JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH

Principles of Ventilation

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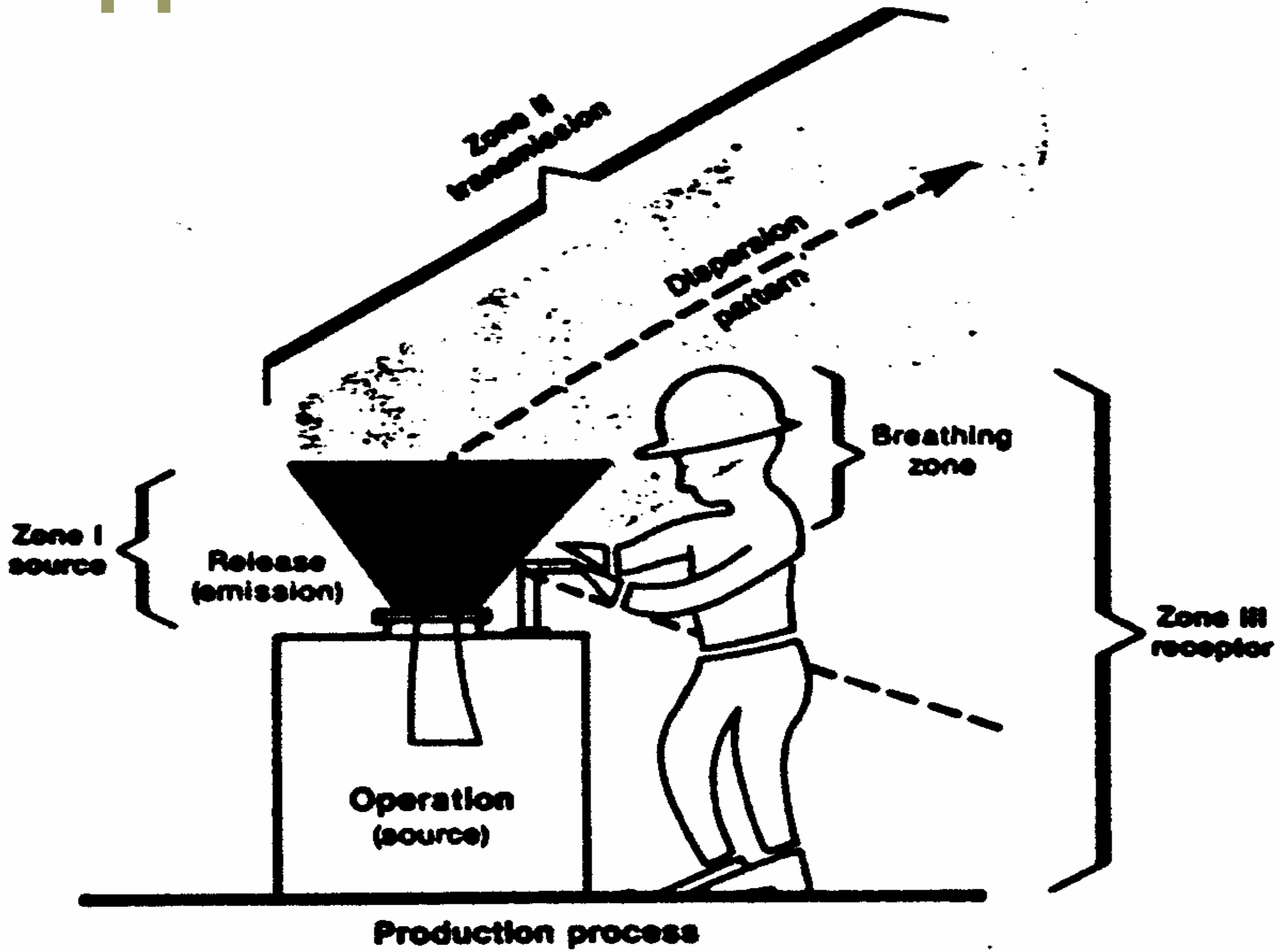
Section A

Introduction

Opportunities for Control



source - transmission - receptor

Source: Peter Lees

Purposes of Industrial Ventilation

- Control of toxic air contaminants to acceptable levels
- Control of noxious odors
- Control of heat and humidity for comfort and health
- Prevention of fire and explosions

Types of Industrial Ventilation

- General ventilation
  - Control of temperature, humidity, and odors
- Dilution ventilation
  - Maintain control of low toxicity gases and vapors below acceptable levels through dilution of concentration

Continued

Types of Industrial Ventilation

- Local exhaust ventilation
  - Capturing and removing contaminants at or near their sources of emission
  - Prevents the transmission of contaminant to worker
  - Given priority in “Hierarchy of Controls”

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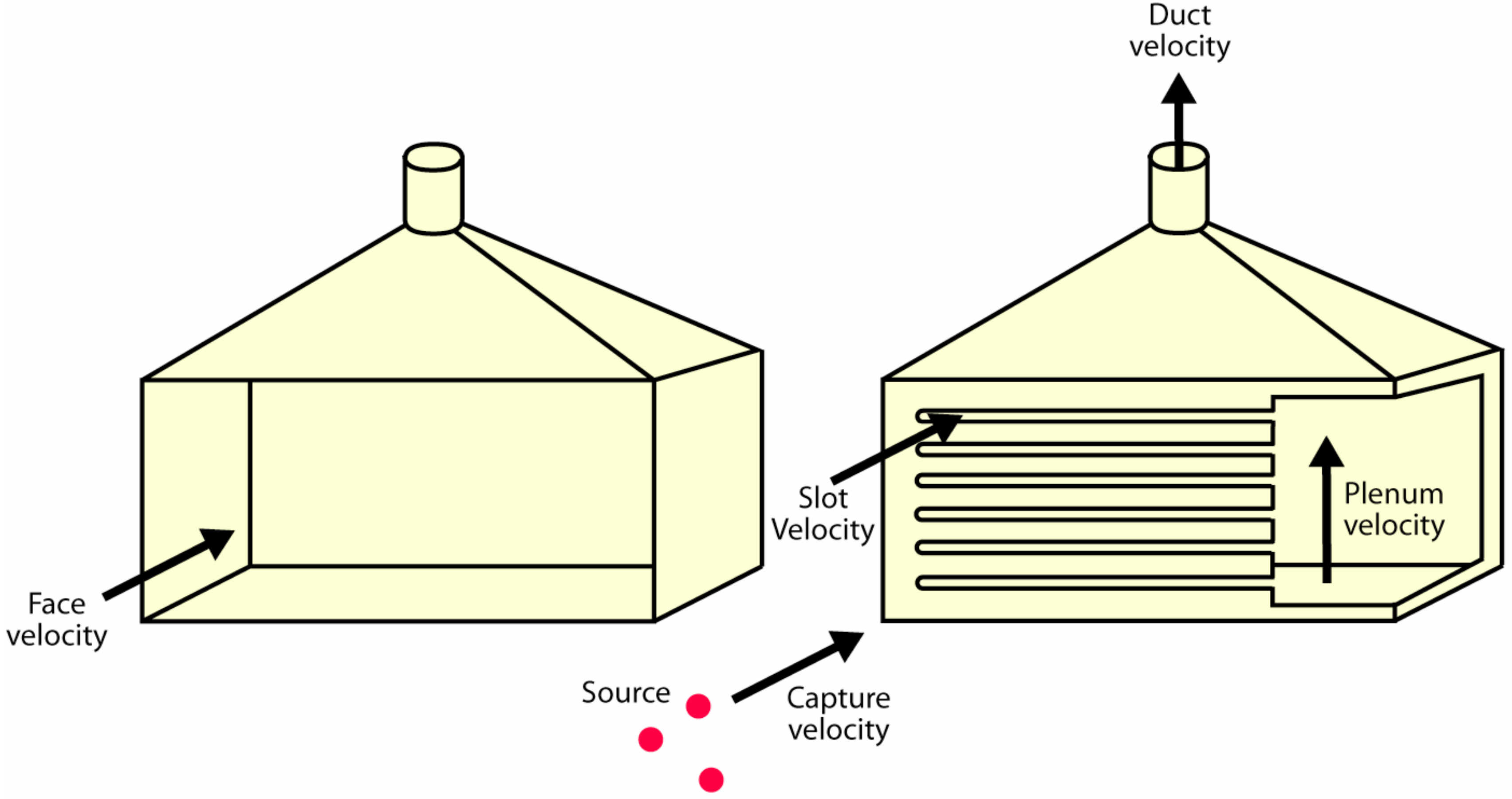
Section B

Ventilation—Basic Principles

Ventilation Terminology



Adapted from ACJH Manual

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Ventilation Terminology

- Capture velocity
  - 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

Continued

Ventilation Terminology

- Face velocity
  - Air velocity at the hood or slot opening
  - An important design parameter
  - Surrogate marker of performance (i.e., can be tested)

Continued

Ventilation Terminology

- Duct velocity
  - Air velocity through the cross-section of the duct
  - Must be sufficient to prevent gravitational settling of particulate contaminants
  - Important design parameter
  - Can be measured

Basic Ventilation Equation

$$Q = A*V$$

- Where:
  - Q = air flow rate (ft3/min)
  - A = cross-sectional area of duct or opening (ft2)
  - V = average air velocity (ft/min)
- Also referred to as continuity equation

Continued

Basic Ventilation Equation

$$Q = A*V$$

- Example
  - If fan is unchanged and number of hoods is doubled, then the resulting hood face velocities will be 1/2 original velocity (possibly reducing air velocity to less-than-needed capture velocity)

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Section C

Ventilation—Design and Testing

Hood Proximity and Exhaust Volume

- To maintain desired capture velocity, locate hood as close to source as possible
- Air volume requirement increases as square of the distance
- Reduces required make-up air and associated costs

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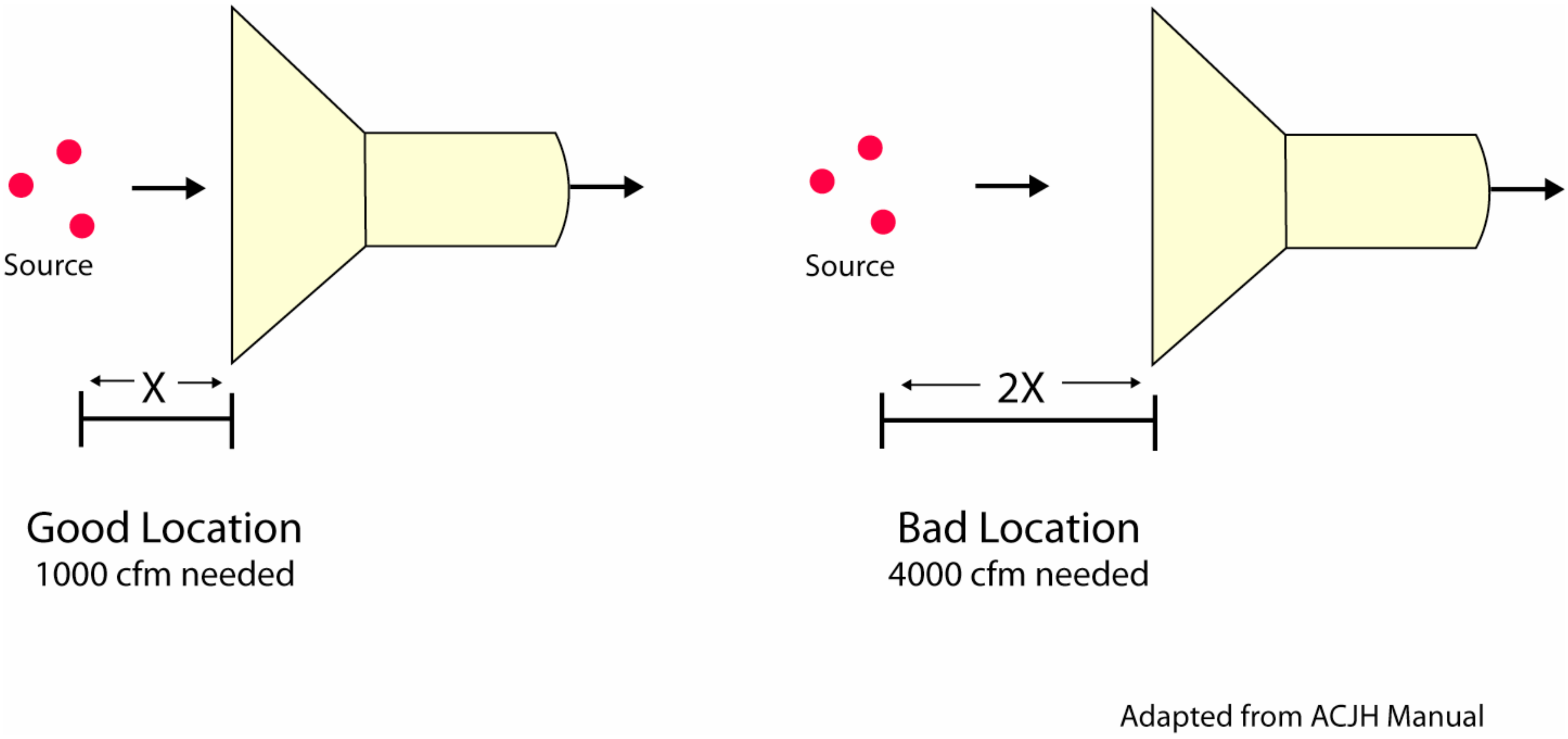
Hood Proximity and Exhaust Volume



Use 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

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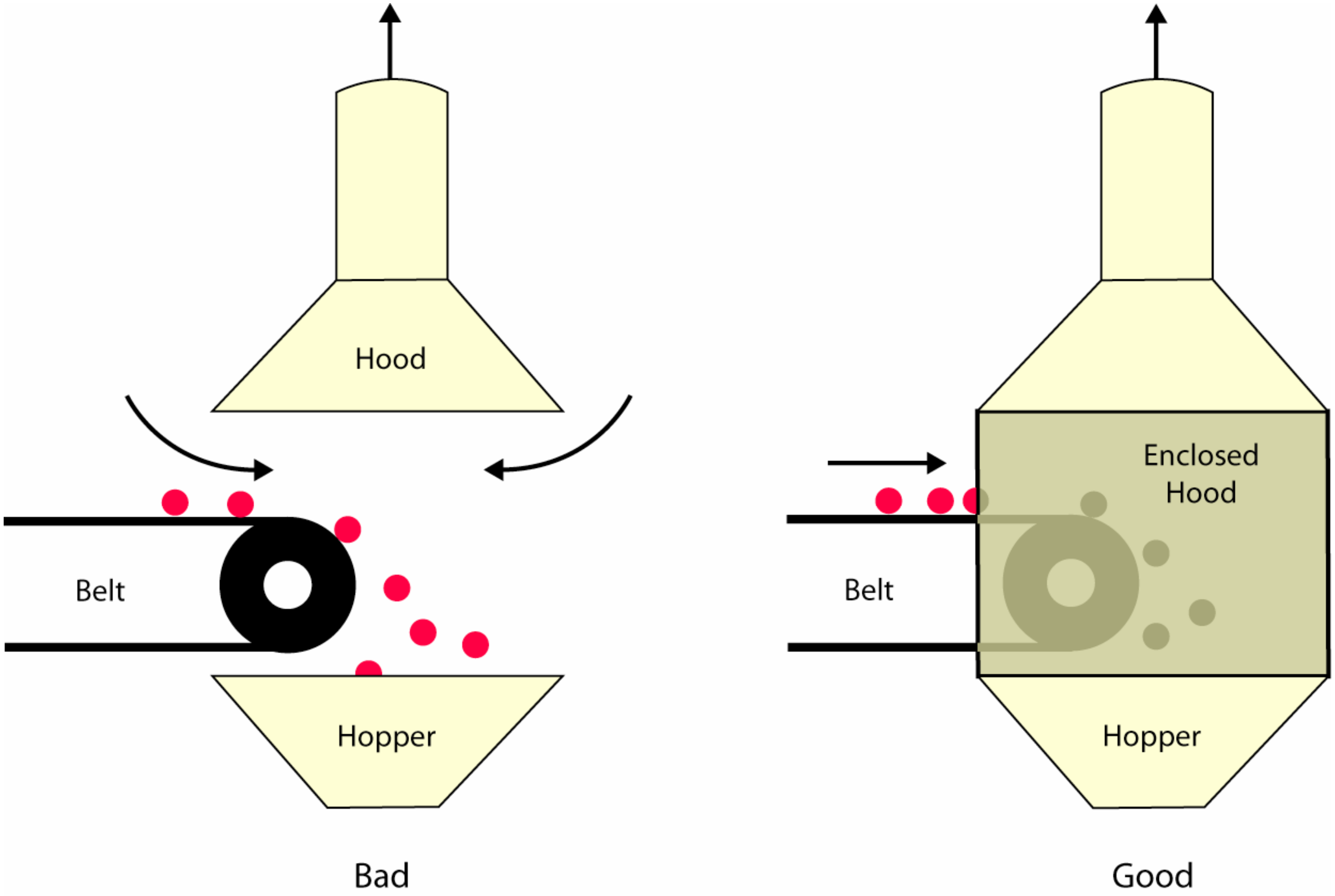
Use of Enclosures



Adapted from ACJH Manual

Direction of Air Movement

- Direction of air movement should carry air contaminants away from breathing zone
- Results in reduced worker exposure
- Results in better hood capture performance

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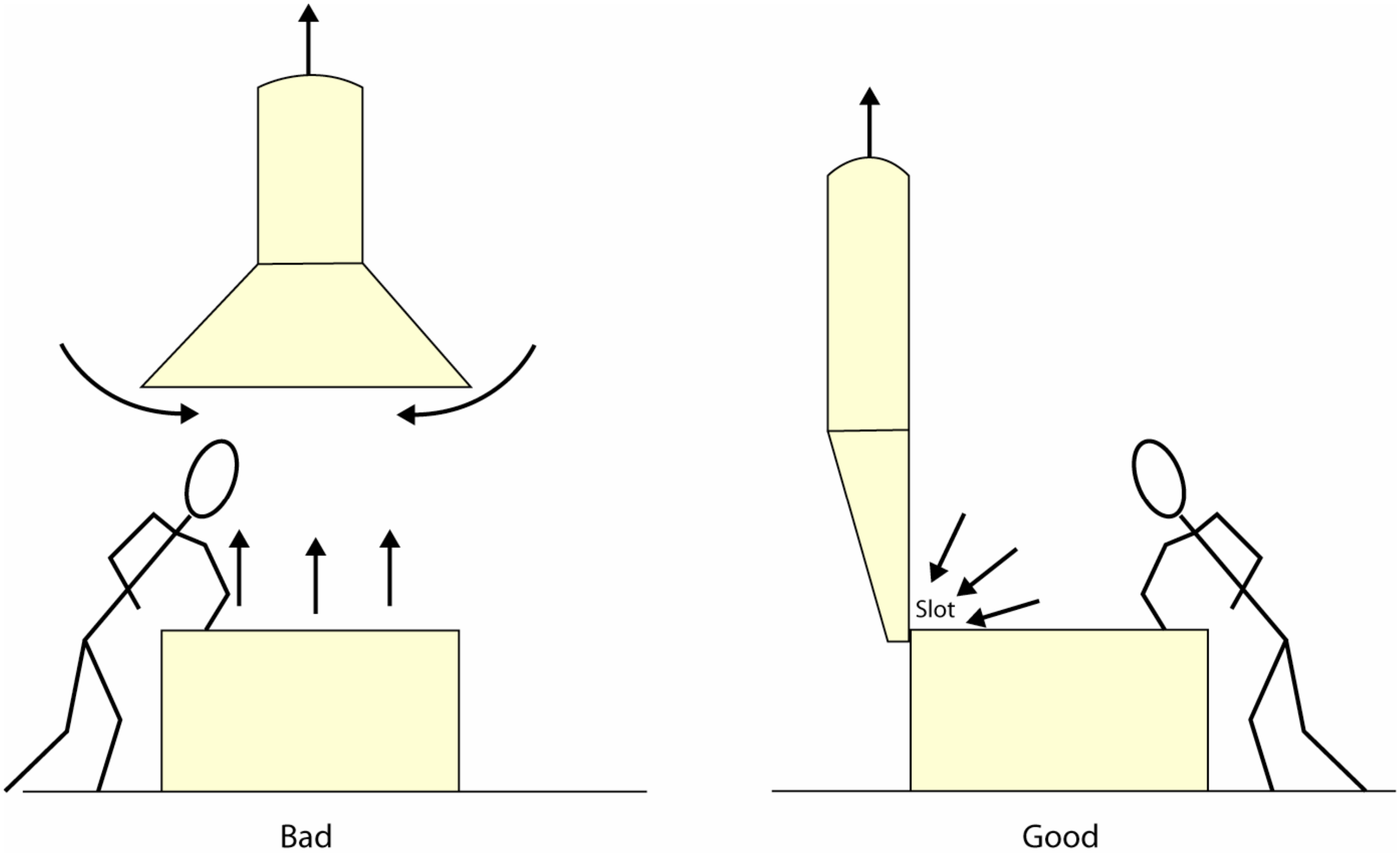
Direction of Air Movement



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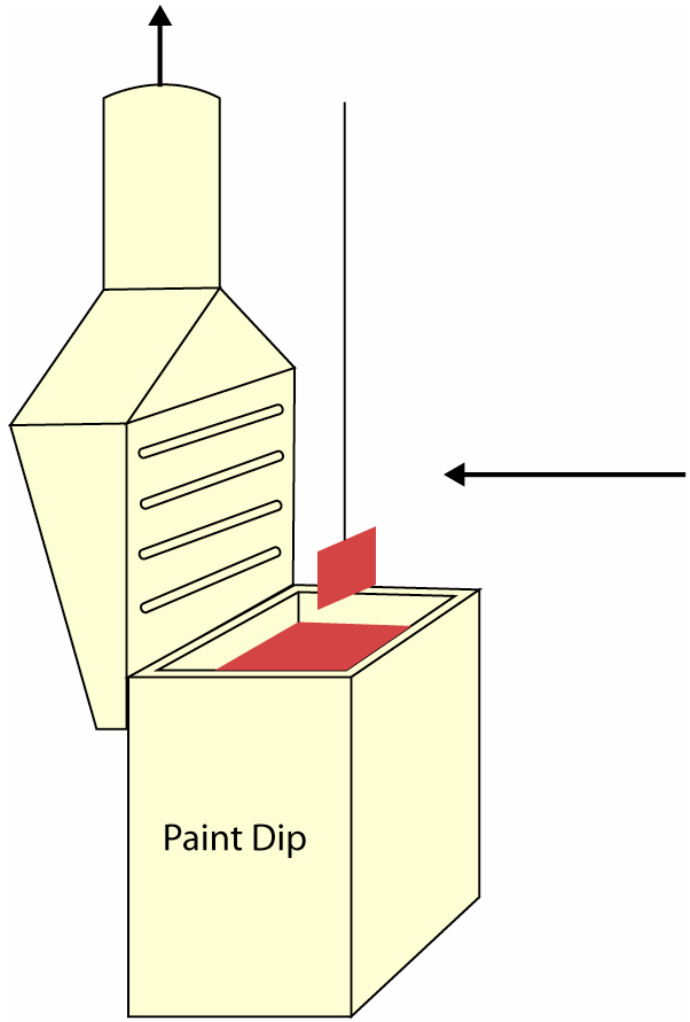
Direction of Air Movement



Adapted from ACJH Manual

Design Velocities

- All ventilation systems are designed to operate most effectively within a given air-flow range
- Usually measured by hood face velocity
  - Laboratory hood = 75–100 ft/min
- Operation at other than design velocities can often have unintended (bad) consequences

Continued

Principles of Supply Air Design

- Supply air volume = exhaust air volume (balanced)
- Avoid interference with exhaust hoods (currents and eddies may compromise exhaust systems)
- Air enter at living zone

Continued

Principles of Supply Air Design

- Supply air must be conditioned (temperature and humidity)
- Air entry points located away from source of contaminants to eliminate air currents which could interfere with exhaust

Testing Ventilation Systems

- Ensure it meets design criteria
- Comply with regulatory standards
- Determine system balance
- Determine if maintenance or repair required
- Determine whether existing system is capable of handling additional hoods