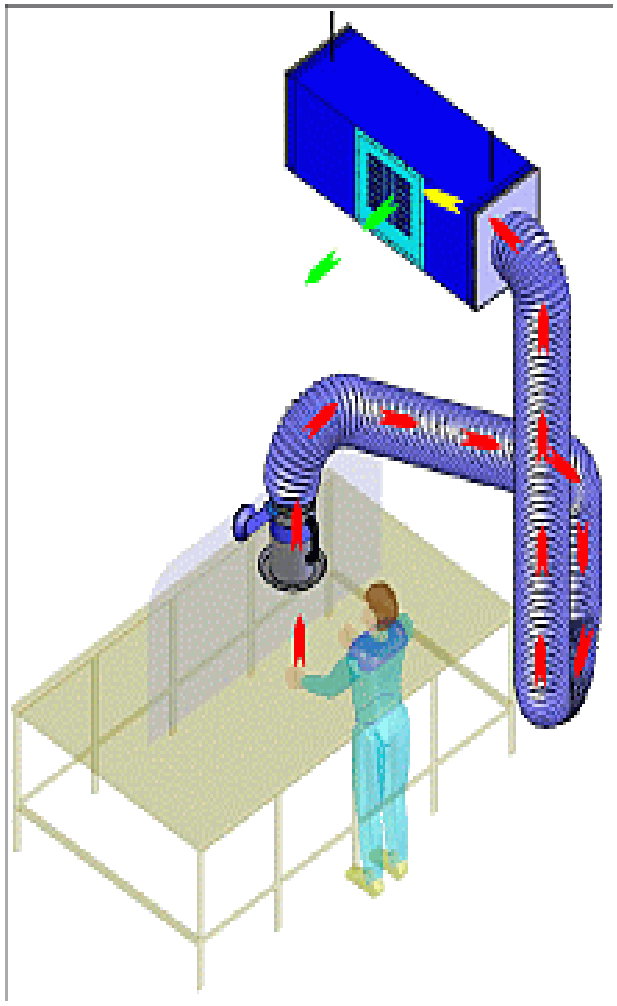
Gambar, Contoh cara ventilasi pengeluaran setempat Sebelah kiri kontaminan ditarik melalui meja kerja sebelum mencapai zona pernapasan si pekerja. Sebelah kanan asap dari pengelasan ditarik kedalam sistim pembuangan udara

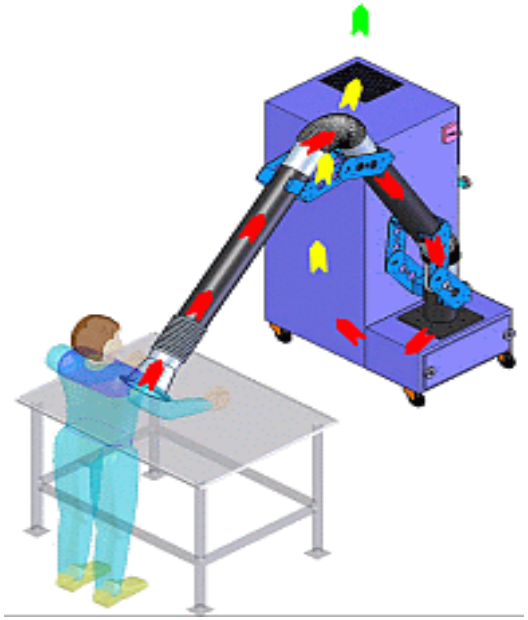


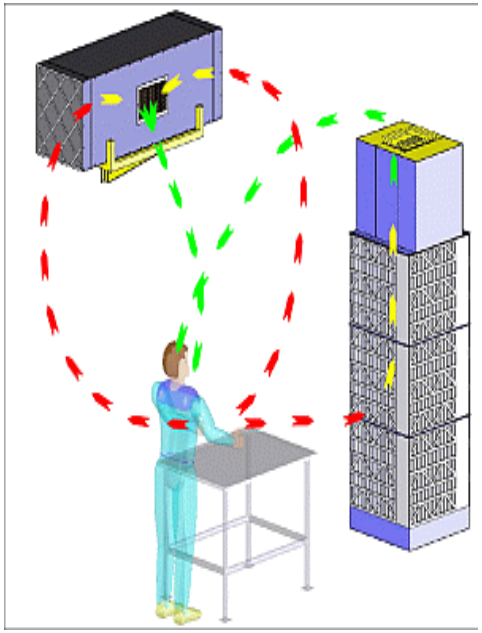


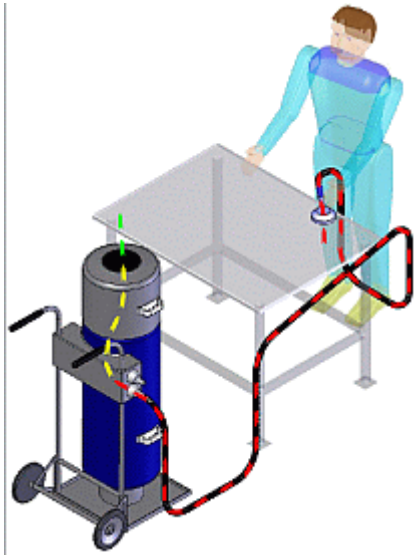
MODEL VENTILASI PENGELUARAN SETEMPAT

Local Exhaust Ventilation (LEV) systems







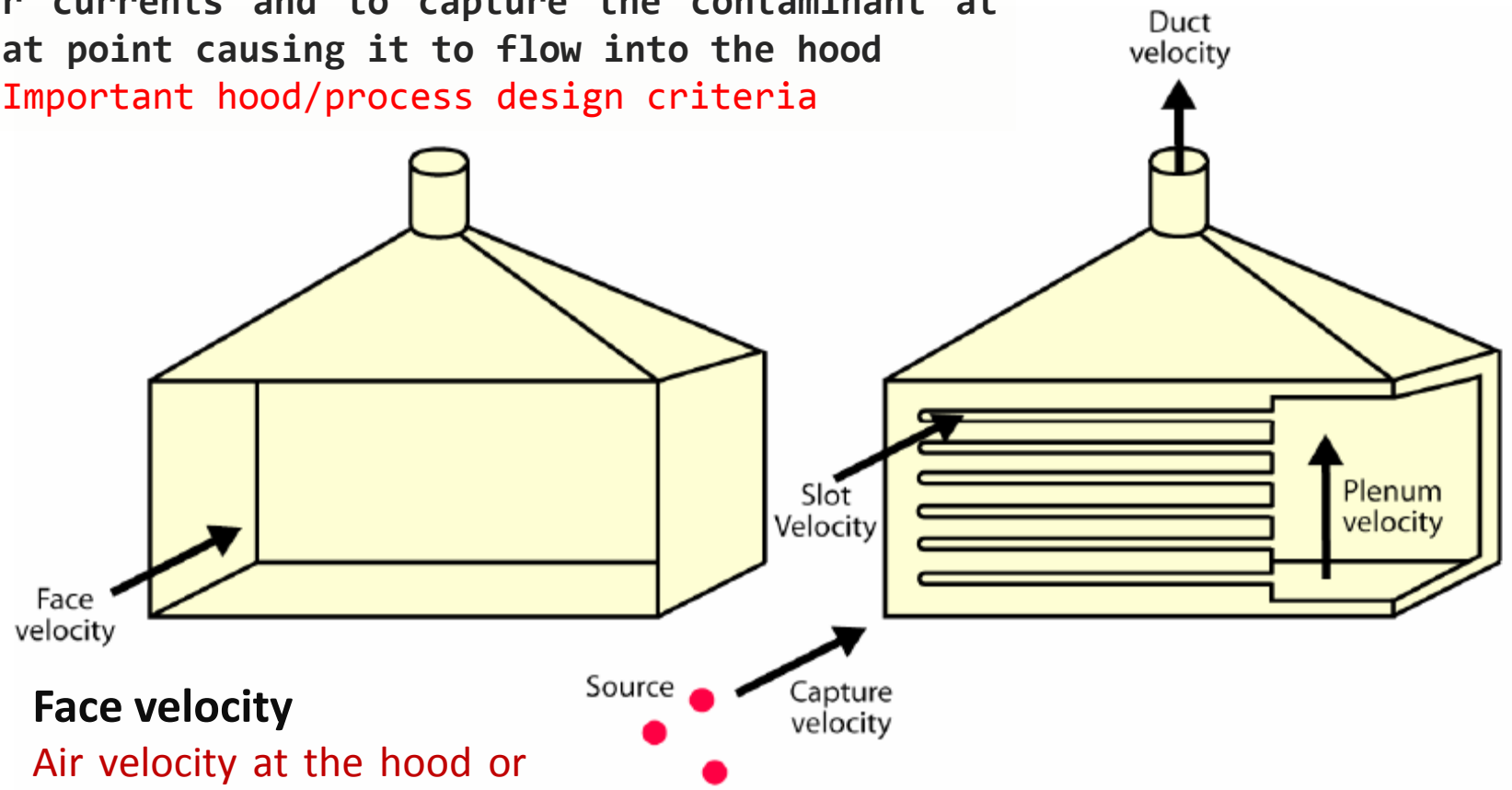


What is Local Exhaust Ventilation?

Ventilation Terminology

<u>Capture Velocity</u> - Air velocity at any point in front of the hood necessary to overcome opposing air currents and to capture the contaminant at that point causing it to flow into the hood

- Important hood/process design criteria



Face velocity

Air velocity at the hood or slot opening

Adapted from ACJH Manual

Effect of Side Baffles

Figure 3. Beneficial Effect of Side Baffles on Hood Capture Velocities

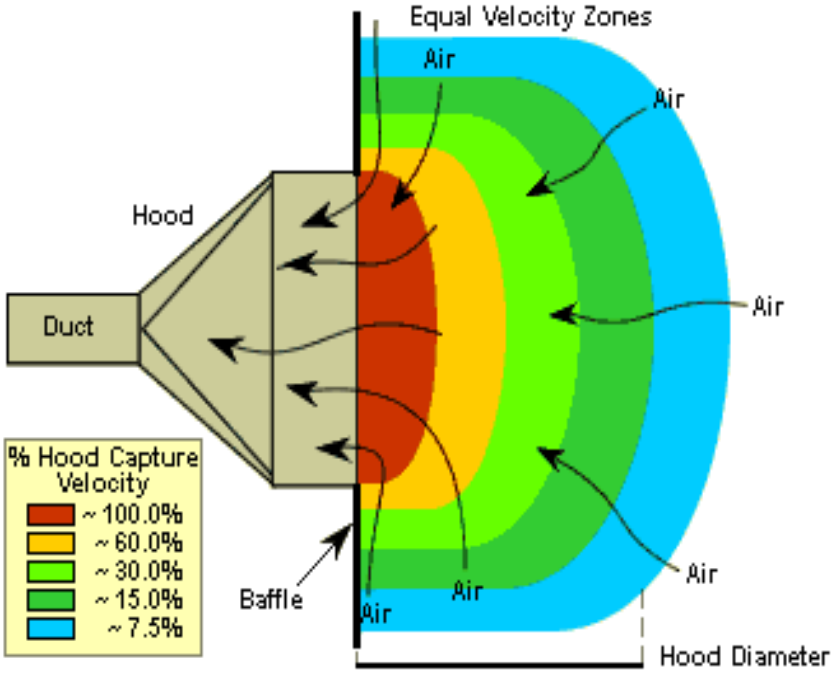
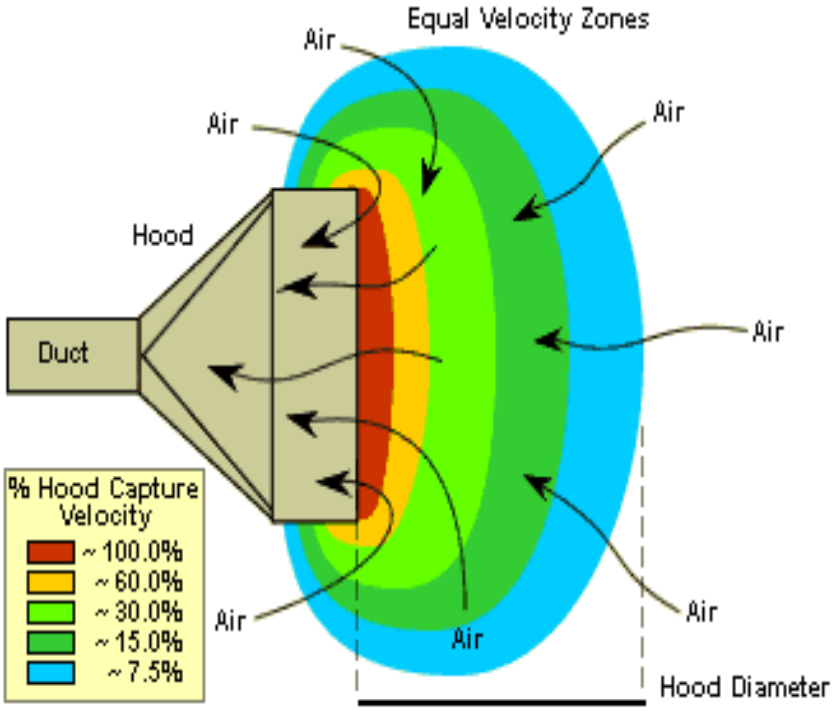
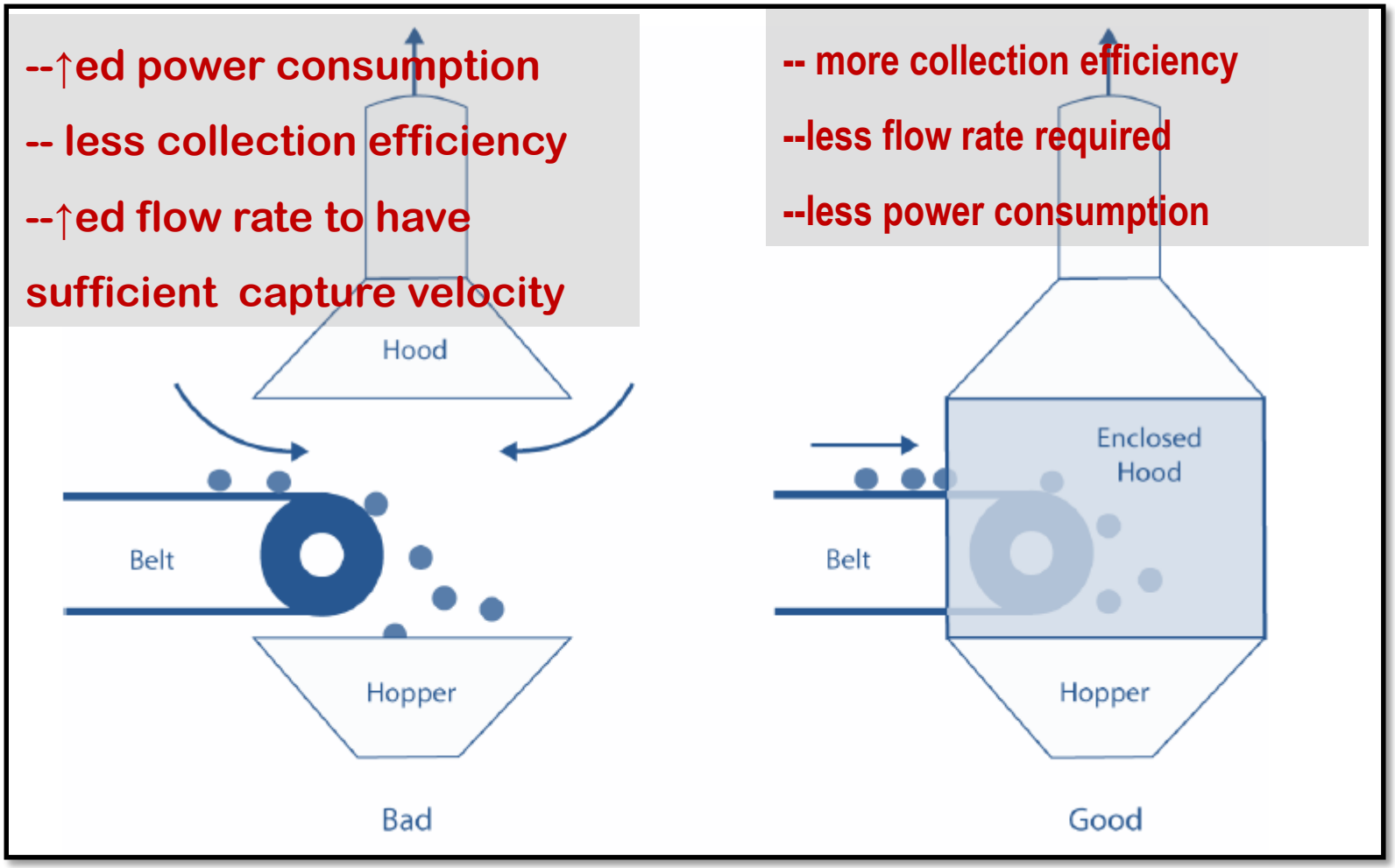


Figure 1. Hood Capture Velocities Near a Hood



Use of Enclosures



Benefits of ENCLOSURES

- Using techniques such as enclosures, **control capabilities are maximized**
- **Air volumes requirements** are drastically minimized
- **Reduces required make-up air** and associated costs

Direction of Air Movement

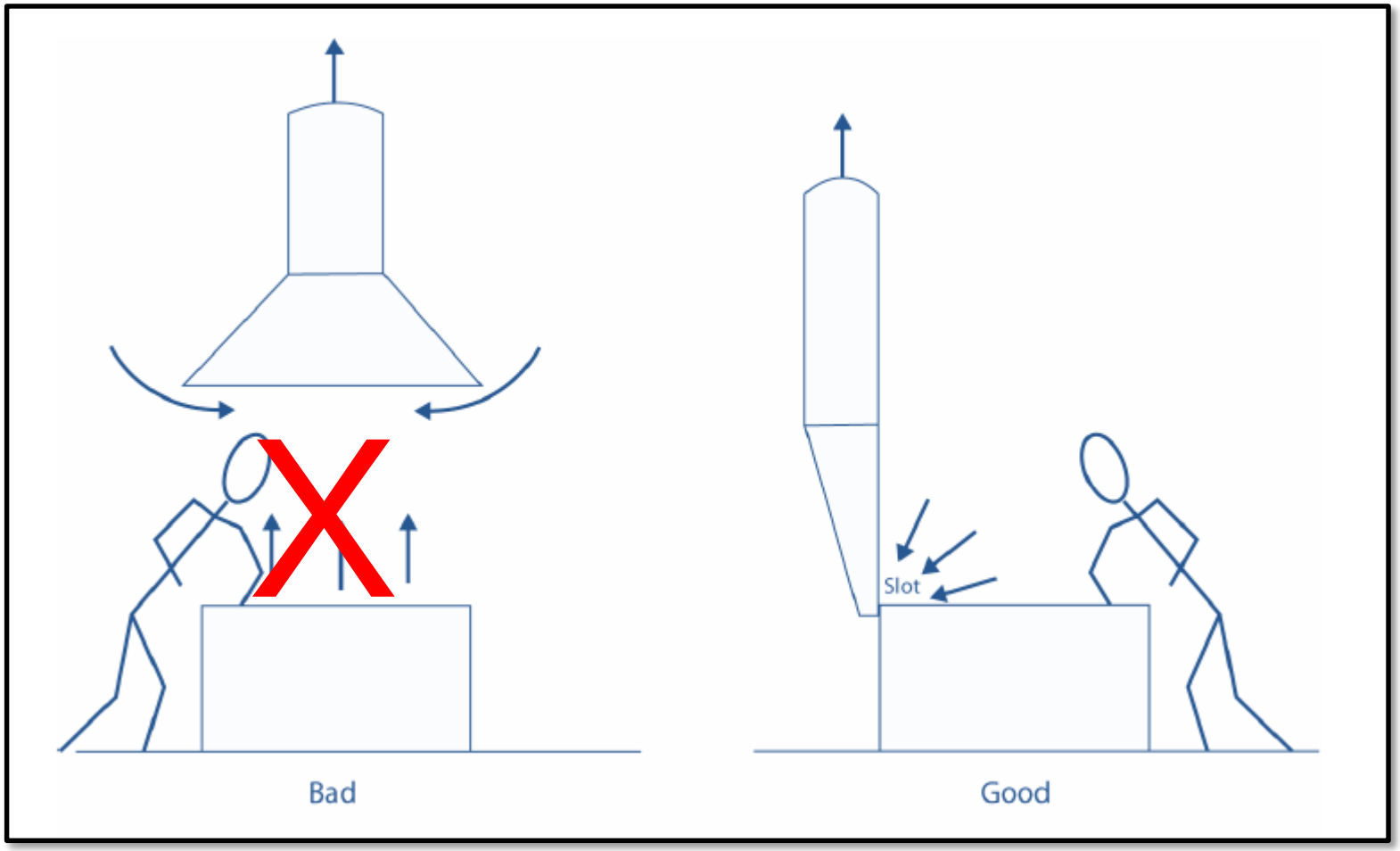
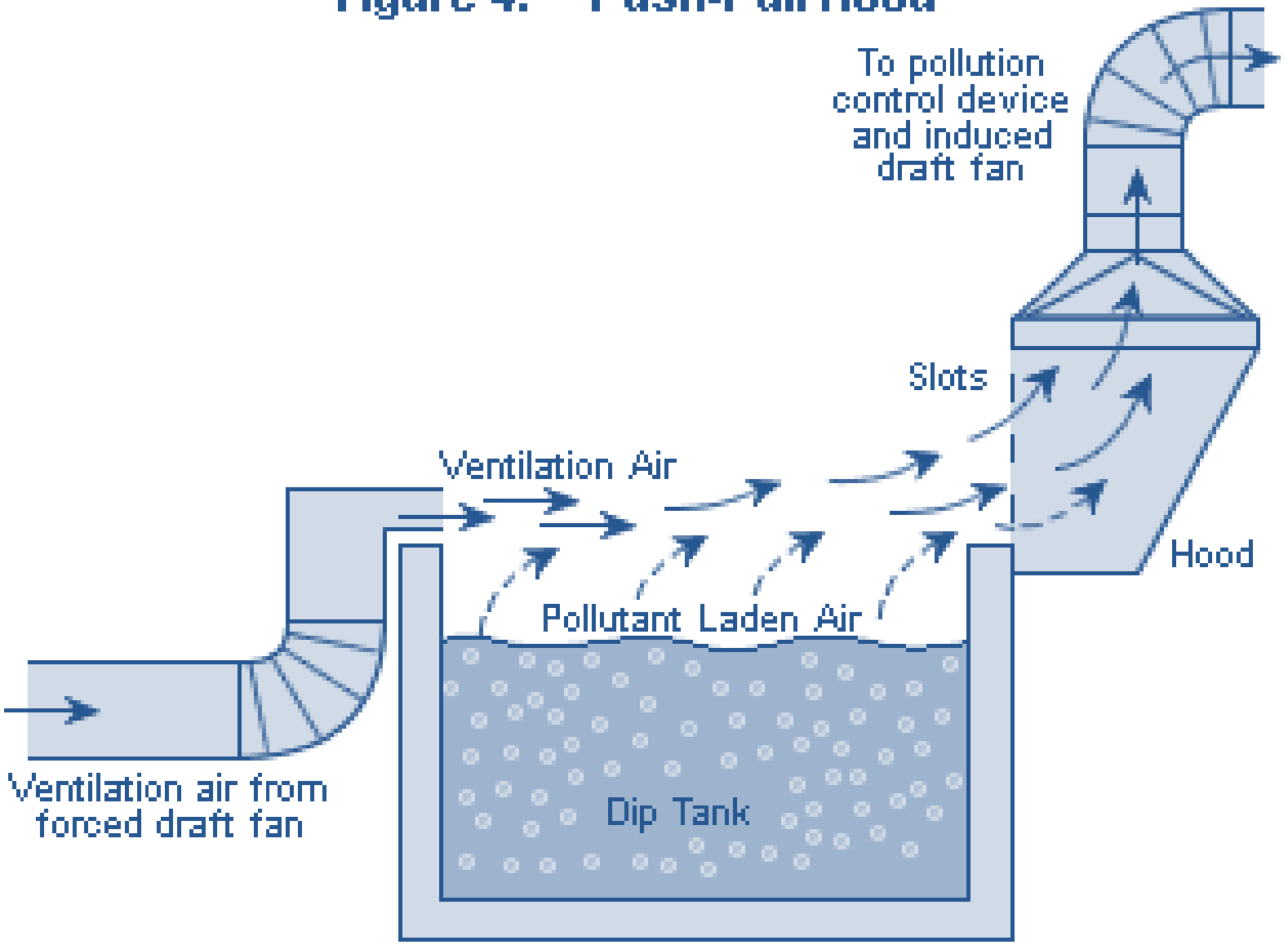


Figure 4. Push-Pull Hood



Selection of capture velocity

Dispersion of Contaminant	*Examples*	*Capture Velocity, ft/min*
Released with practically no velocity into quiet air.	Evaporation from tank; degreasing.	50–100
Released at low velocity into moderately still air.	Spray booths; intermittent container filling; low-speed conveyor transfers; welding; plating; pickling.	100–200
Active generation into zone of rapid air motion.	Spray painting in shallow booths; barrel filling; conveyor loading; crushers.	200–500
Released at high initial velocity into zone of very rapid air motion.	Grinding; abrasive blasting; tumbling.	500–2000

In each category above, a range of capture velocities is shown. The proper choice of values depends on several factors:

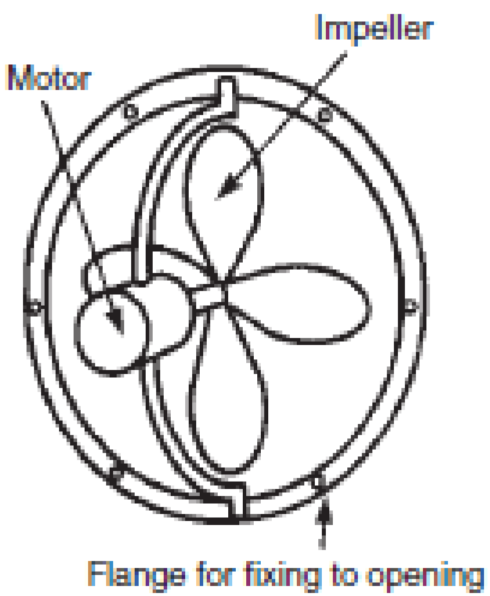
Lower End of Range	*Upper End of Range*
1. Room air currents minimal or favorable to capture.	1. Disturbing room air currents.
2. Contaminants low toxicity or of nuisance value only.	2. Contaminants of high toxicity.
3. Intermittent, low production.	3. High production, heavy use.
4. Large hood-large air mass in motion.	4. Small hood-local control only.

(Source: From American Conference of Governmental Industrial Hygienists (ACGIH®) *Industrial Ventilation: A Manual of Recommended Practice*, 23rd ed. Copyright 1998, Cincinnati. Reprinted with permission.)

FANS

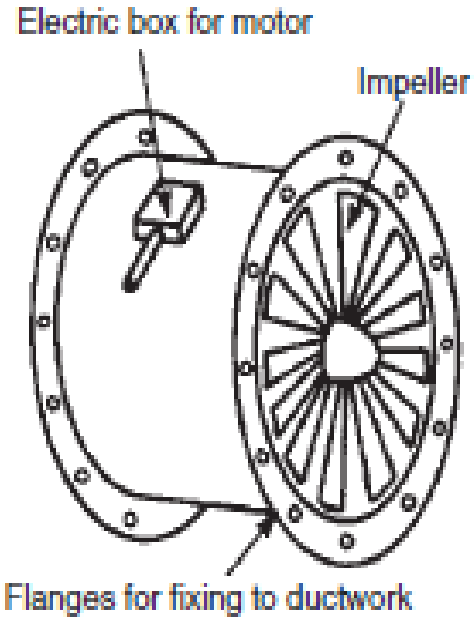
- **Propeller Fan**

Does **not create much air pressure** and has limited effect in ductwork. Ideal for use at **air openings in windows and walls.**



Propeller fan

TYPES OF FAN



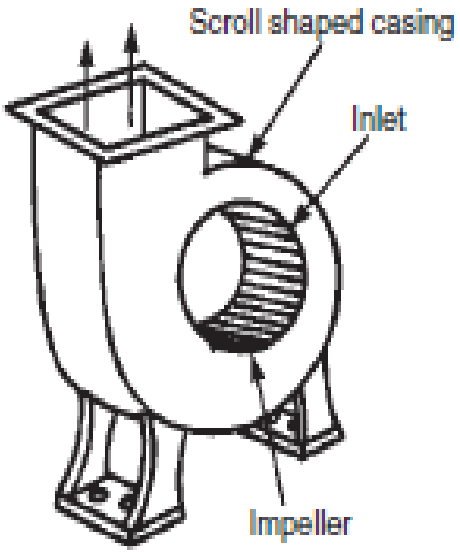
Axial flow fan

FANS

- Axial Flow Fan

can develop **high pressure** and is used for **moving air through long sections of ductwork**. The fan is integral with the run of ducting and does not require a base.

TYPES OF FAN



Centrifugal fan

FANS

- Centrifugal Fan

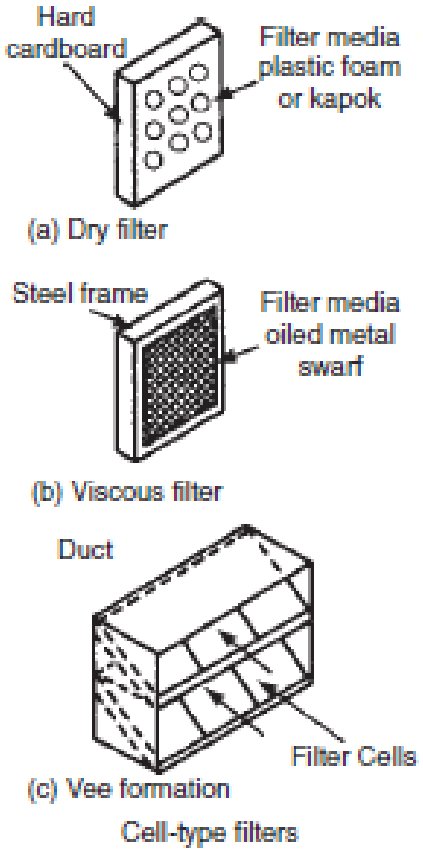
can **produce high pressure** and has the capacity for **large volumes** of air. Most suited to larger installations such as **air conditioning systems**. It may have one or two inlets. Various forms of impeller can be selected depending on the air condition. Variable impellers and pulley ratios from the detached drive motor make this the most versatile of fans.

TYPES OF FAN

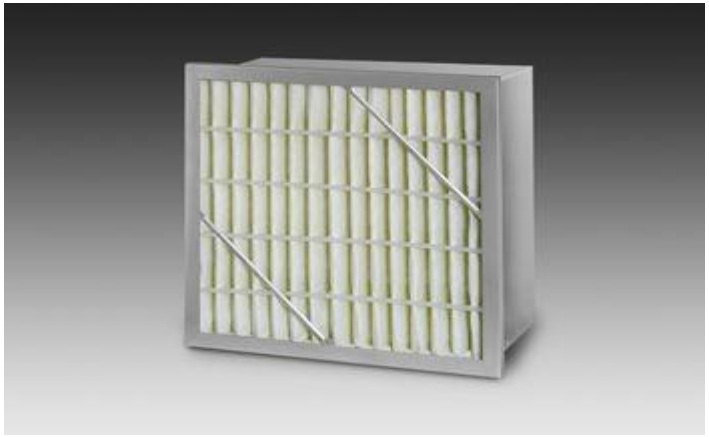
AIR FILTERS

CELL OR PANEL TYPE

- Flat or in a vee formation to increase the surface contact area.
- Available in dry or wet (viscous) composition in disposable format for simple fitting within the ductwork. A rigid outer frame is necessary to prevent flanking leakage of dirty air.
- Dry filters can be vacuum cleaned to extend their life, but in time will be replaced. The viscous filter is coated with an odorless, non-toxic, non-flammable oil. These can be cleaned in hot soapy water and recoated with oil.

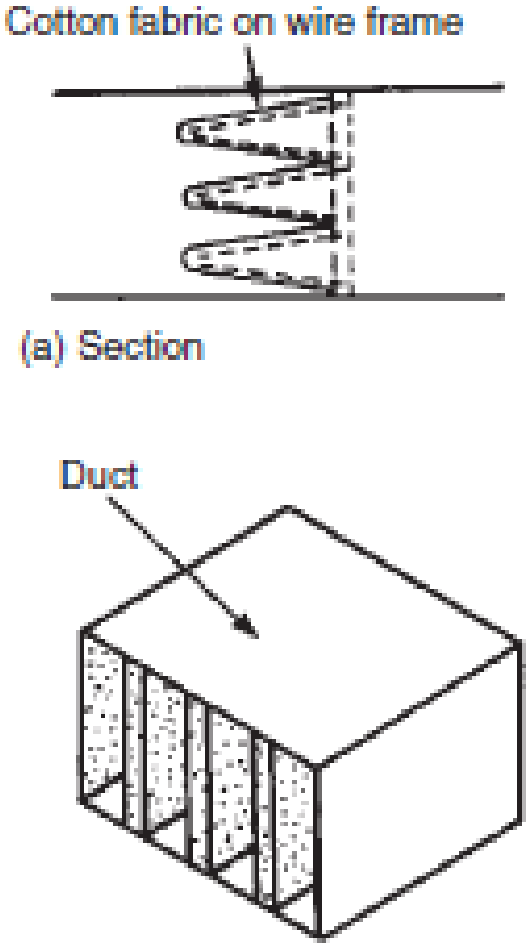


Cell-type filters



BAG TYPE

- A form of filtration material providing a large air contact area.
- When the fan is inactive the bag will hang limply unless wire reinforced.
- It will resume a horizontal profile during normal system operation.
- Fabric bags can be washed periodically and replaced.

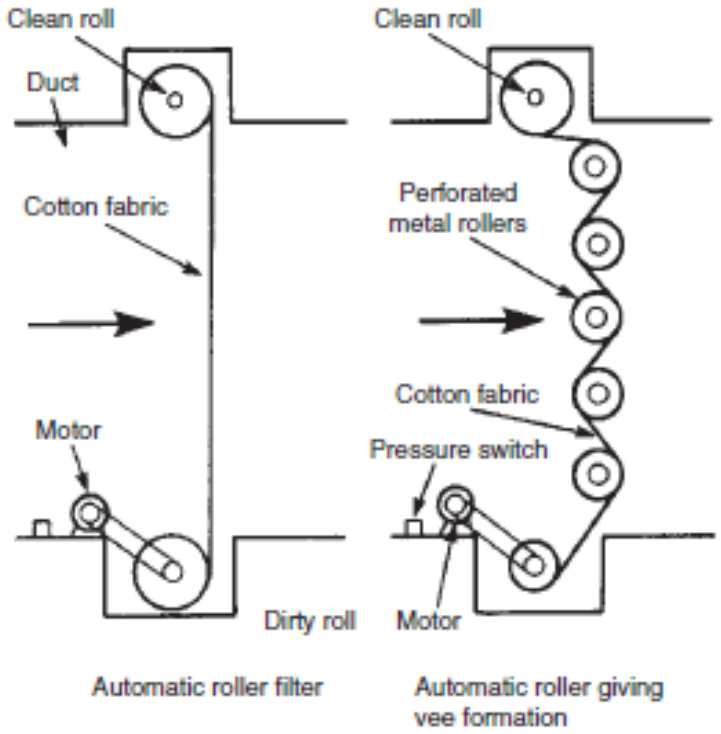


Bag-type filters

AIR FILTERS

ROLLER TYPE FILTER

- Operated manually or by pressure sensitive switch.
- As the filter becomes less efficient, resistance to air flow increases.
- The pressure effects a detector which engages a motor to bring down clean fabric from the top spool.
- Several perforated rollers can be used to vee format and increase the fabric contact area.

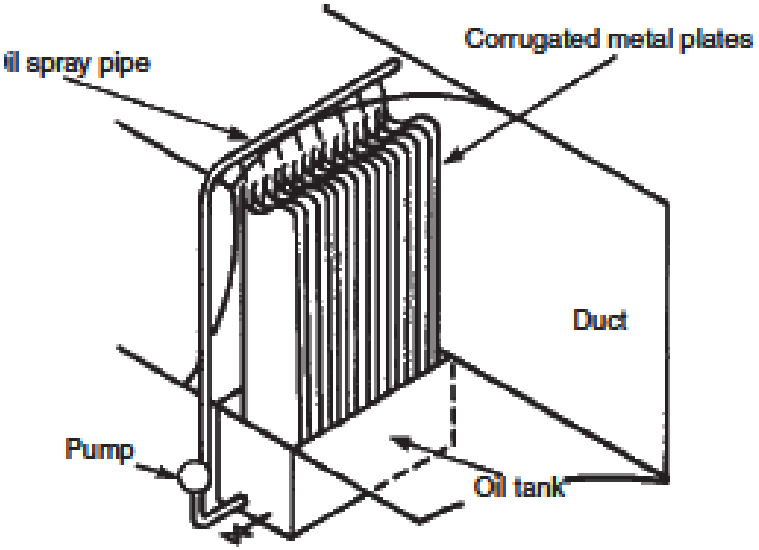


AIR FILTERS

AIR FILTERS

VISCOUS TYPE FILTER

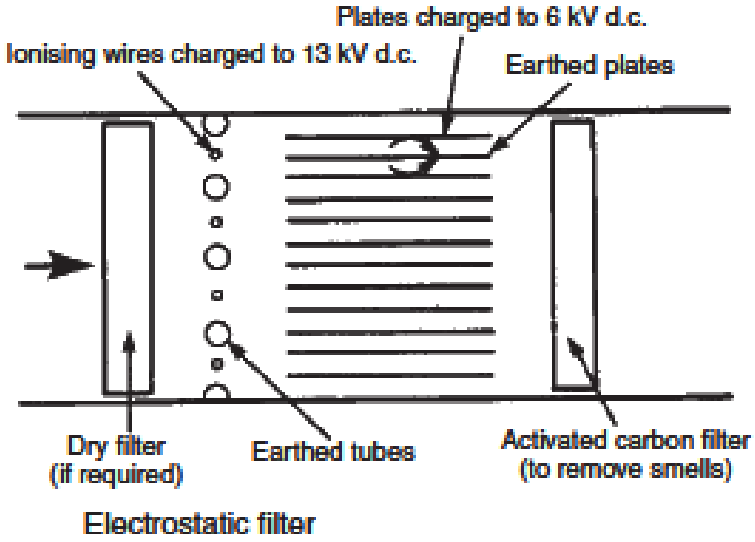
- These have a high dust retention capacity and are often specified for application to industrial situations.
- An improvement on the panel type has close spaced corrugated metal plates continuously sprayed with oil. A rotating variation has filter plates hung from chains.
- The lower plates in the cycle pass through a bath of oil which removes attached particles and resurfaces the plates with clean oil.



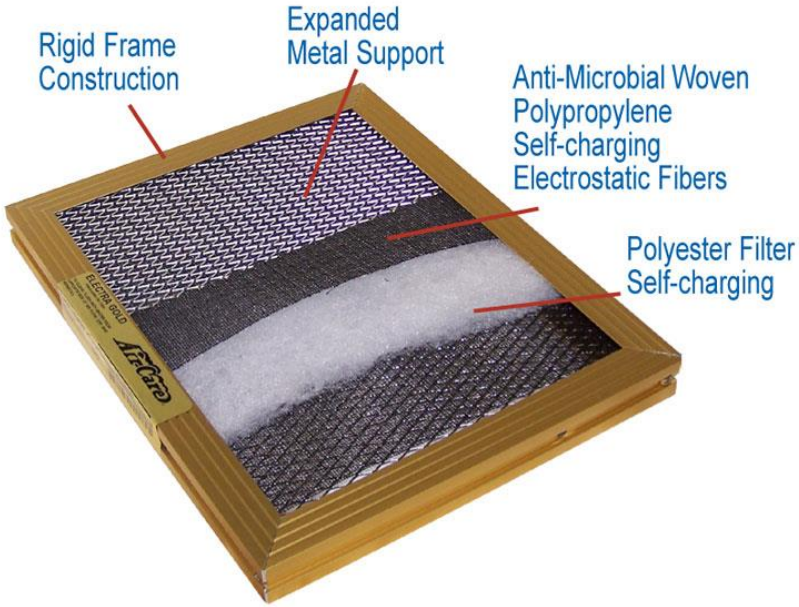
Automatic viscous filter (oil-spray type)

ELECTROSTATIC UNIT TYPE

- This has an ionising area which gives suspended dust particles a positive electrostatic charge.
- These are conveyed in the air stream through metal plates which are alternately charged positive and earthed negative.
- Positively charged particles are repelled by the positive plates and attracted to the negative plates.
- The negative plates can also be coated with a thin layer of oil or gel for greater retention of dust.
- The unit can have supplementary, preliminary and final filters as shown below, giving an overall efficiency of about 99%.



Electrostatic filter



AIR FILTERS

LEV system is usually preferred control method, if:

- Air contaminants pose serious health risk.
- Large amounts of dusts or fumes are generated.
- Increased heating costs from ventilation in cold weather are a concern.
- Emission sources are near the workers' breathing zones.

Jenis sistem ini biasanya merupakan metode pengendalian dianjurkan jika:

- kontaminan udara menimbulkan risiko kesehatan yang serius.
- jumlah besar debu atau asap yang dihasilkan.
- Peningkatan biaya pemanasan dari ventilasi dalam cuaca dingin sering dilakukan.
- Emisi sumber sedikit jumlahnya.
- Emisi sumber yang dekat dengan zona pekerja 'bernapas

Dilution (general) ventilation/Ventilasi Pengenceran Udara		Local exhaust ventilation/Ventilasi pengeluaran setempat	
Keuntungan	Kekurangan	Keuntungan	Kekurangan
Biasanya biaya peralatan dan instalasi,lebih rendah	**Tidak sepenuhnya menghilangkan udara yang berkontaminan.**	**Dapat menghilagkan contaminant pada sumber dan memindahkannya dari tempat kerja.**	**Biaya lebih tinggi untuk desain, instalasi dan peralatan.**
Tidak membutuhkan perawatan yang spesifik/rutin	**Tidak bisa digunakan untuk bahan kimia sangat beracun.**	**Digunakan untuk bahan kimia di udara yang sangat beracun.**	**Memerlukan pembersihan, inspeksi dan pemeliharaan., secara reguler**
Efektif untuk mengontrol jumlah kecil bahan kimia toksisitas rendah.	**Tidak efektif untuk debu atau uap logam atau sejumlah besar gas atau uap.**	**Dapat menangani segala macam kontaminan termasuk debu dan asap logam.**	
Efektif mengontrol gas atau uap yang mudah terbakar .	**Membutuhkan sejumlah besar makeup udara panas atau dingin**	**Membutuhkan upaya yang lebih kecil untuk makeup udara**	
Untuk sumber kontaminan yang tersebar., atau mobile	**Tidak efektif untuk menangani , gas , atau uap, atau emisi tidak teratur**	**Dikurangi biaya energi karena ada kurangnya makeup udara panas atau dingin**	

What is HVAC?

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