

Lesson Topic 2.2

VENTILATION

Introduction

As Gas Free Engineer Personnel you will be required to know the various methods and equipment used for ventilation in preparation for and during gas free operations.

Enabling Objectives

- **Describe General, Dilution, Supply, Exhaust, and Local Exhaust ventilation and required air changes prior to entry into an enclosed and/or confined spaces in accordance with NSTM Chapter 074 Vol. 3, Gas Free Engineering.**
- **Describe the characteristics, maintenance, and safety precautions for the Ramfan 2000 blower in accordance the RAM FAN manufacturer's technical manual.**

Enabling Objectives

- **Describe how to perform set-up procedures to include the determination of the number of blowers required, Location of blowers, Layout of exhaust ducting in accordance with NSTM Chapter 074 Vol. 3, Gas Free Engineering.**
- **Calculate the rate of exhaust ventilation or supply air needed to provide adequate ventilation in accordance with NSTM Chapter 074 Vol. 3, Gas Free Engineering.**

Ventilation is defined as the introduction and movement of fresh air into a space to remove contaminated air, or to control the temperature of the space or tank.

COMBUSTION THRESHOLDS

TEMPERATURE



**Ignition
Temperature
Is?**

Minimum temperature at which self sustained combustion occurs without an external ignition source.

**Fire Point
Is?**

Temperature at which sufficient vapors are released to support continuous combustion once ignited.

**Flash Point
Is?**

Minimum temperature at which sufficient vapors are released to form an ignitable mixture.

Ventilation is required for

- Steaming of tanks
- Cleaning of tanks
- Oxygen deficient atmospheres
- Explosive atmospheres
- Toxic atmospheres
- After fire
- Routine movement of air aboard ships

VENTILATION - LIMITATIONS

- Flammable, O₂ deficient or enriched atmospheres are the result of inadequate natural or mechanical ventilation
- Ship configuration, portable blowers availability, duct limits restrict ventilation
- Providing temporary ventilation using portable fans or blowers can limit hazards to an acceptable level

VENTILATION OBJECTIVES

- Remove contaminated air from space
- Limit flammable atmospheres to 10% or less of LEL
- Limit toxic concentrations to PEL
- Capture & remove contaminants or dilute to safe levels
- Provide fresh, breathable air for health and comfort

VENTILATION PRIOR TO ENTRY

“There will be a minimum of *two air* changes prior to entry into a confined space unless installed ventilation is in operation”

NSTM 074-21.3

EXAMPLE

- SPACE 20ft X 10ft X 10ft = 2000 ft³
- RAMFAN VOLUMETRIC FLOW RATE = 2000 FT³ / MIN
- How many minutes needed for two complete air changes?
- **2 MINUTES NEEDED FOR 2 COMPLETE AIR CHANGES**

Types of Ventilation

WARNING: PRIOR TO ANY VENTILATION, THE GFE MUST DETERMINE IF THE SPACE PRESENTS AN UPPER EXPLOSIVE LIMIT (UEL) DANGER. IF A UEL CONDITION OR THE POTENTIAL EXISTS, HAVE APPROPRIATE FIREFIGHTING ASSESTS STANDING BY. PROCEED WITH CAUTION. SECURE THE HEAT OR FUEL SOURCE AS THE SITUATION DICTATES AND RIG GROUNDED EXHAUST VENTILATION.

Types of Ventilation

◆ Natural

» The natural movement of air throughout a space.

◆ Mechanical

» The use of electrical or pneumatic fans

» Provides supply or exhaust air

Types of Ventilation

◆ Supply

- » Moving fresh air into a space or compartment and displacing contaminated air through any available opening.

Types of Ventilation

WARNING: NEVER BLOW AIR INTO A SPACE THAT CONTAINS FLAMMABLES, TOXIC PARTICLES OR TOXIC ATMOSPHERES.

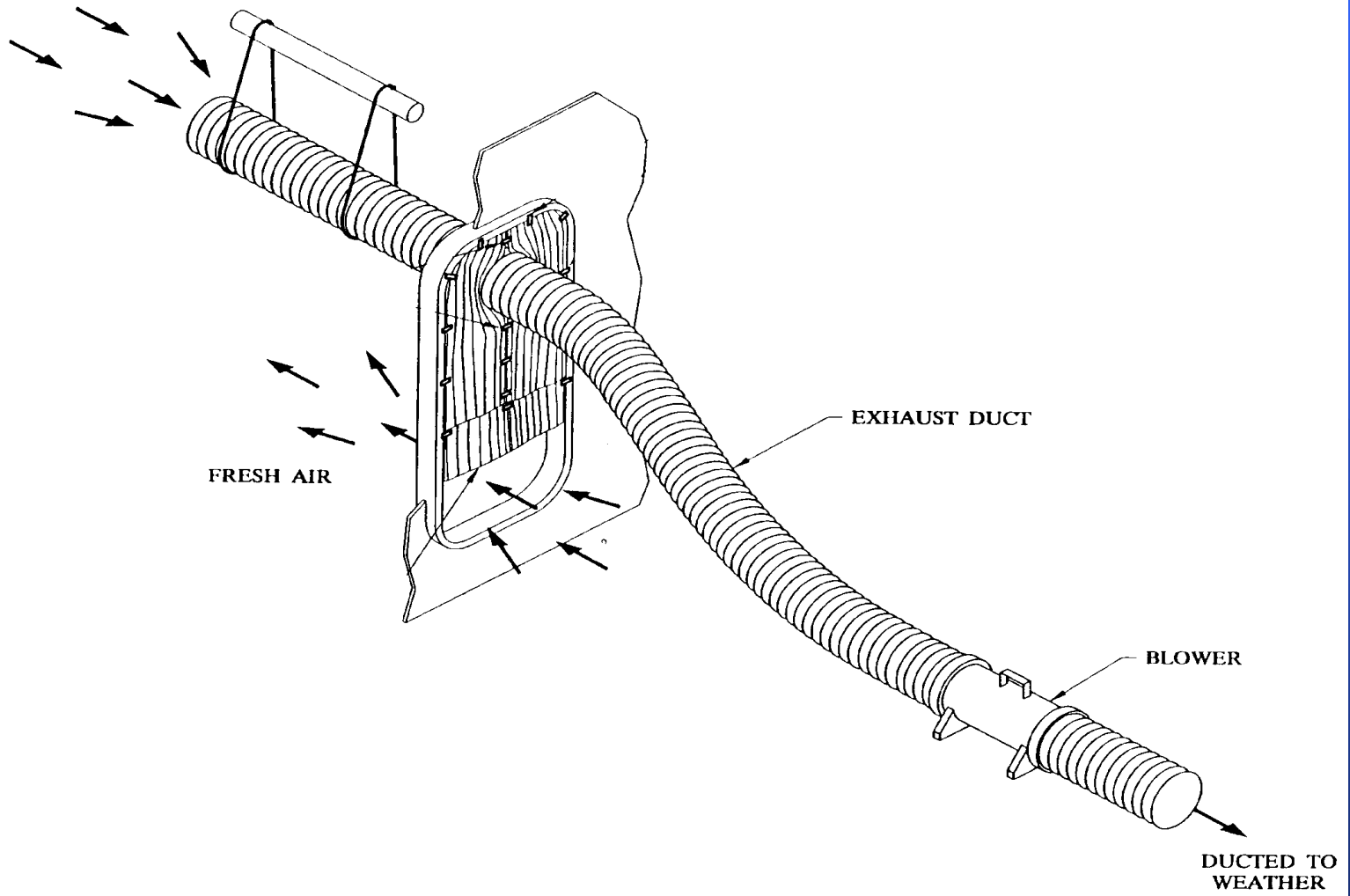
Types of Ventilation

◆ Exhaust

- » Removing air from a space or compartment.
- » Less efficient air movement than supply.
- » Better method of control and removal of particle contaminants.

EXHAUST CONFIGURATION PREFERRED OVER SUPPLY

- Supply can produce a static charge build-up
- Supply could introduce foreign objects into space
- Supply can result in contamination of adjacent spaces



Types of Ventilation

◆ General

- » Provides uncontaminated air for breathing and to maintain general comfort of personnel.
- » It may be used to maintain concentrations of toxic and flammable atmospheres at acceptable levels where the sources of such contaminants are small and evolution of airborne contaminants is low.
- » The requirement for general ventilation is one complete air change every three minutes.

Types of Ventilation

◆ General ventilation

Note: In a confined space there will be two complete air changes prior to entry.

Types of Ventilation

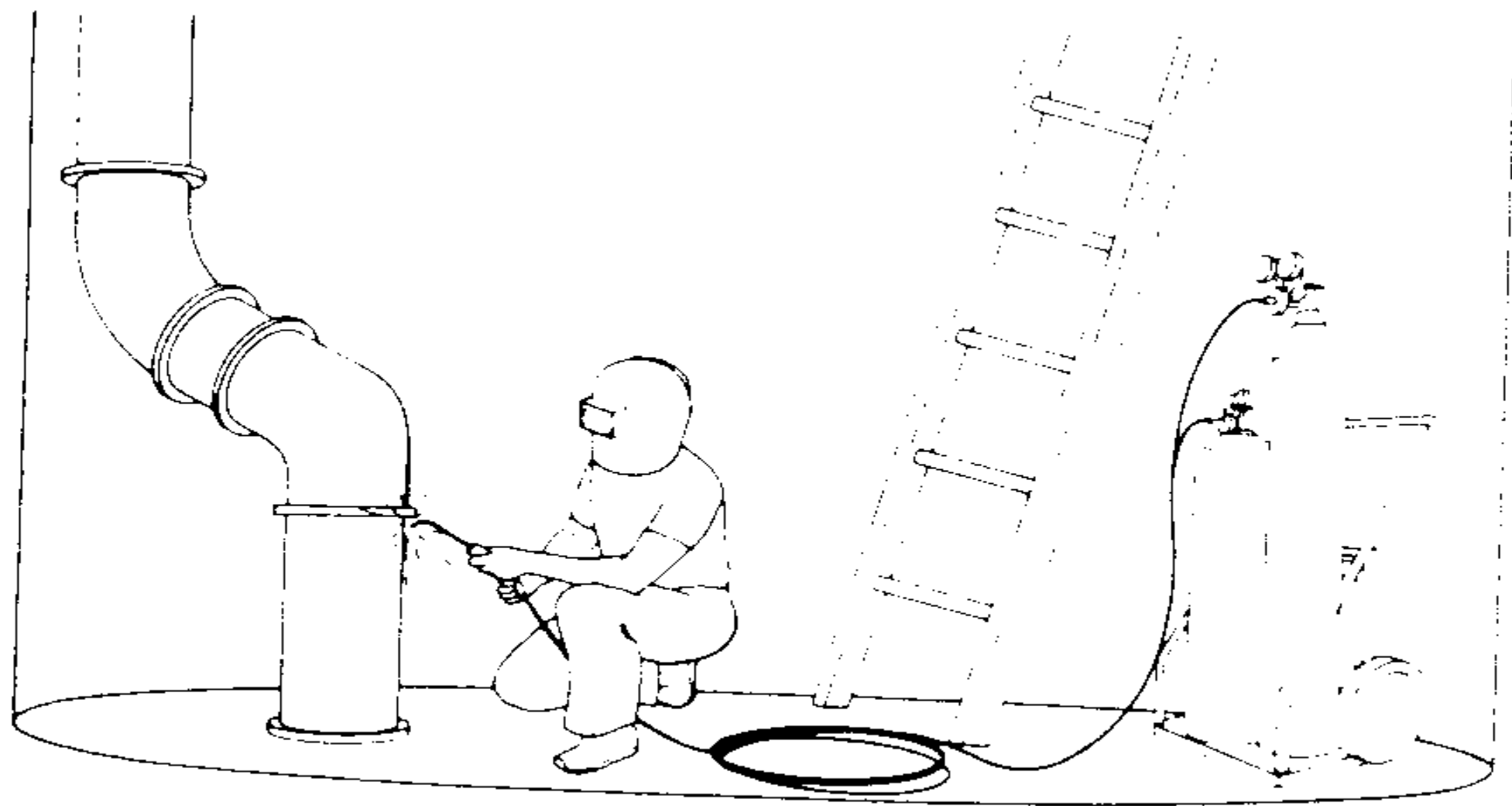
◆ Local exhaust

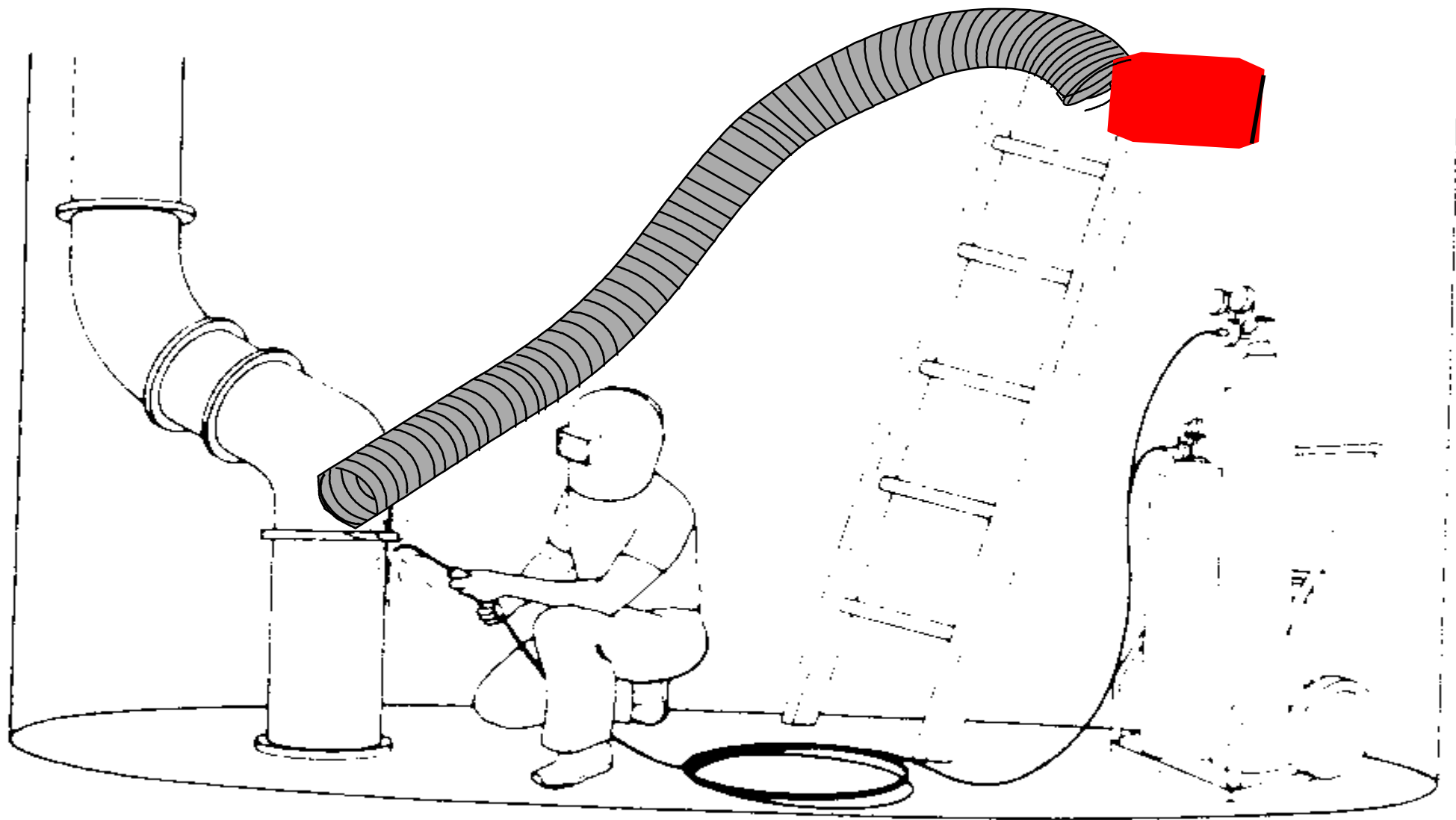
- » Positioning exhaust intake 6 - 10 inches from the work area to draw or carry contaminants away.

Types of Ventilation

◆ Local exhaust

- » Positioning exhaust intake 6 - 10 inches from the work area to draw or carry contaminants away.
- » To be effective, the work zone farthest from the exhaust inlet requires an air flow of 100 feet per minute (FPM) towards the exhaust.





Types of Ventilation

WARNING: ALWAYS SUPPLY PERSONNEL WITH NIOSH APPROVED RESPIRATORY PROTECTION EQUIPMENT FOR WORKING WITH HIGHLY TOXIC MATERIALS SINCE EVEN SLIGHT VENTILATION SYSTEM TROUBLE MAY RESULT IN SIGNIFICANT PERSONNEL EXPOSURE

Types of Ventilation

◆ Dilution

- » Used to draw air out of a space with portable ventilation and replacing the stagnant air with fresh air drawn in by natural air circulation.

Types of Ventilation

◆ Dilution

- » Used to draw air out of a space with portable ventilation and replacing the stagnant air with fresh air drawn in by natural air circulation.
- » Used when effective local exhaust ventilation is impossible due to the nature of the space or other factors.

**WARNING: RESPIRATORY PROTECTION MUST
BE WORN**

DILUTION VENTILATION VOLUME FORMULA

- **One complete air change every 3 minutes**
- **If welding, results compared to NSTM 074 vol 3 requirements on page 21-6**

DILUTION FOR SPRAY PAINTING

- ◆ Ventilation shall dilute contaminants to 10% or < of the LEL
- ◆ Ventilate *continuously* during and then afterward
- ◆ Test as necessary during operations
- ◆ If concentrations of flammable vapors exceeds 10% of the LEL, **STOP** operations, continue ventilation

SERIAL # 98-00001

INITIAL CERTIFICATE

SHIP/UNIT/ACTIVITY: USS NAVIN R. JOHNSON

ITEM/COMPARTMENT/SPACE: CHAIN LOCKER (5-8)

TYPE OF OPERATION TO BE CONDUCTED: CLEAN

INITIAL DATE OF TEST: HOUR: 300

INITIAL EXPIRATION: HOUR: 2100

VENTILATION REQUIRED: YES

TYPE: DILUTION - 1 RAM/AN EXHAUSTING

THROUGH WTD 4-92-1 TO WEATHER. CO

OPERATION WHILE PERSONNEL IN SPA

INERTED GAS: N/A

OR
PRESSED UP WITH: N/A

REQUIREMENTS/CONCLUSIONS/PRESCRIBED PRECA

ALL PERSONNEL USE RHINE AIR PUMP, A

ALLS. RE-INSPECT EVERY TWO HOURS.

OBSERVER MAINTAIN COMMS WITH WO

RESCUE CONTROL POINT USING WIFCO

3 Ventilation Options:

Local Exhaust Ventilation:

Ex.: Welding,

Painting,

Using Solvents

Dilution Ventilation

Ex.: Reducing Toxins,

Controlling Flammable Vapors

General Exhaust Ventilation

*Ex.: Providing Cool Comfort Air in a
Hazard-Free Atmosphere*

Air Moving Devices

Air Moving Devices

- Installed or fixed systems
 - Not designed for GFE applications.
 - Can be used with restrictions:
 - » Chief engineers permission
 - » Does not discharge into another space.
 - » All ducting is inspected prior to use.

Air Moving Devices

- Portable ventilation equipment
 - Ram Fan 2000
 - » Operated by pressurized water (Between 40-180 PSI)
 - » Lightweight - 35 lbs
 - » Rated at 2000 CFM
 - » Explosion proof
 - » 1 1/2" swivel inlet and outlet fitting



Air Moving Devices

■ Maintenance

- Inspections should be made on a planned schedule to check operation of equipment.
- A preventive maintenance system schedule that calls for thorough regular checks on all ventilation equipment will prevent costly slowdowns and work stoppages due to breakdowns on the job.

Fan and Ducting Locations

VENTILATING FLAMMABLE ATMOSPHERES

- **Equipment explosion proof or intrinsically safe**
- **Equipment grounded to control static electricity**

BLOWING VS DRAWING

**“NEVER BLOW AIR INTO A SPACE WHICH
CONTAINS FLAMMABLE OR TOXIC PARTICLES”**

NSTM 074-21.6.4



**WHEN MAY I BLOW AIR INTO
A SPACE?**

BLOWING AIR

- ❏ No flammables present or being generated**
- ❏ No toxics present or being generated**
- ❏ Only to provide clean air for breathing and comfort**

DUCTING

- Greater length and bends results in greater friction
- Maximum of three 15 ft ducts per fan



Fan and ducting locations

- Exhaust fans or blowers shall be located on the weather deck whenever possible so that the exhaust ducts within the ship are under negative pressure.
- Locating fans or blowers at the exhaust inlet would result in a positive pressure on exhaust ducts and potential leakage of flammable or toxic atmosphere into other ship spaces.

Fan and ducting locations

- General considerations in selecting a blower are:
 - Volume of air to be moved
 - Type and amount of motive power available
 - Initial atmospheric test results
 - Potential hazards

Fan and ducting locations

■ Duct work

- Duct work and tubing are necessary in most ventilation systems to direct, hold pressure, and contain the supplied or exhausted air.
- Arrangement, position, and direction are important. Duct work should be as short as possible, with bends and elbows at a minimum, to reduce friction loss.

Fan and ducting locations

■ Duct work

– Types of duct work

» Galvanized sheet metal duct

- ☞ Used in large jobs

- ☞ Most effective

» Non-collapsible tubing

- ☞ Restricted spaces

Fan and ducting locations

- Duct work

- Types of duct work (Cont'd)

- » Collapsible tubing

- Discharge side of fan

- » Flexible metal hose

- Used for suction or discharge

- Good for local exhaust in welding and burning operations

- Comes in various lengths and sizes

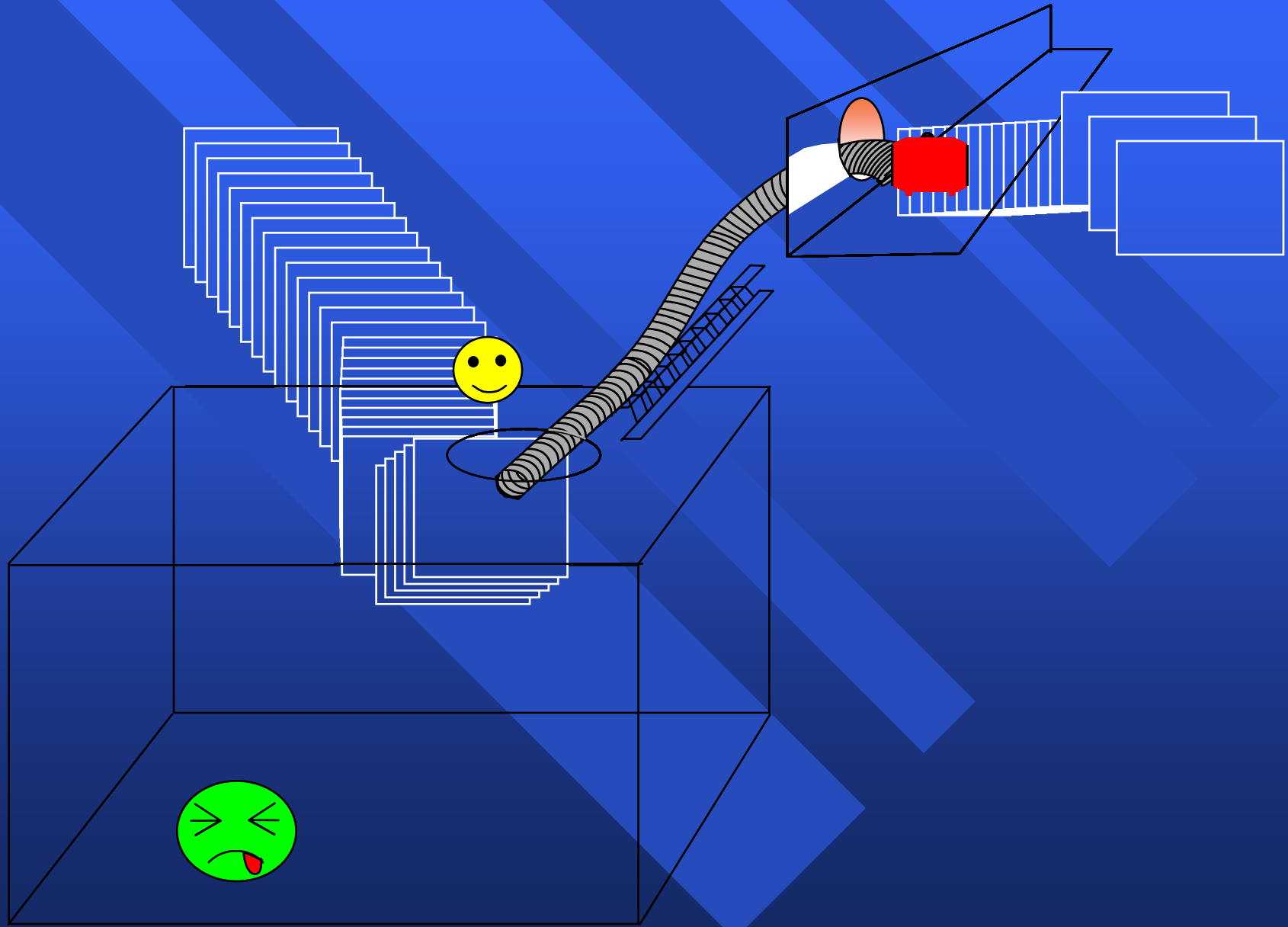
Ventilation situations and duct locations

SHORT CIRCUITING

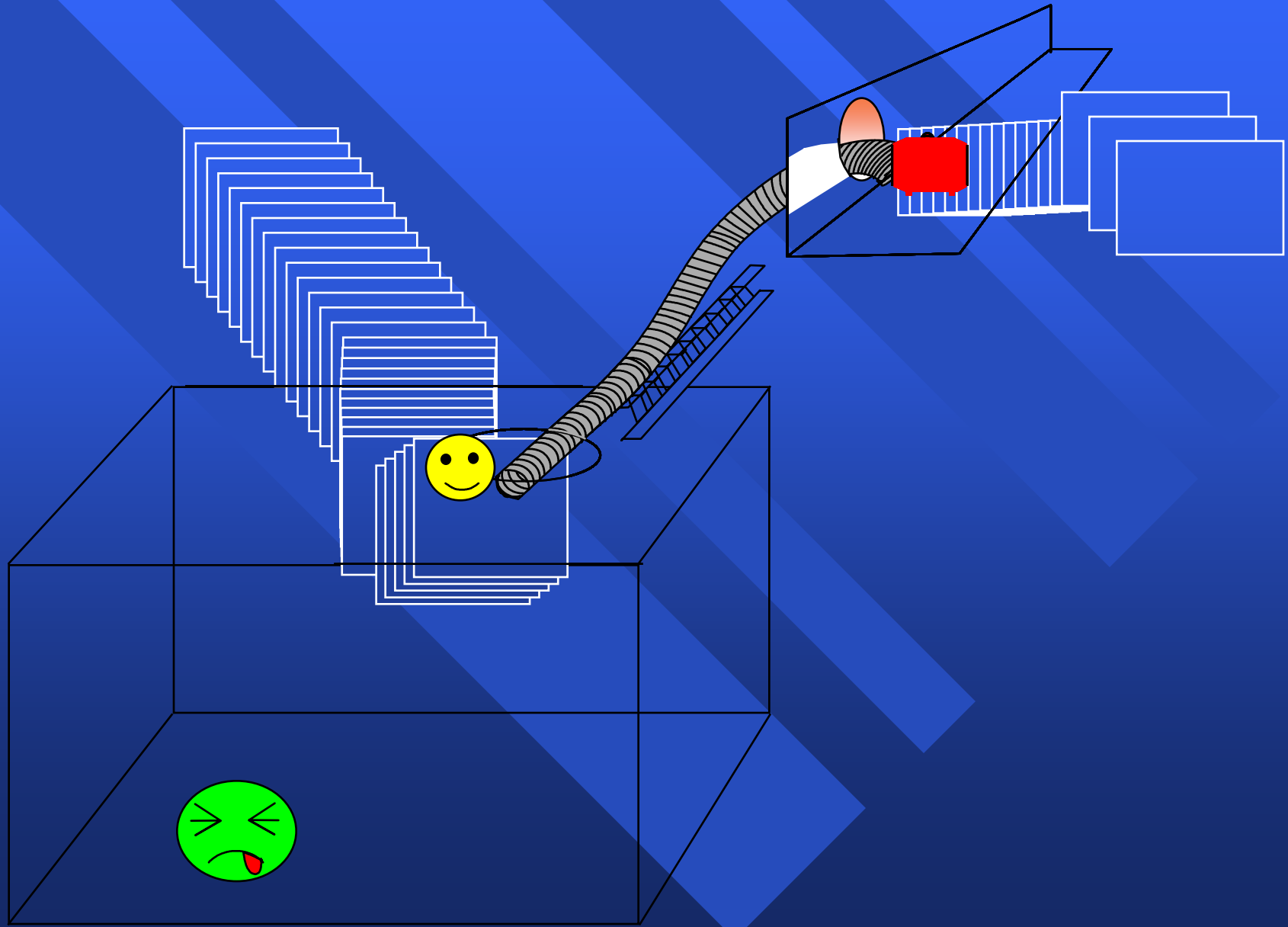
- Source of make up air is too close to the exhaust trunk
- Effective volume ventilated is insufficient
- Remedy?

Place trunk further into space

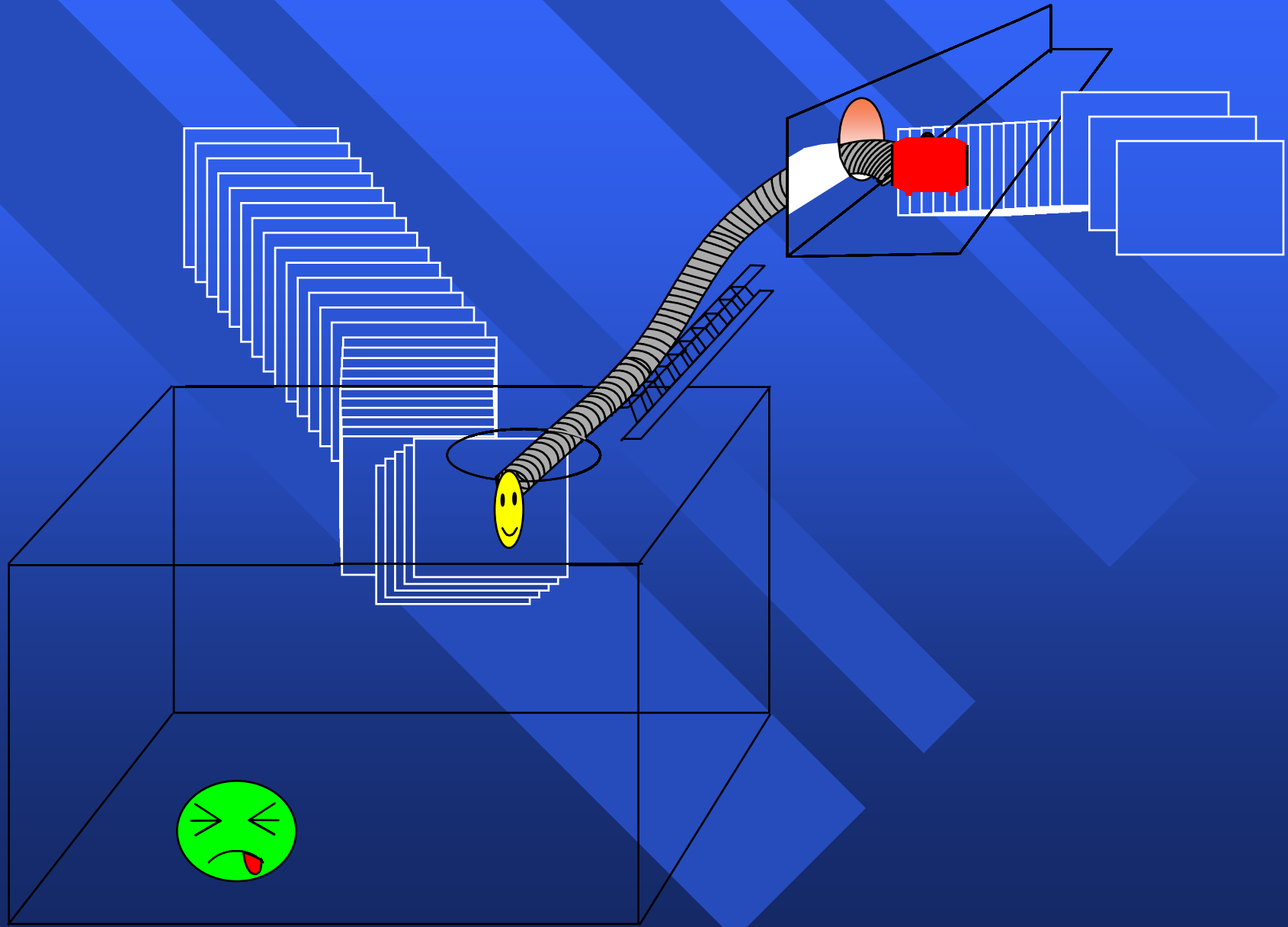
SHORT CIRCUITING



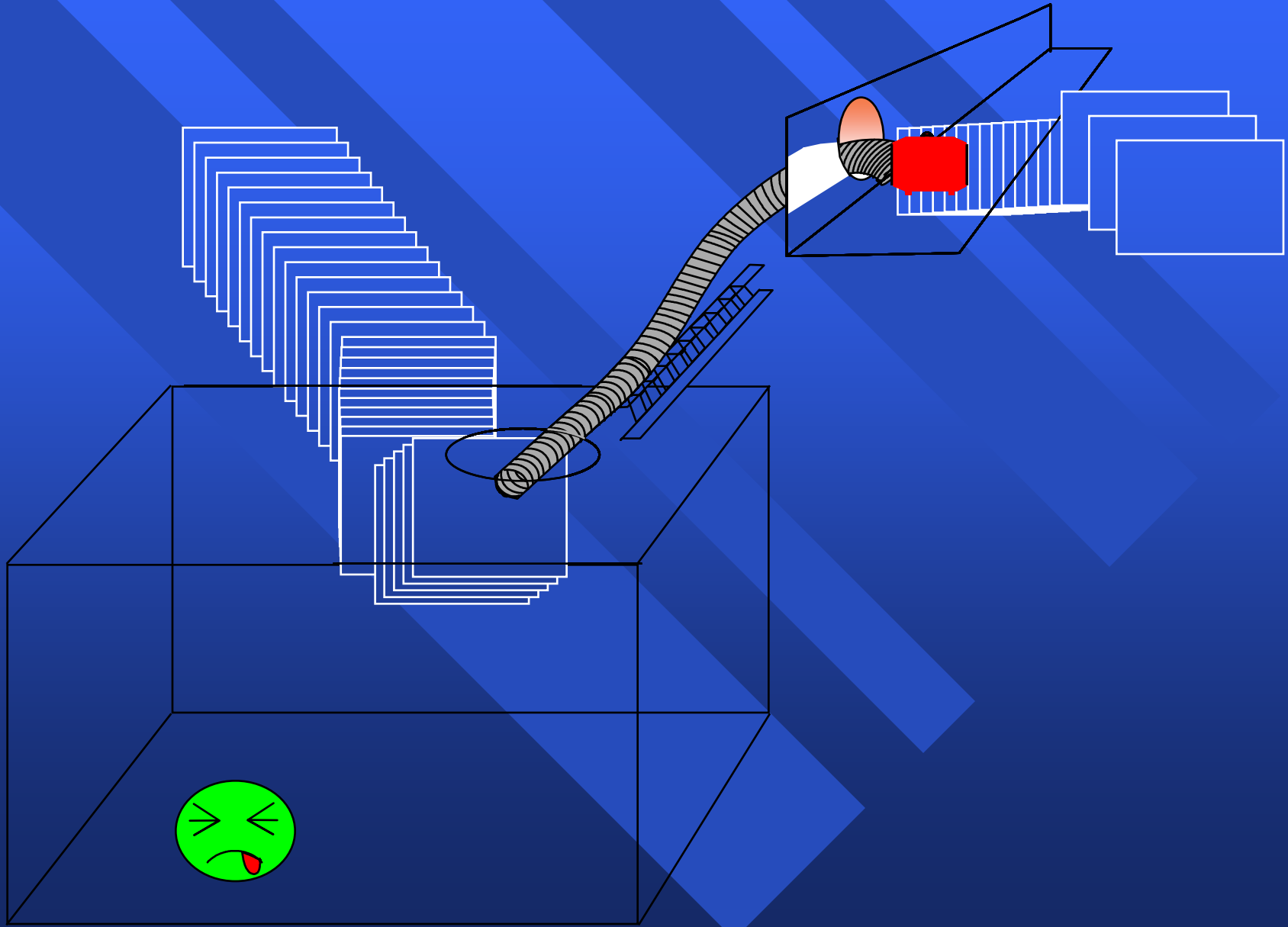
SHORT CIRCUITING



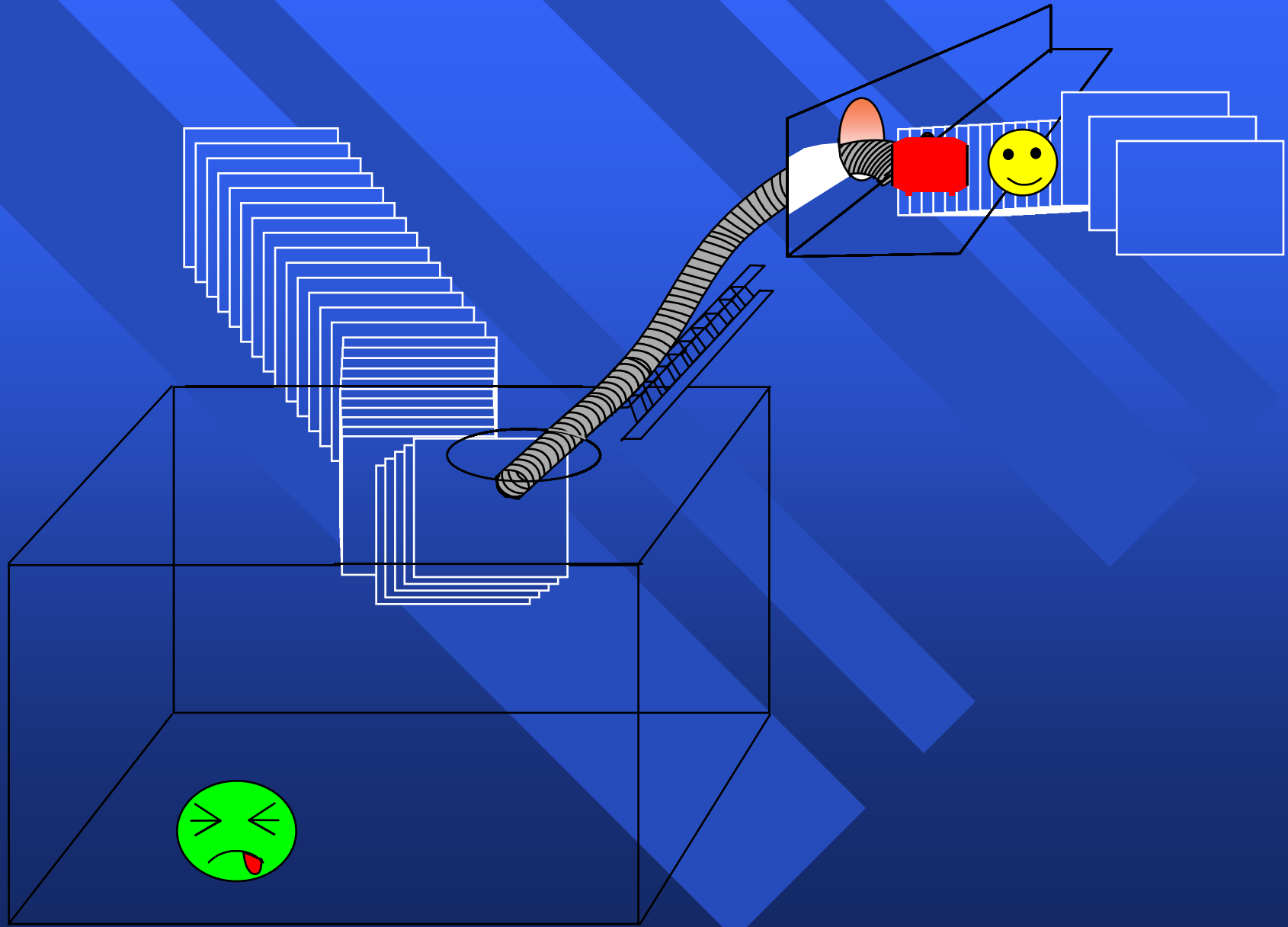
SHORT CIRCUITING



SHORT CIRCUITING



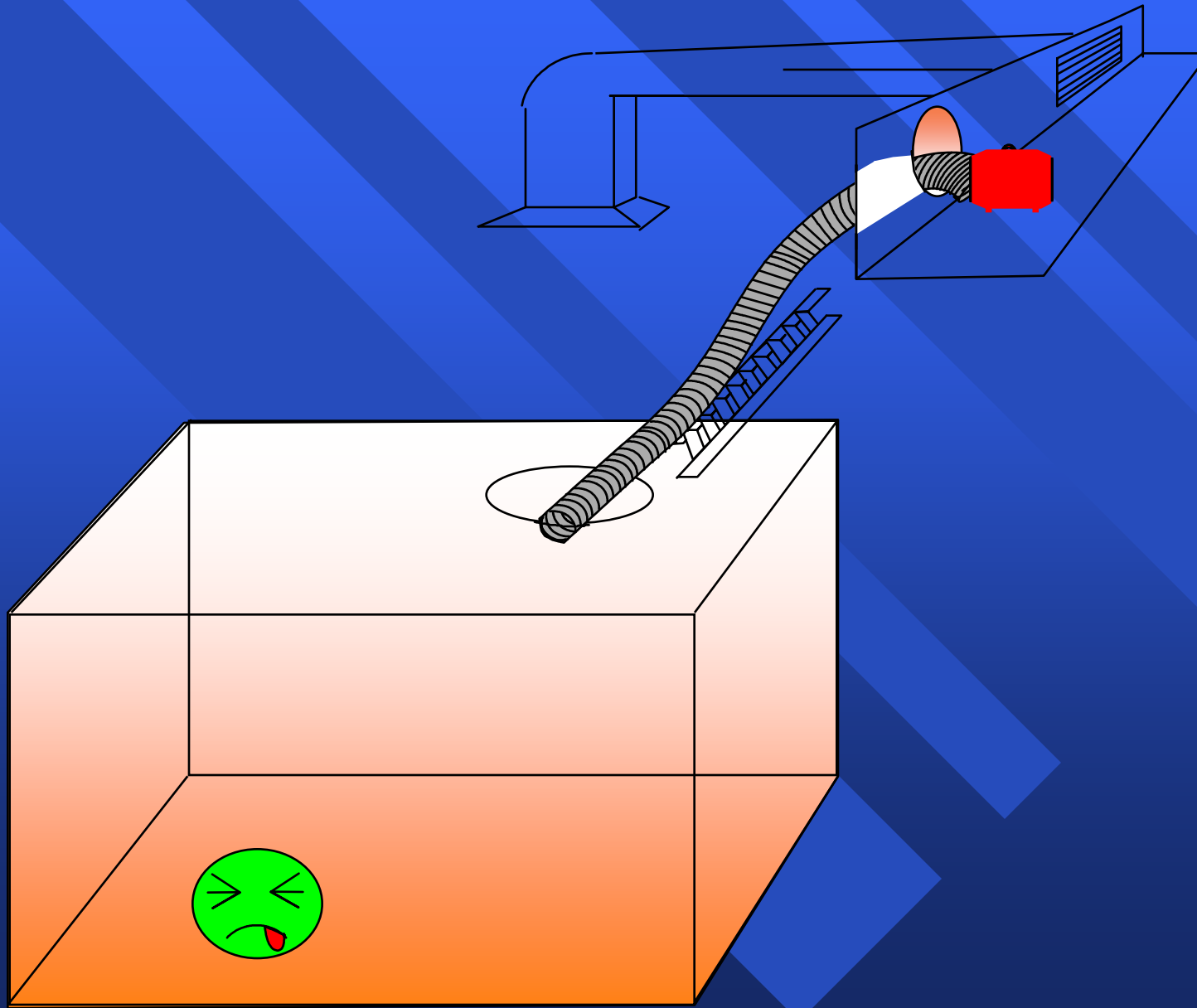
SHORT CIRCUITING



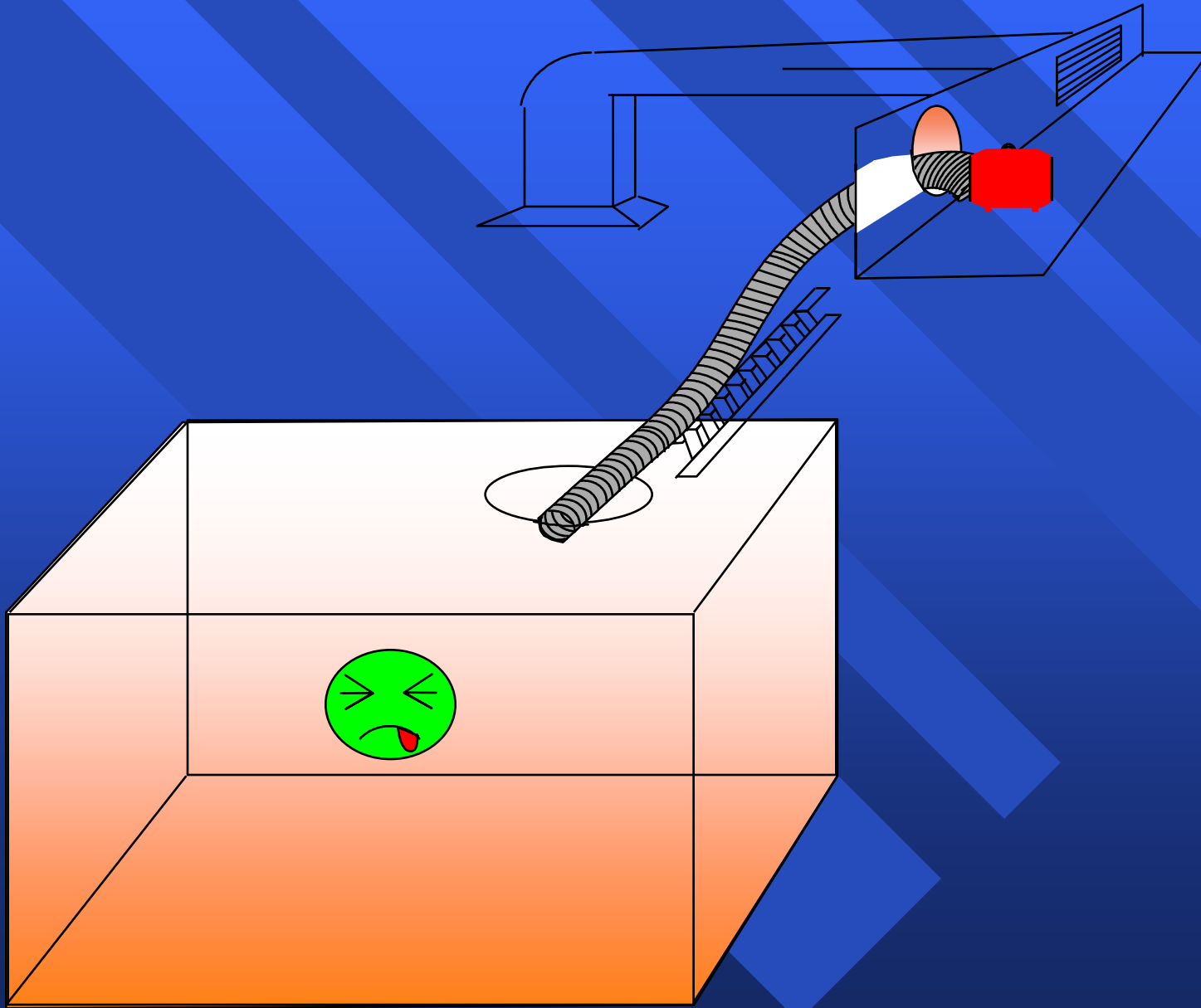
RECIRCULATION OF CONTAMINATED AIR

- Exhaust discharge is drawn back into the make-up air
- Drawn back into space

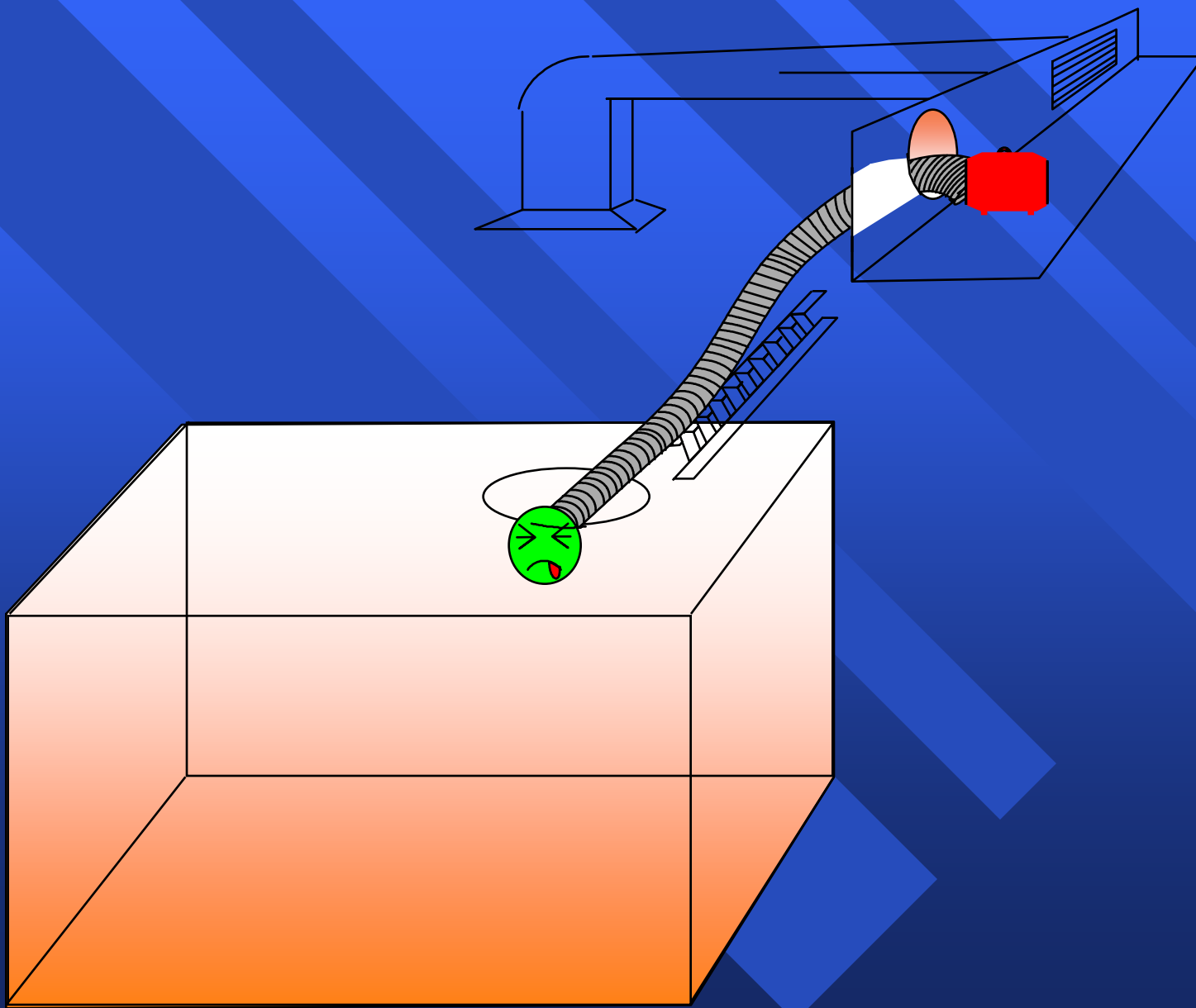
RECIRCULATION



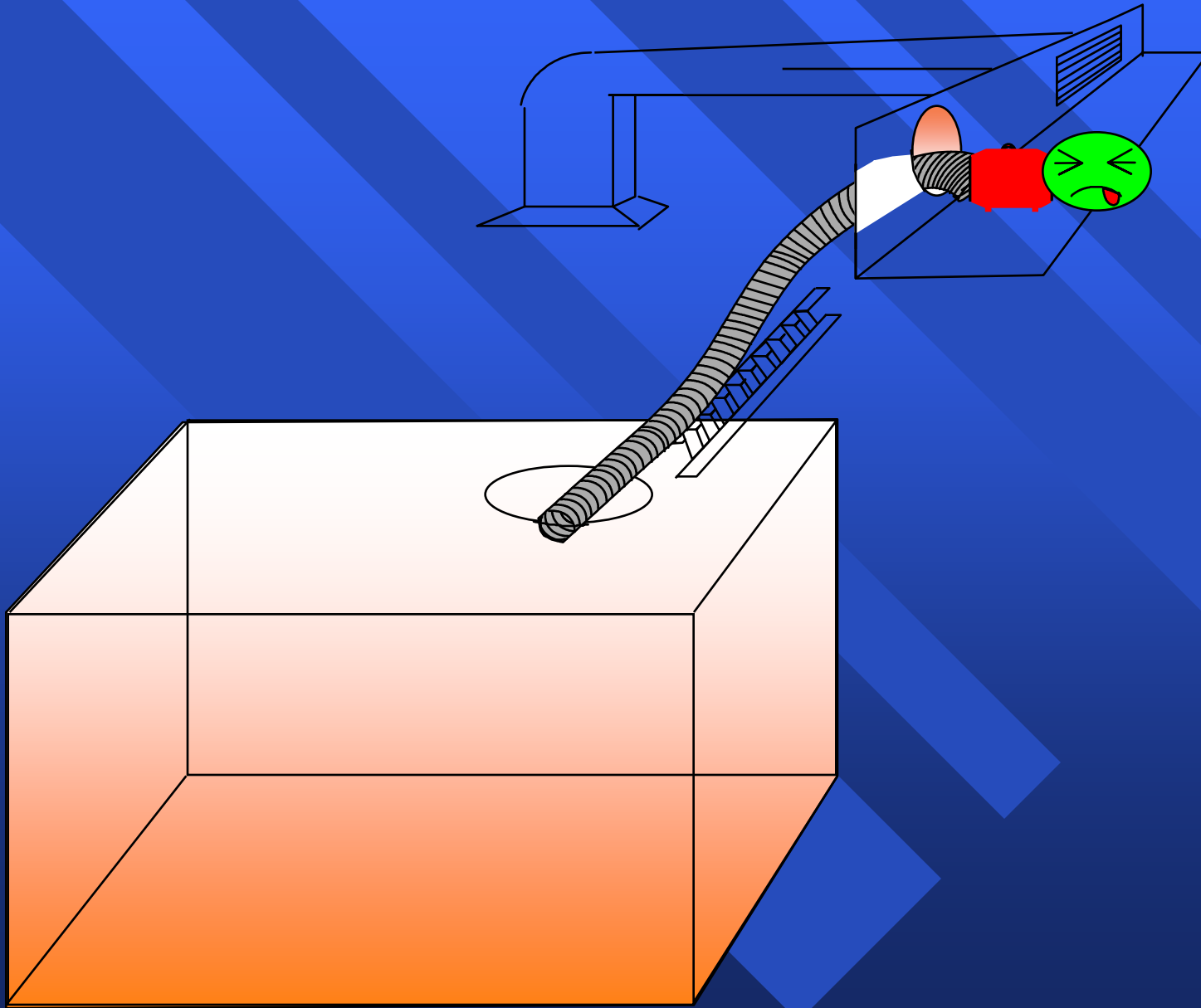
RECIRCULATION



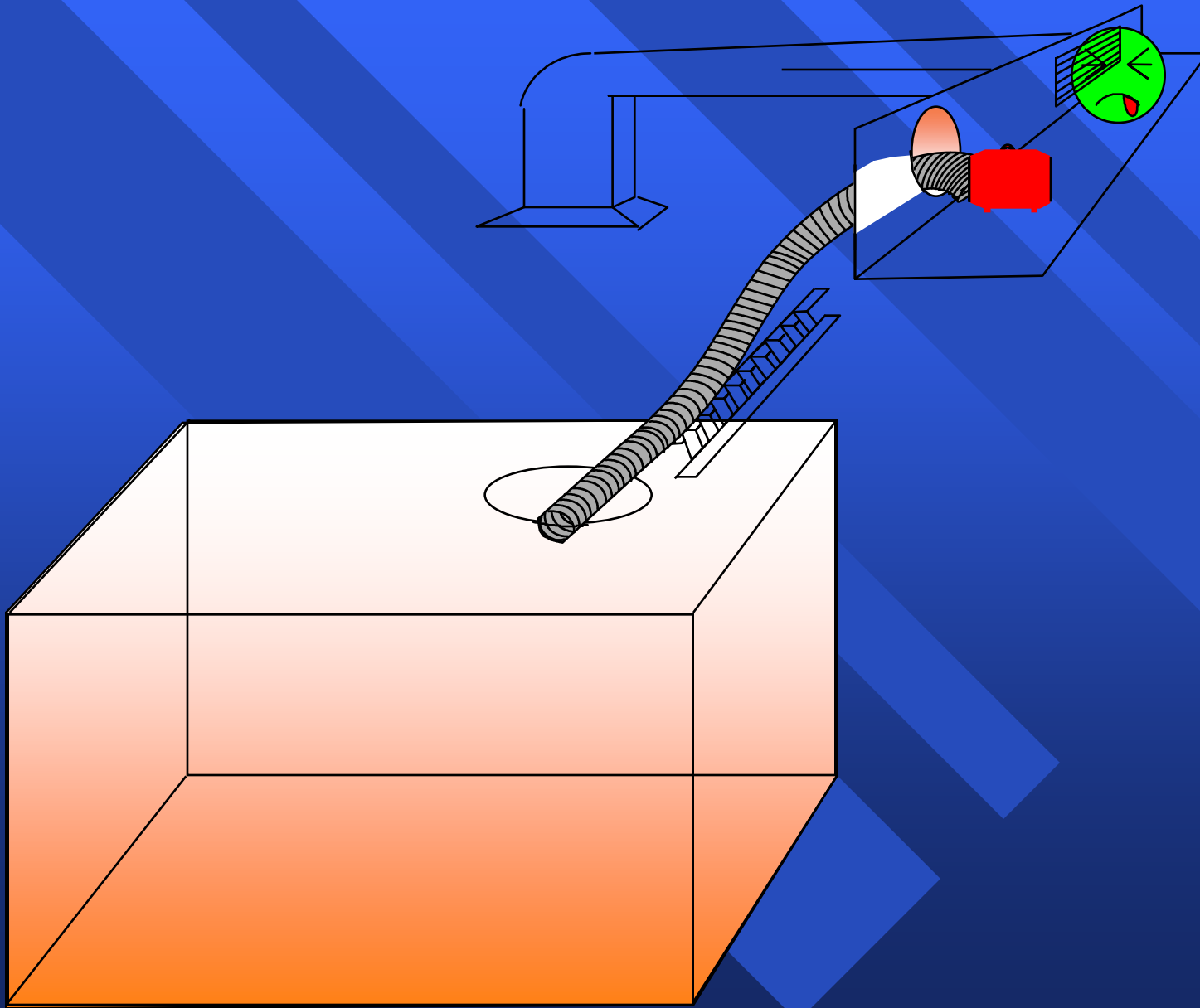
RECIRCULATION



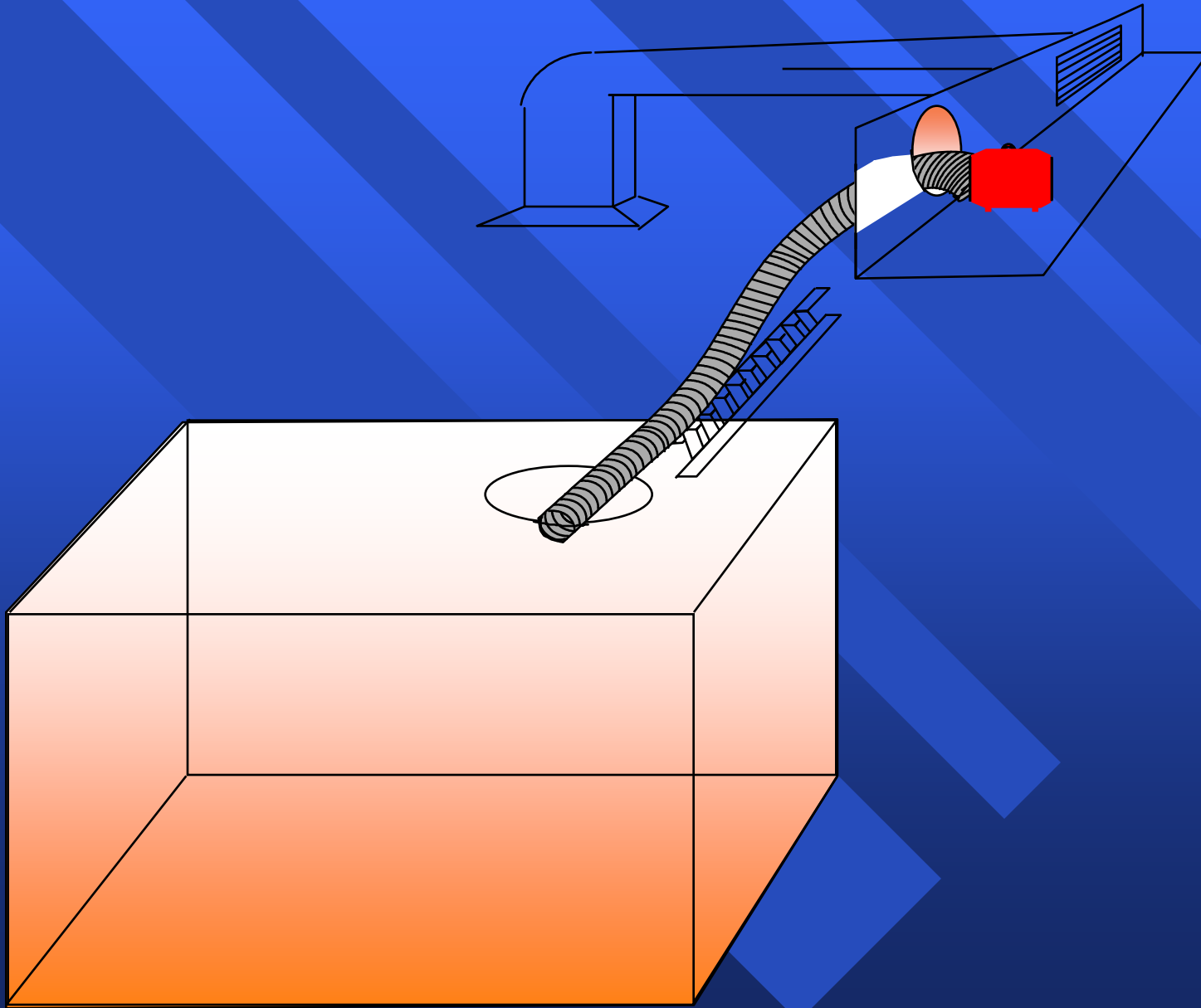
RECIRCULATION



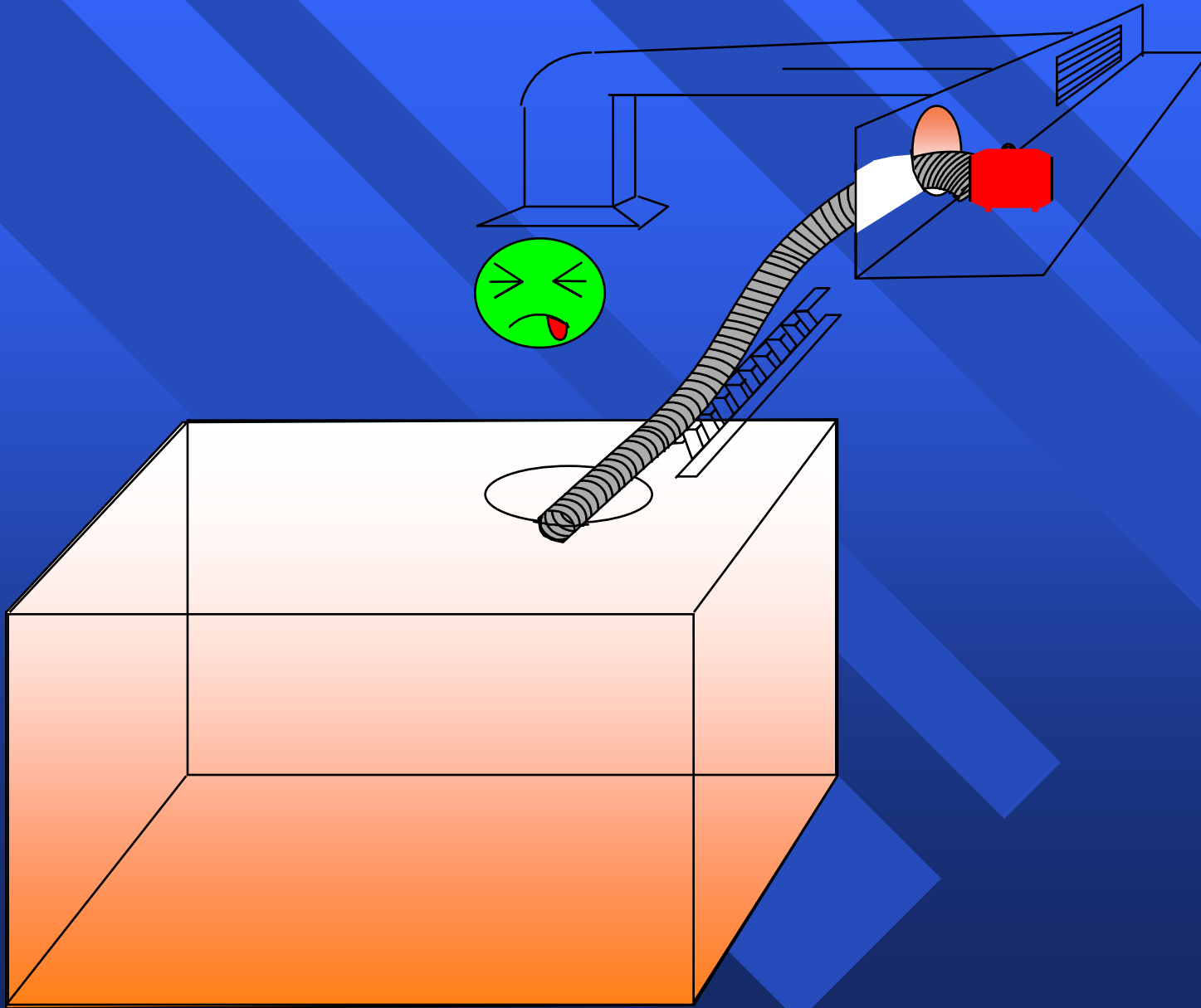
RECIRCULATION



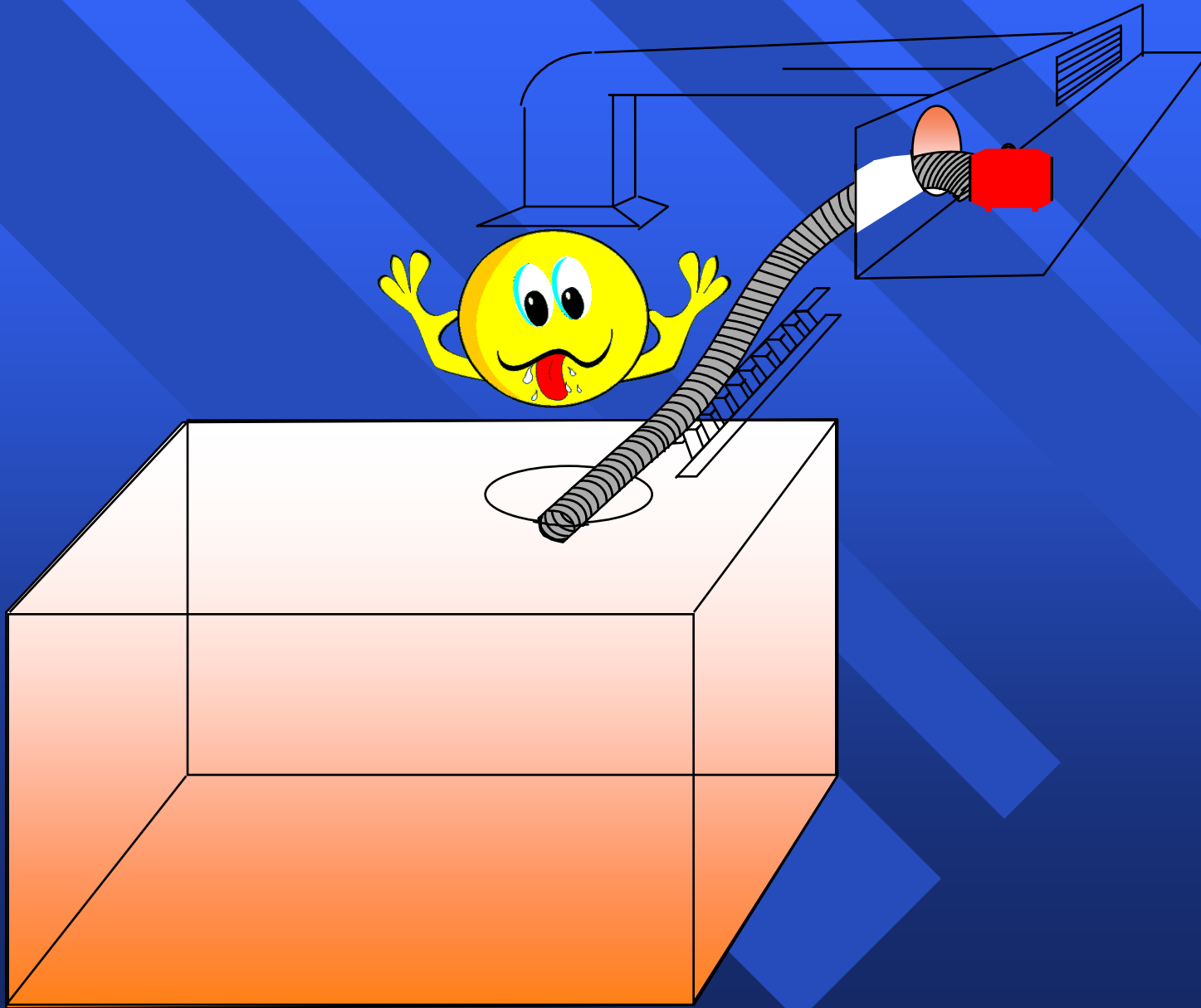
RECIRCULATION



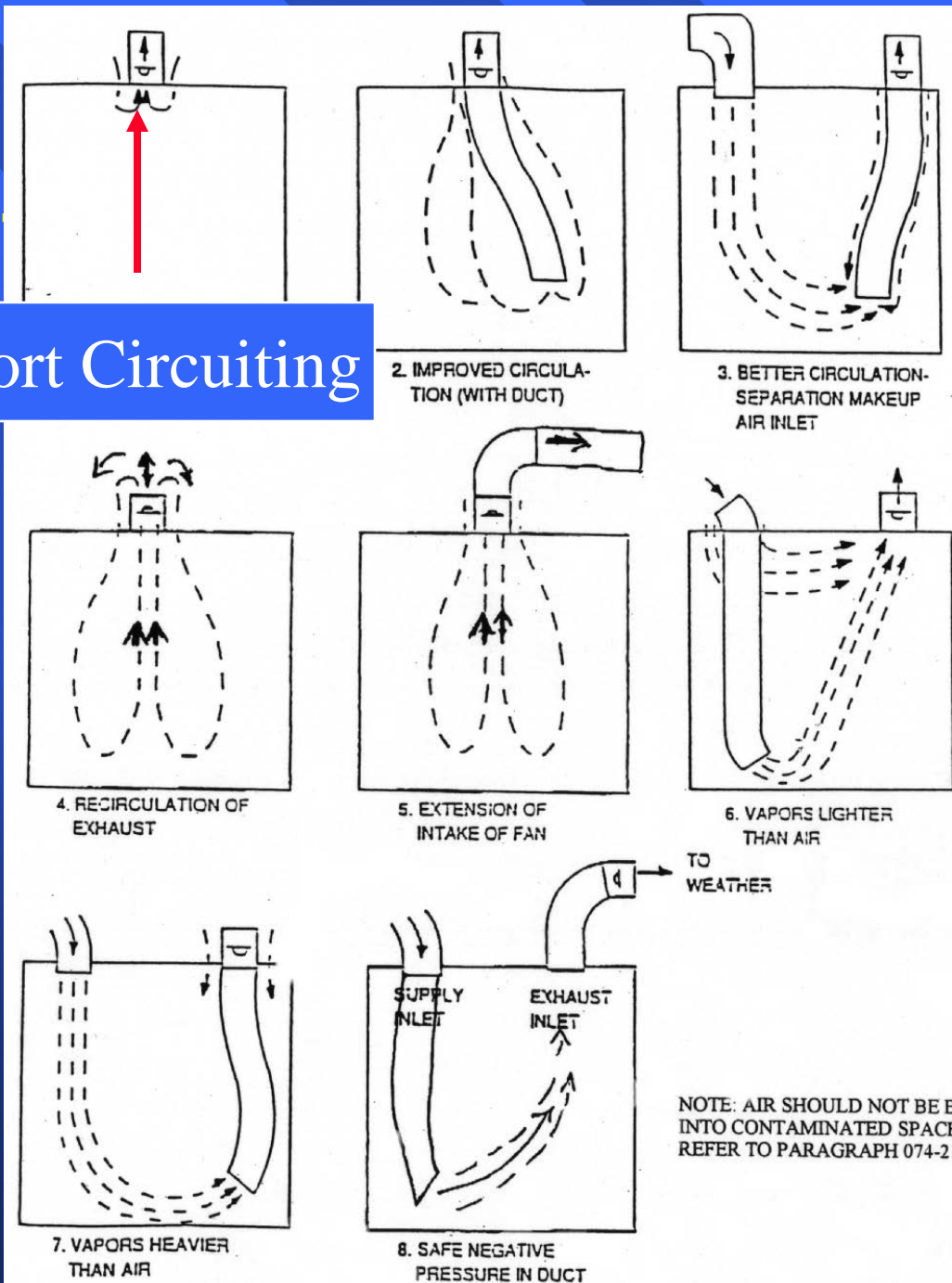
RECIRCULATION



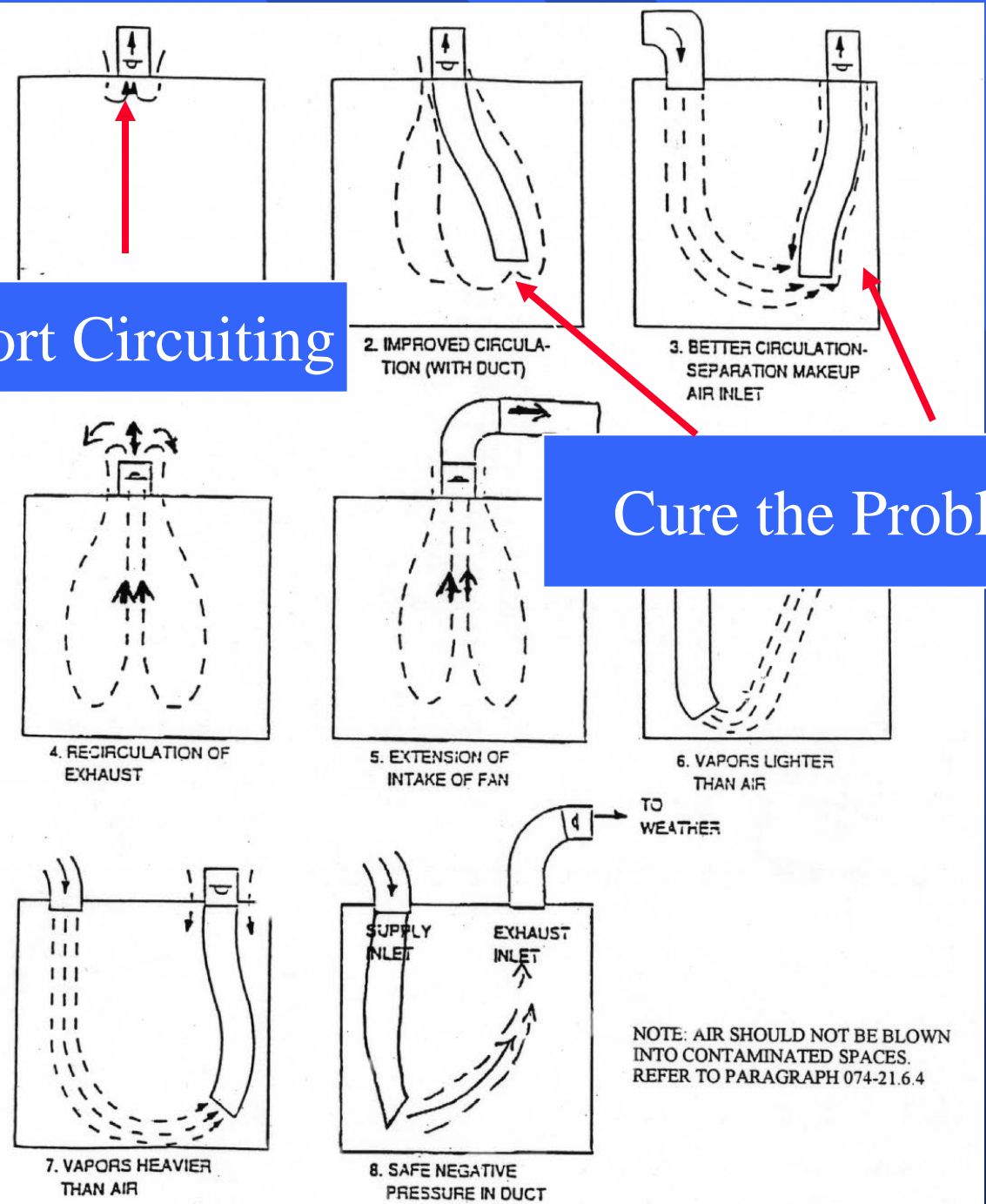
RECIRCULATION



Short Circuiting

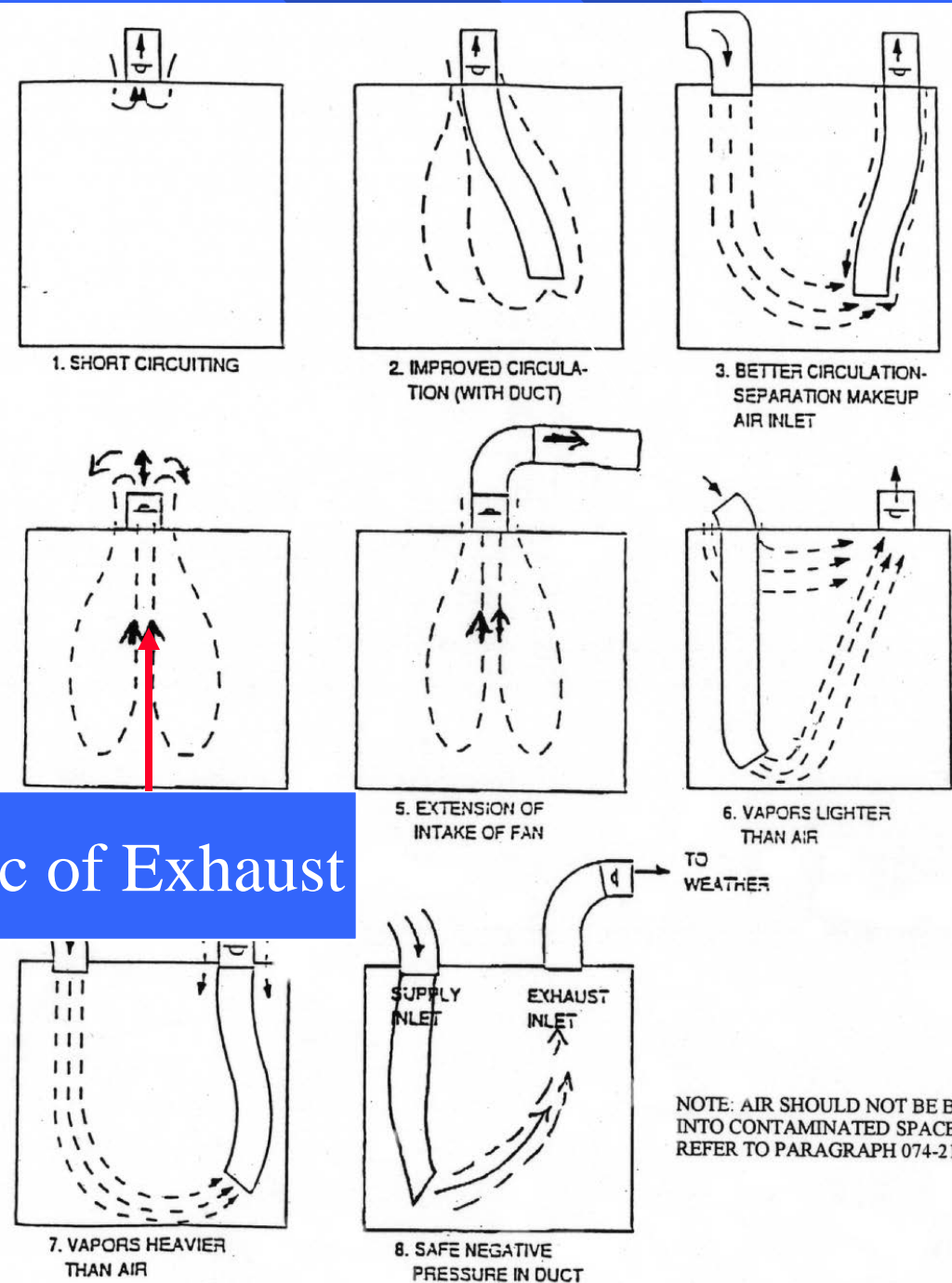


NOTE: AIR SHOULD NOT BE BLOWN INTO CONTAMINATED SPACES. REFER TO PARAGRAPH 074-21.6.4



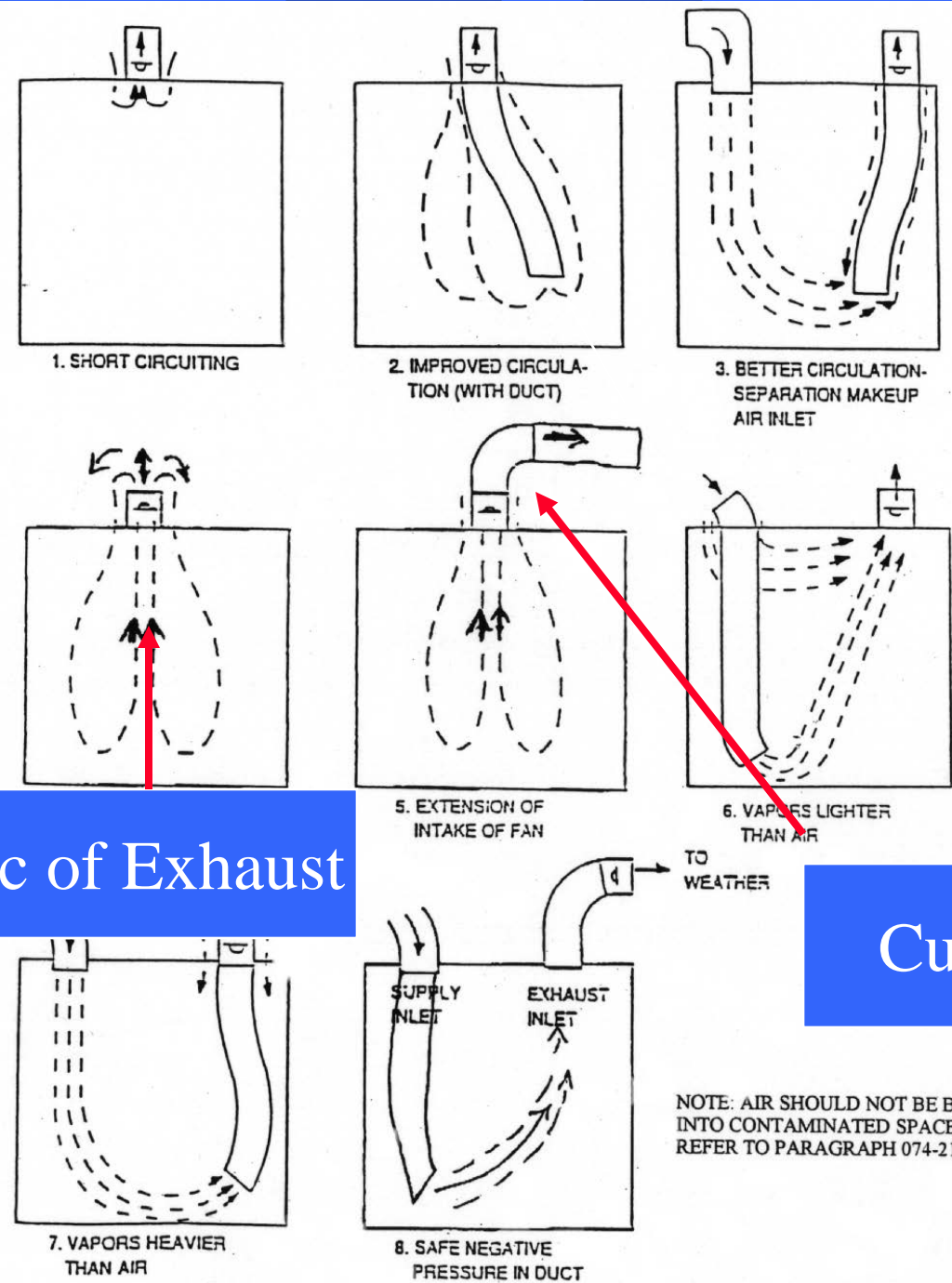
Short Circuiting

Cure the Problem



Recirc of Exhaust

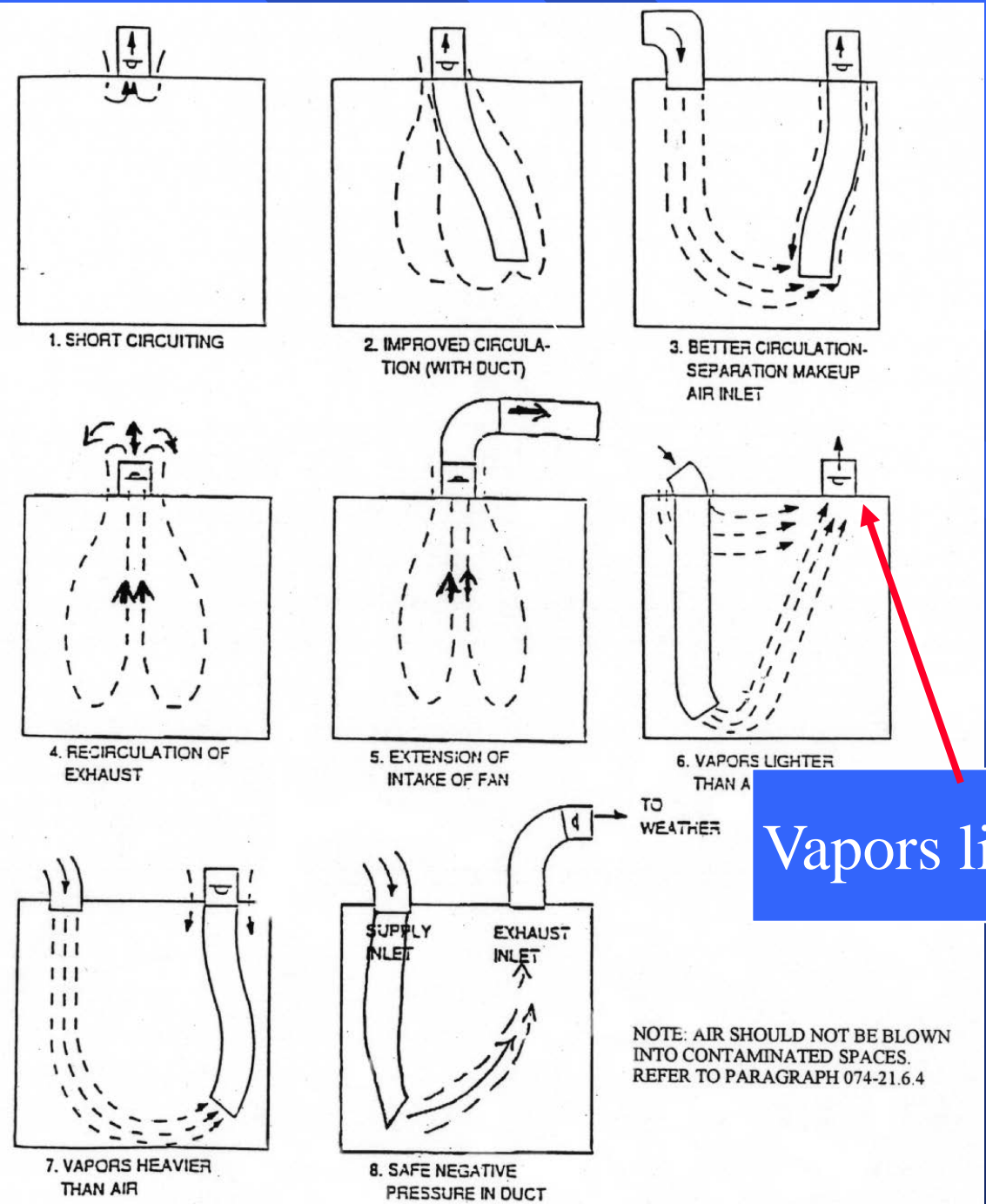
NOTE: AIR SHOULD NOT BE BLOWN INTO CONTAMINATED SPACES. REFER TO PARAGRAPH 074-21.6.4



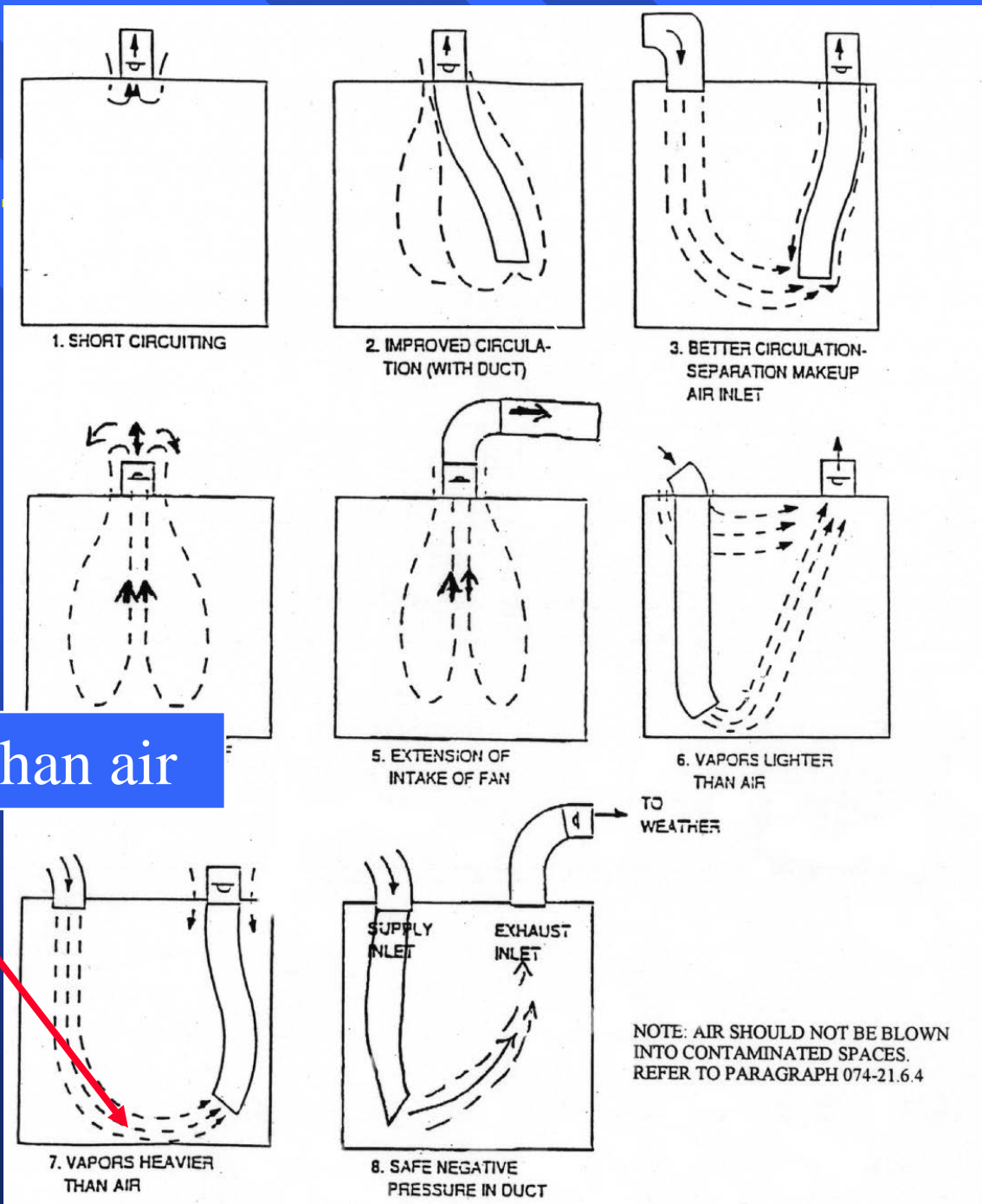
Recirc of Exhaust

Cure the Problem

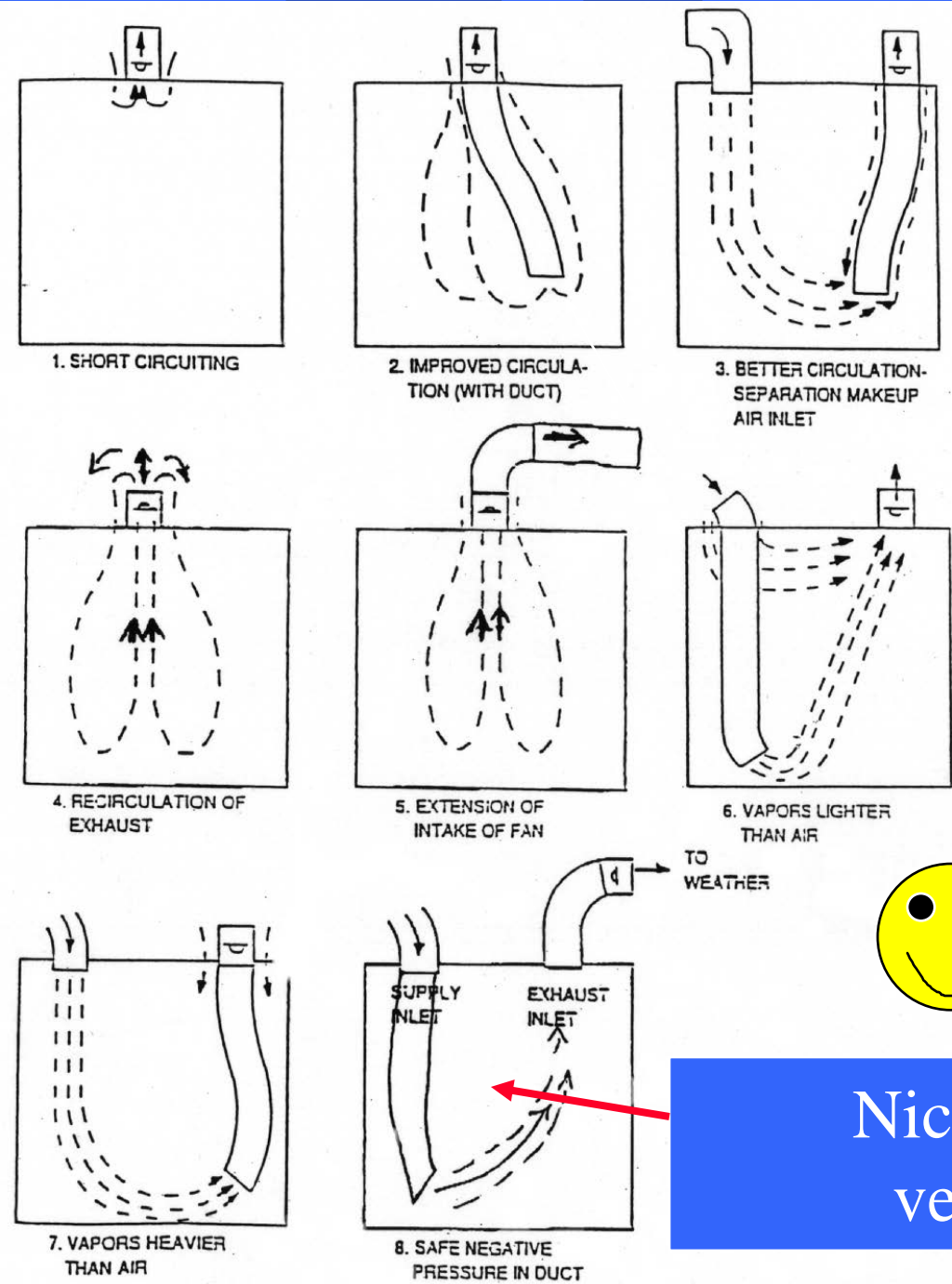
NOTE: AIR SHOULD NOT BE BLOWN INTO CONTAMINATED SPACES. REFER TO PARAGRAPH 074-21.6.4



Vapors lighter than air



Vapors heavier than air

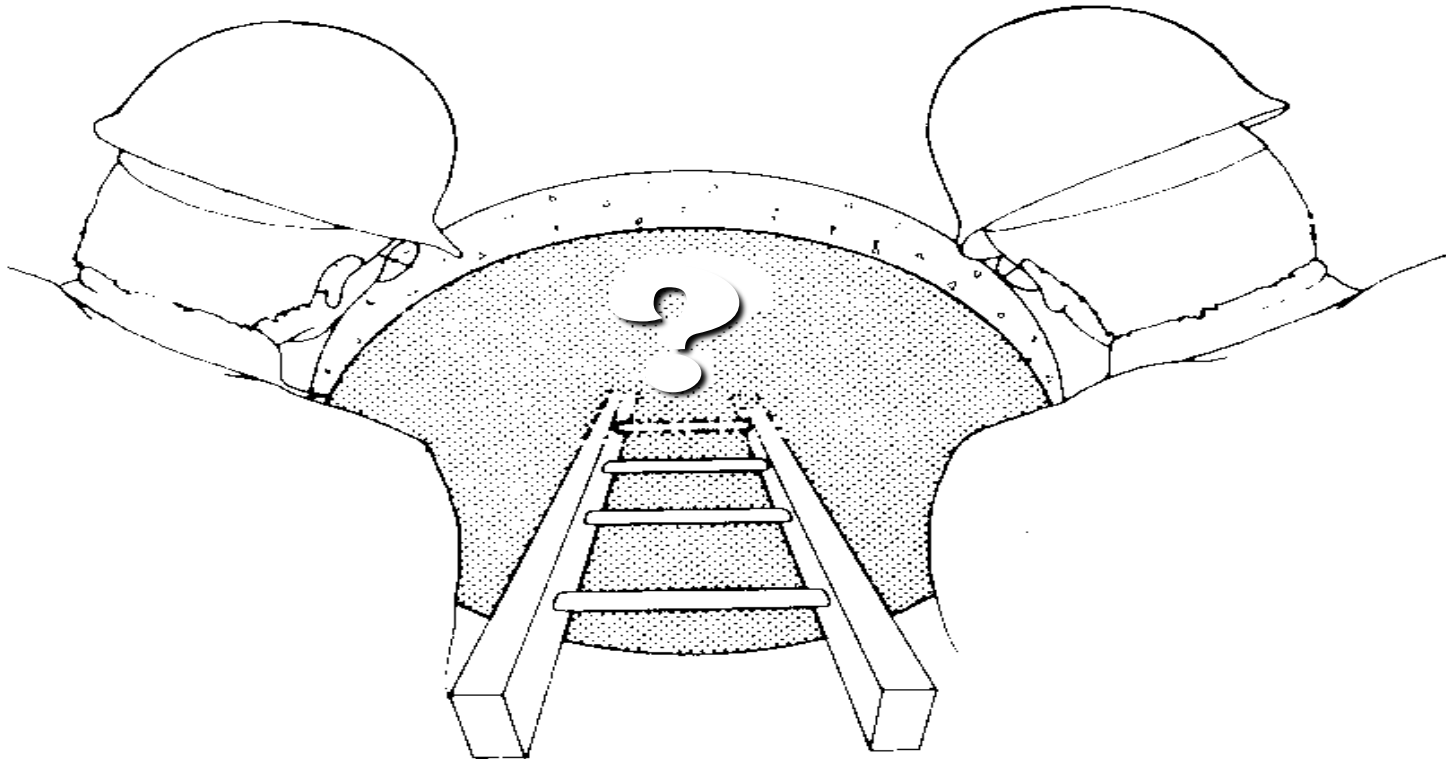


Nice and safe ventilation

THUMBRULES FOR VENTILATION TO MAINTAIN A GAS FREE CONDITION

- ☺ **Always suspect a hazardous condition to exist or be created**
- ☺ **Personnel involved in the work or space entry process must either wear or have ready the proper respiratory gear for the hazard suspected**

**When in doubt,
expect the worst**



Calculating the rate of exhaust and supply air



Calculating the rate of exhaust and supply air.

$$L \times W \times H = V \text{ (Volume)}$$

Calculating the rate of exhaust and supply air.

$$L \times W \times H = V \text{ (Volume)}$$

V

$$\text{CFM (Rated capacity of the blower)} = \frac{V}{\text{Time}}$$

Calculating the rate of exhaust and supply air.

$$L \times W \times H = V \text{ (Volume)}$$

$$\frac{\frac{V}{\text{CFM (Rated capacity of the blower)}}}{\text{Time}} = \frac{\text{Time}}{3} = \# \text{ Blowers}$$



Calculating the rate of exhaust and supply air.

$$L \times W \times H = V \text{ (Volume)}$$

$$\frac{\frac{V}{\text{CFM (Rated capacity of the blower)}}}{\text{Time}} = \# \text{ Blowers}$$



Round it up...

#^!@\$*)^



Review and Summary

Review and Summary

- Ventilation
- Air Moving Devices
- Fan and ducting locations
- Calculating the rate of exhaust and supply air.

ANY QUESTIONS?