

National Training Program

NACT 282 Baghouses



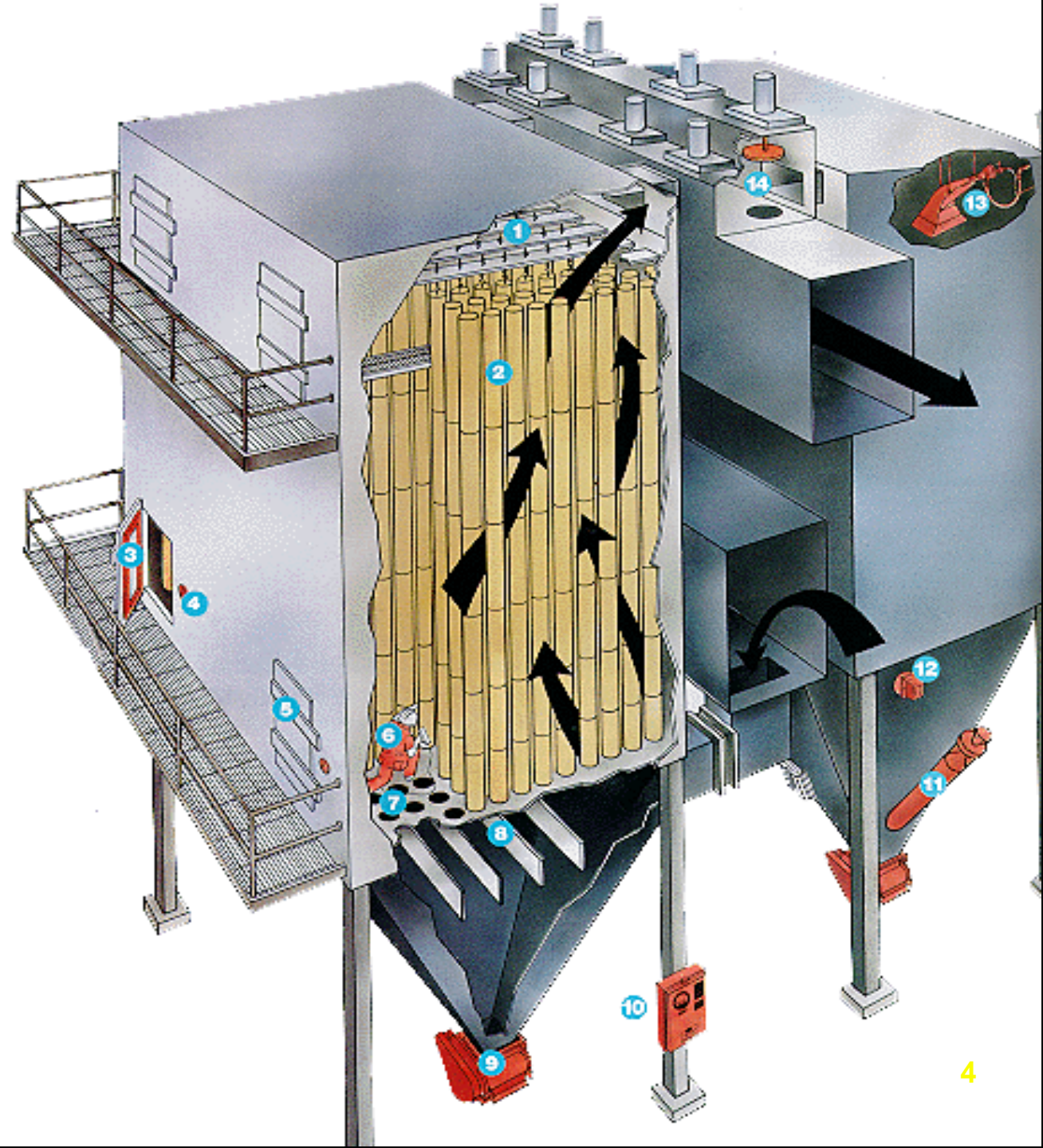
Course Overview

- **What are we looking at?**
- **Why do we care?**
- **How does fabric filtration work?**
- **Types of baghouses**
- **Design and operation of baghouses**
- **Operation and maintenance problems**
- **Baghouse inspection**

What Do They Look Like?



Generic Baghouse (reverse air)

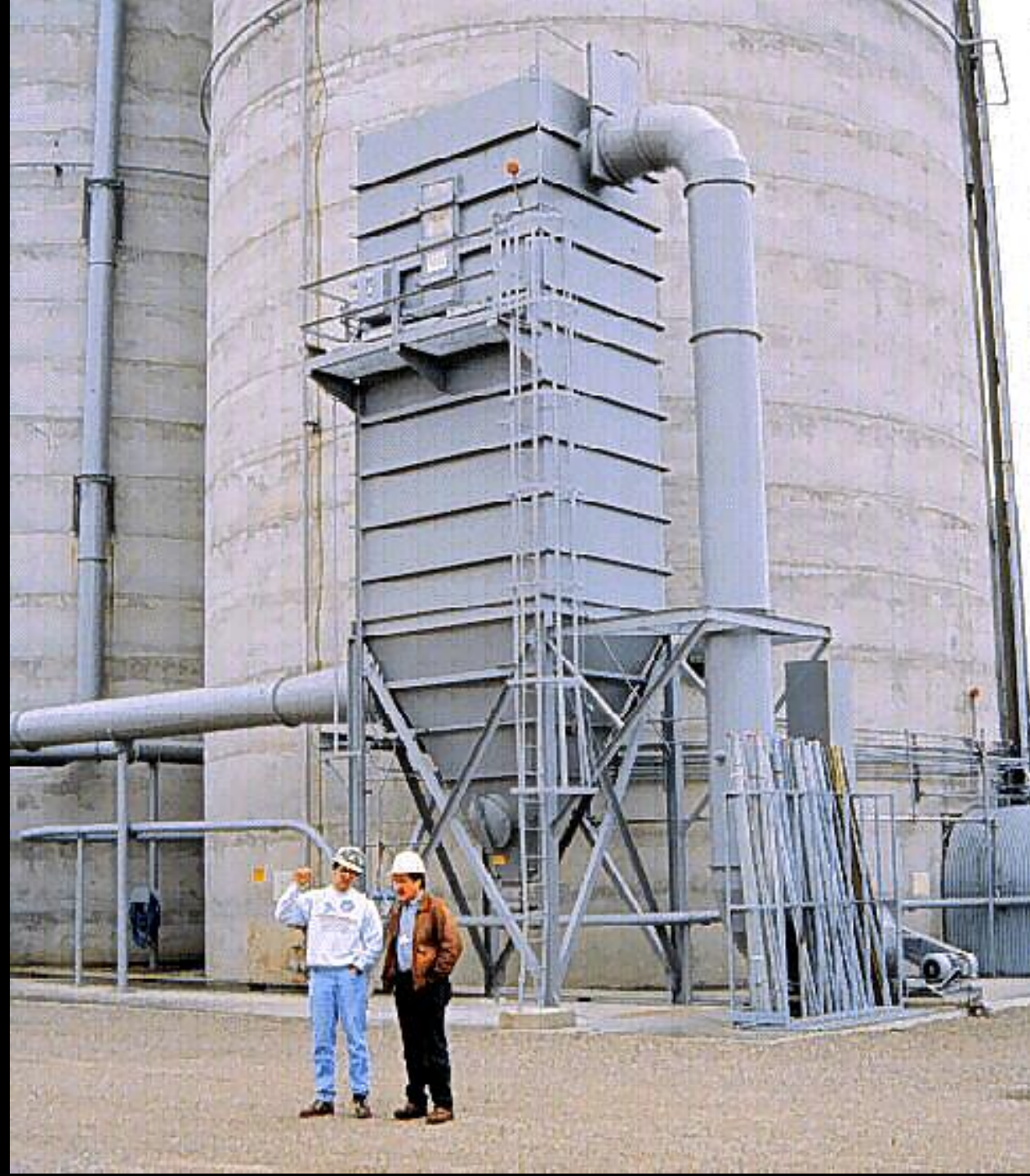






FARMERS RICE
COOPERATIVE

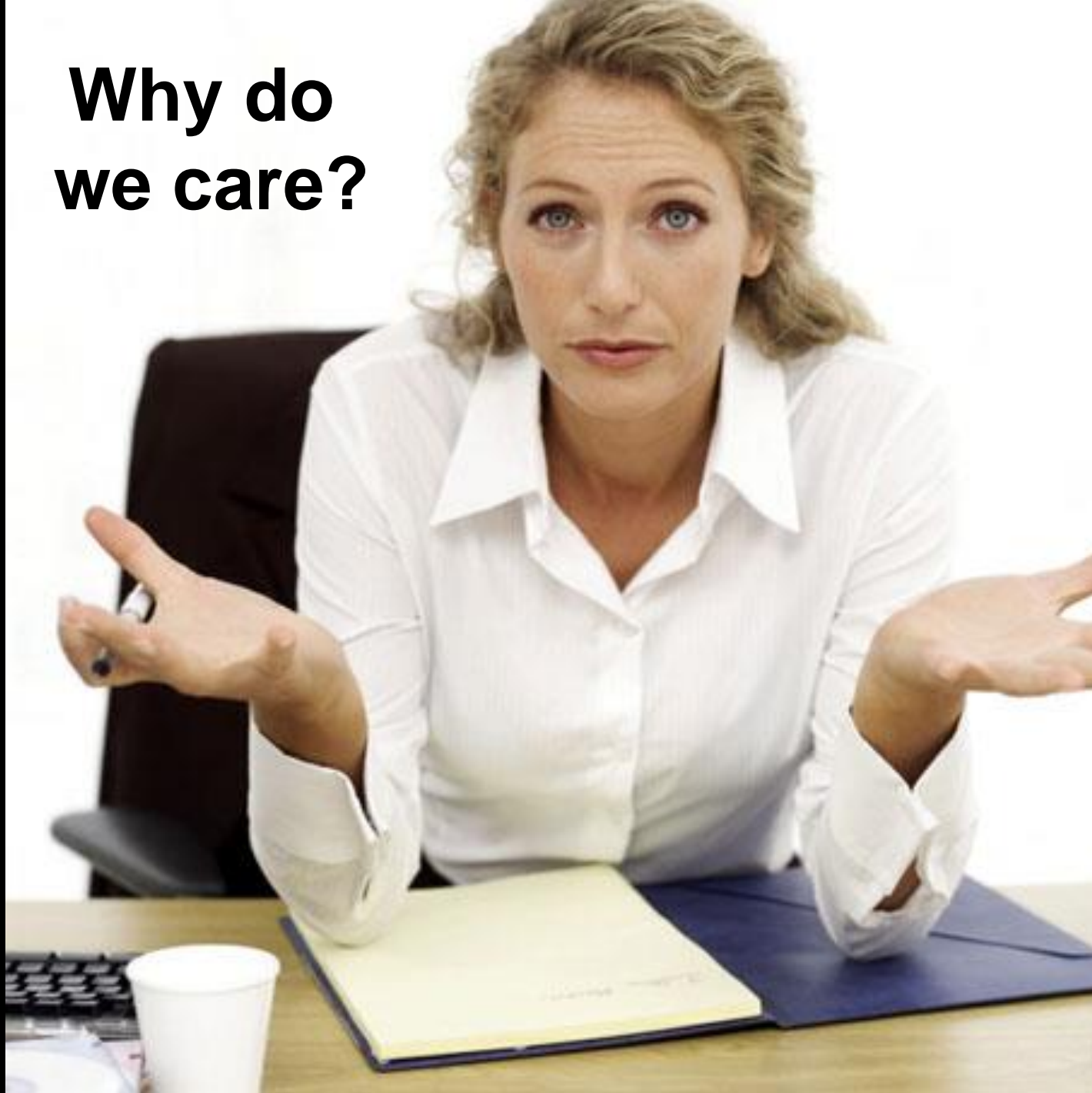








**Why do
we care?**



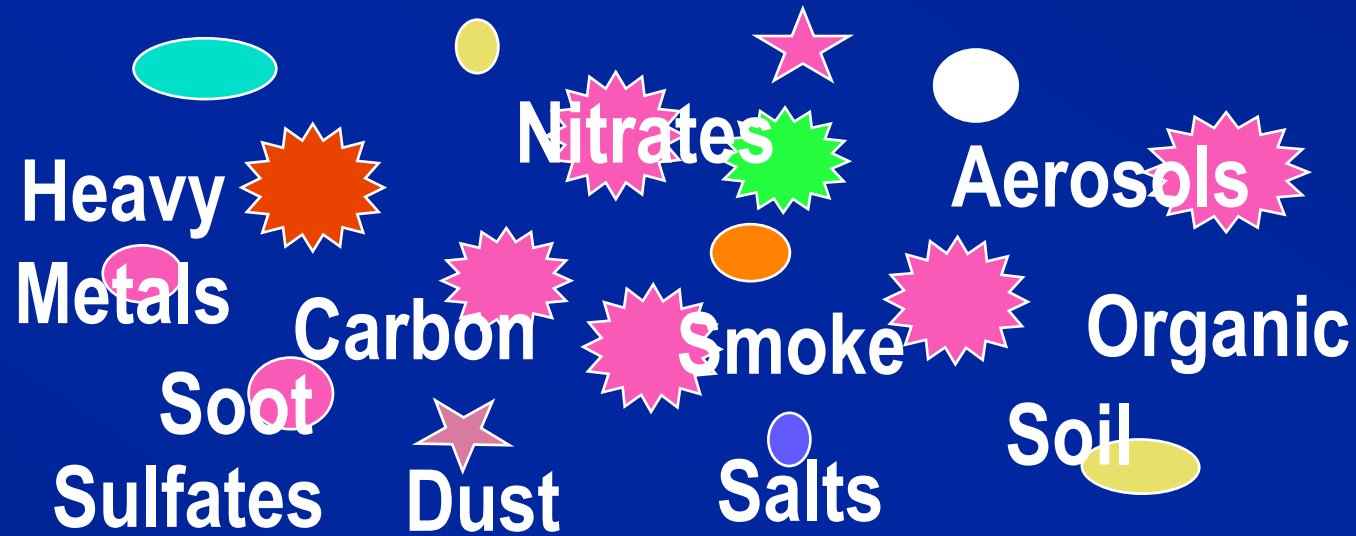




An aerial photograph showing a vast, dense field of discarded plastic waste, including bottles, containers, and other debris in various colors like white, blue, yellow, and red. The waste is piled up in a way that creates a textured, multi-colored surface.

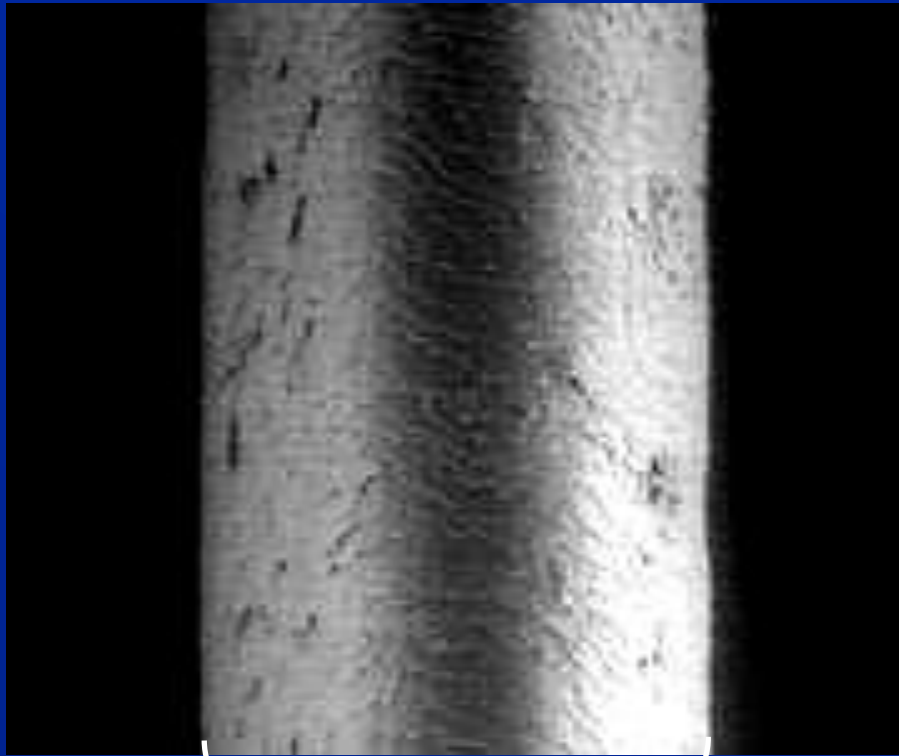
12,000

Particulate Matter: Composition

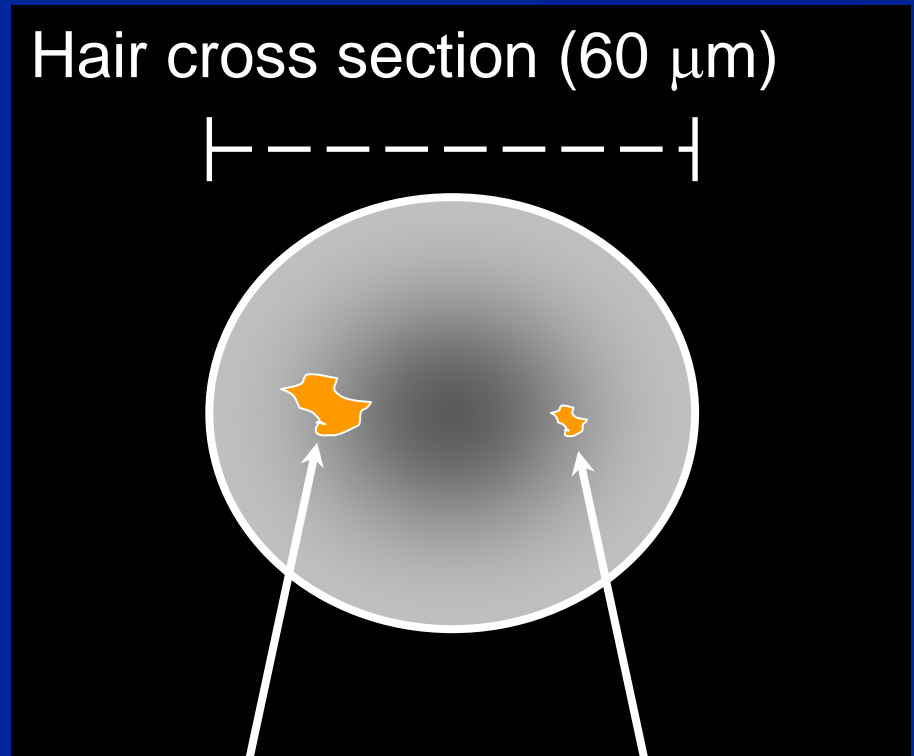


**Complex
Mixture**

How Small is PM?



Human Hair
(60 μm diameter)

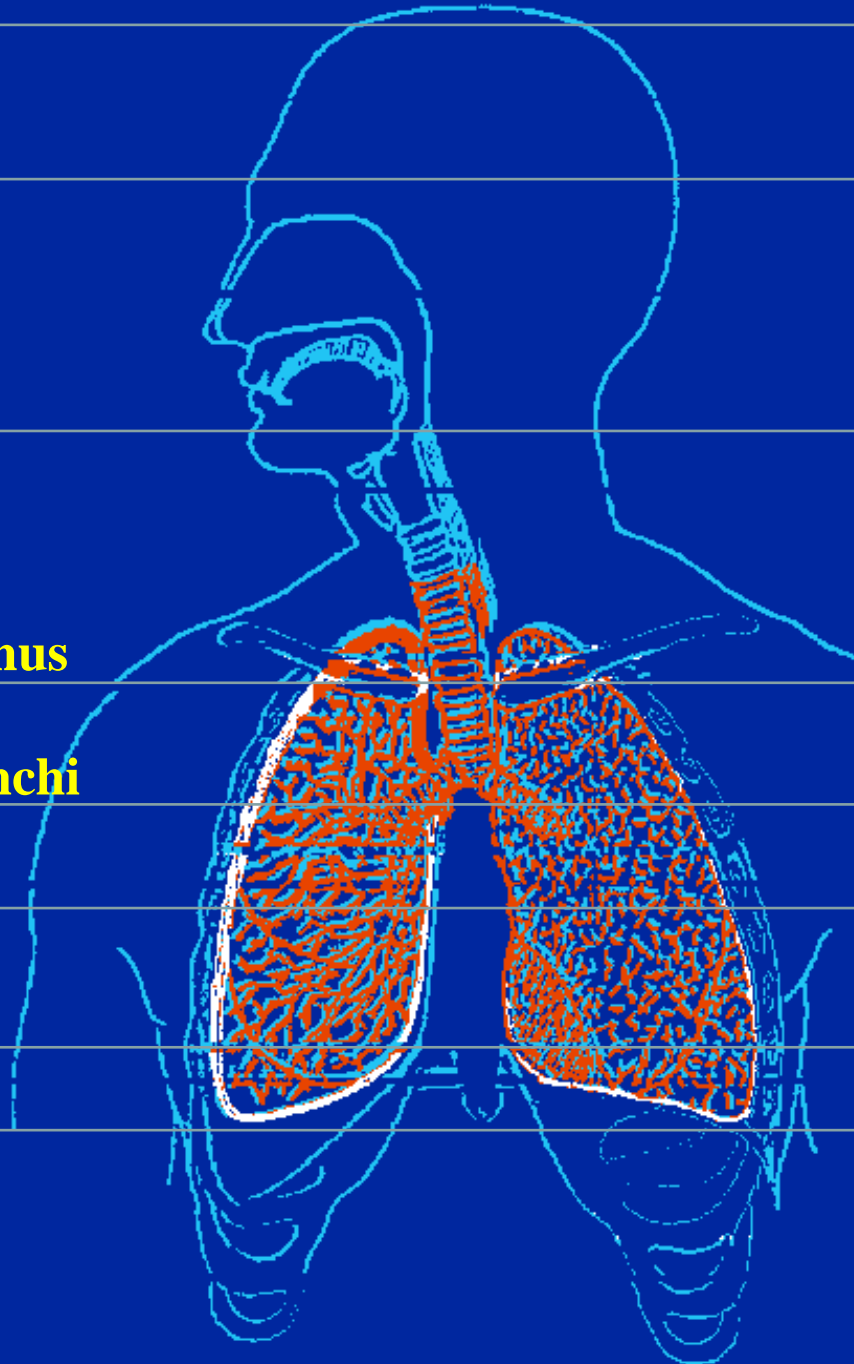


PM₁₀
(10 μm)

PM_{2.5}
(2.5 μm)

**Hair
Skin**

**Pharynx
Trachea
Primary bronchus
Secondary bronchi
Bronchioles
Alveoli**



11 Microns and larger

7 to 11 Microns

4.7 to 7 Microns

3.3 to 4.7 Microns

2.1 to 3.3 Microns

1.1 to 2.1 Microns

0.65 to 1.1 Microns

0.43 to 0.65 Microns

An aerial photograph showing a vast, dense field of discarded plastic waste, including bottles, containers, and other debris, stretching across a landscape. The colors are a mix of white, blue, yellow, and red, creating a chaotic and overwhelming visual of pollution.

12,000

U.S. Mortality Figures In 2005

64,000 = Deaths from particulate air pollution

45,520 = Traffic accident fatalities

32,179 = AIDS deaths

30,694 = Firearm fatalities



Los Angeles - Clear Day



Los Angeles - Smoggy Day



*Most Polluted Regions In the U. S.**

Ozone (SMOG)

1. Los Angeles Region
2. Bakersfield
3. Visalia/Tulare Co.
4. Houston
5. Fresno/Madera
6. Sacramento
7. Dallas/Fort Worth
8. New York Metro
9. Washington, D.C. Metro
10. Baton Rouge, LA

Particulates

1. Pittsburgh
2. Los Angeles Metro
3. Fresno
4. Bakersfield/Kern Co.
5. Birmingham, AL
6. Logan, UT
7. Salt Lake City
8. Sacramento
9. Detroit
10. Washington, D.C. Metro

How do They Work?

HR Manager

Marketing Manager

Logistics manager

Safety Manager

Security Manager

Communications Manager

Project Manager

QA Manager

Public Relations

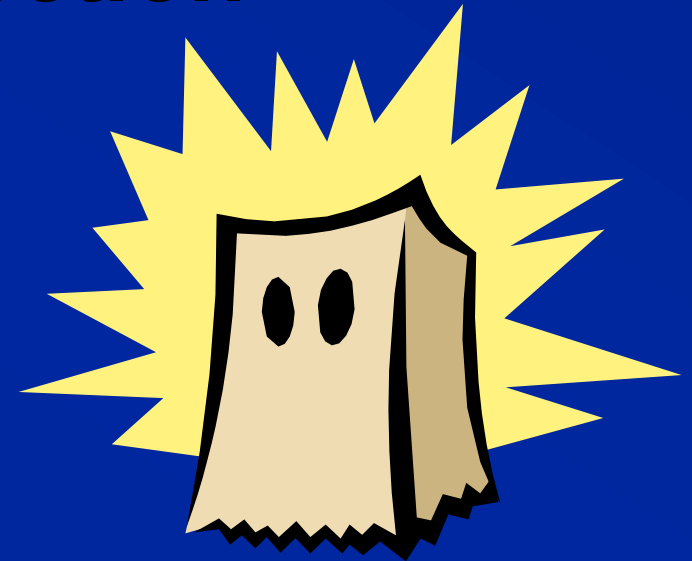
Product Development Manager

Me



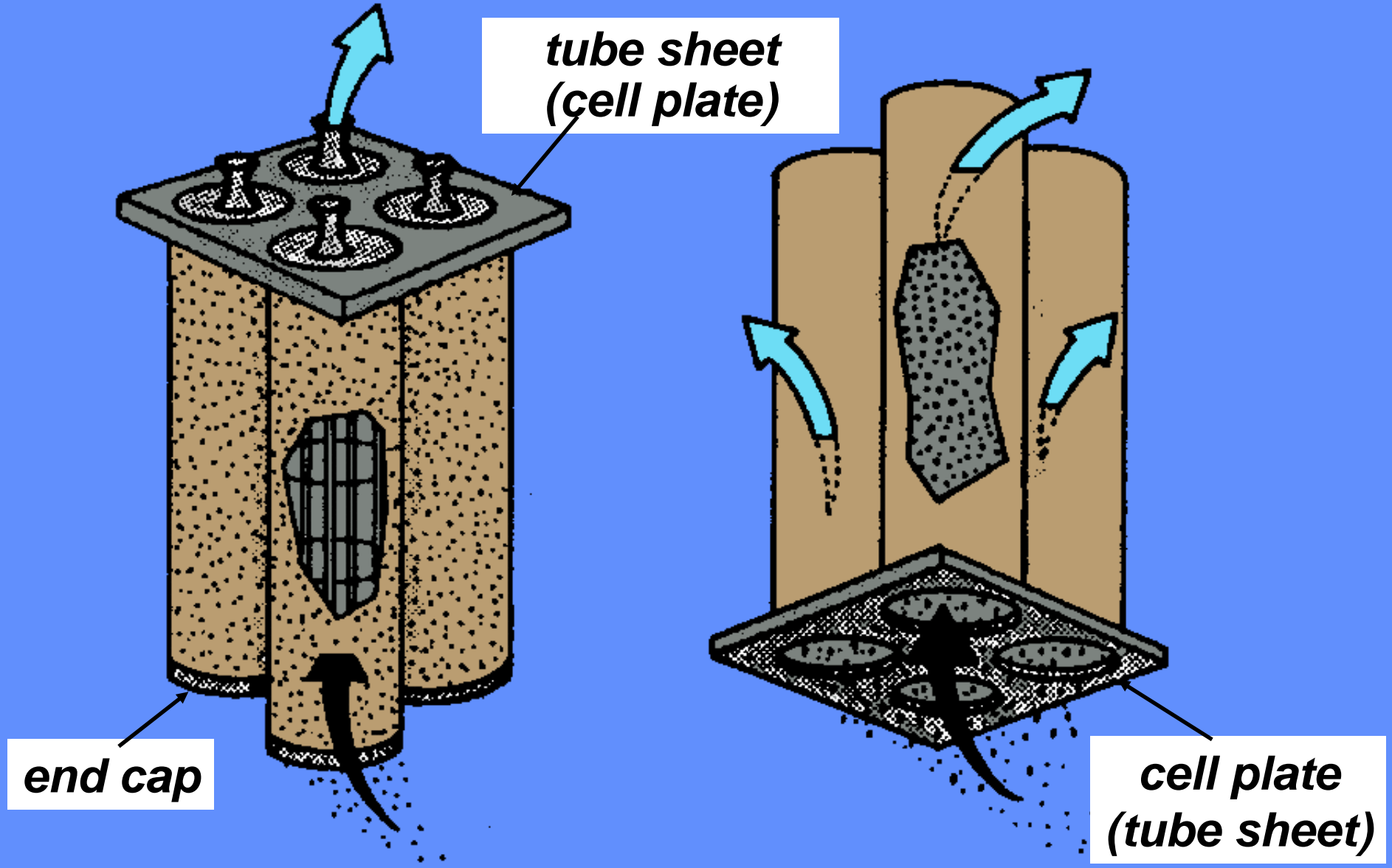
Baghouses may be classified in several ways

- **Method of dust collection**
- **Bag design**
- **Fan location**
- **Method of cleaning**



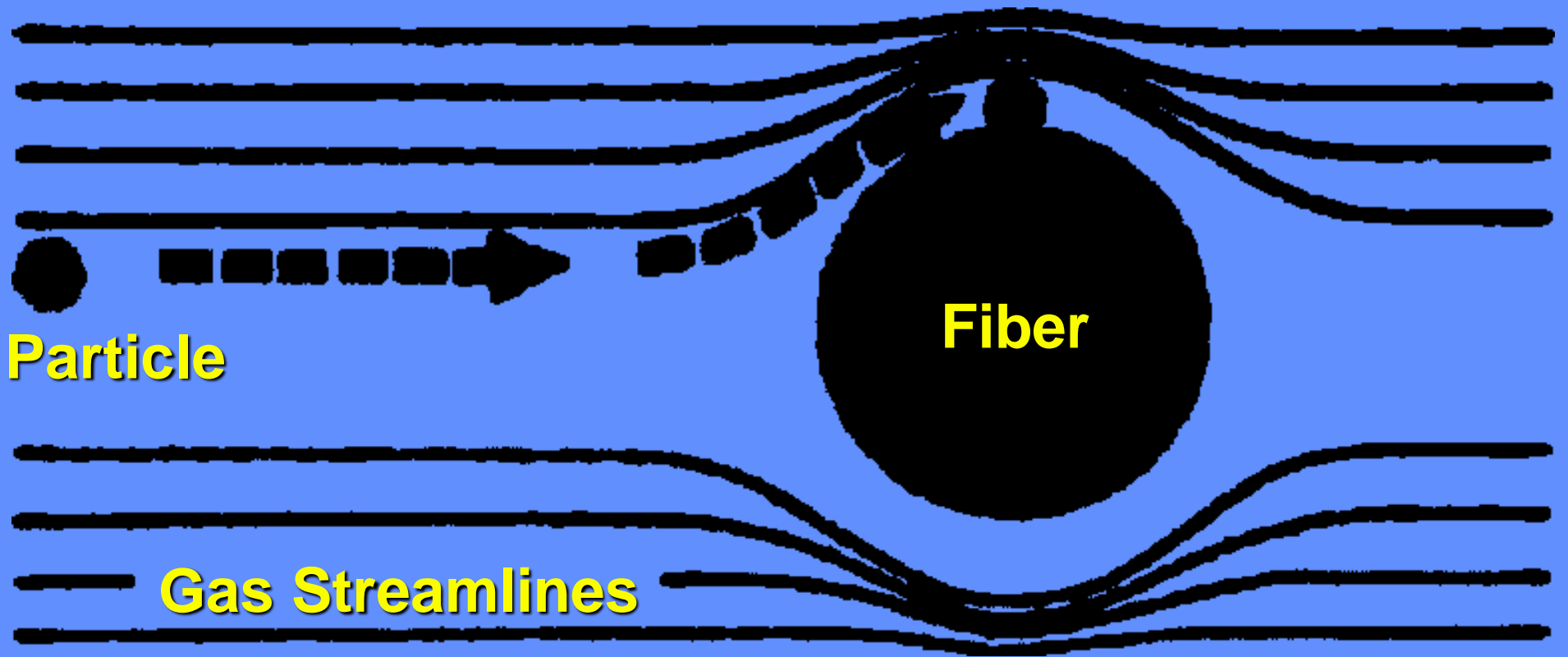
Exterior Filtration

Interior Filtration

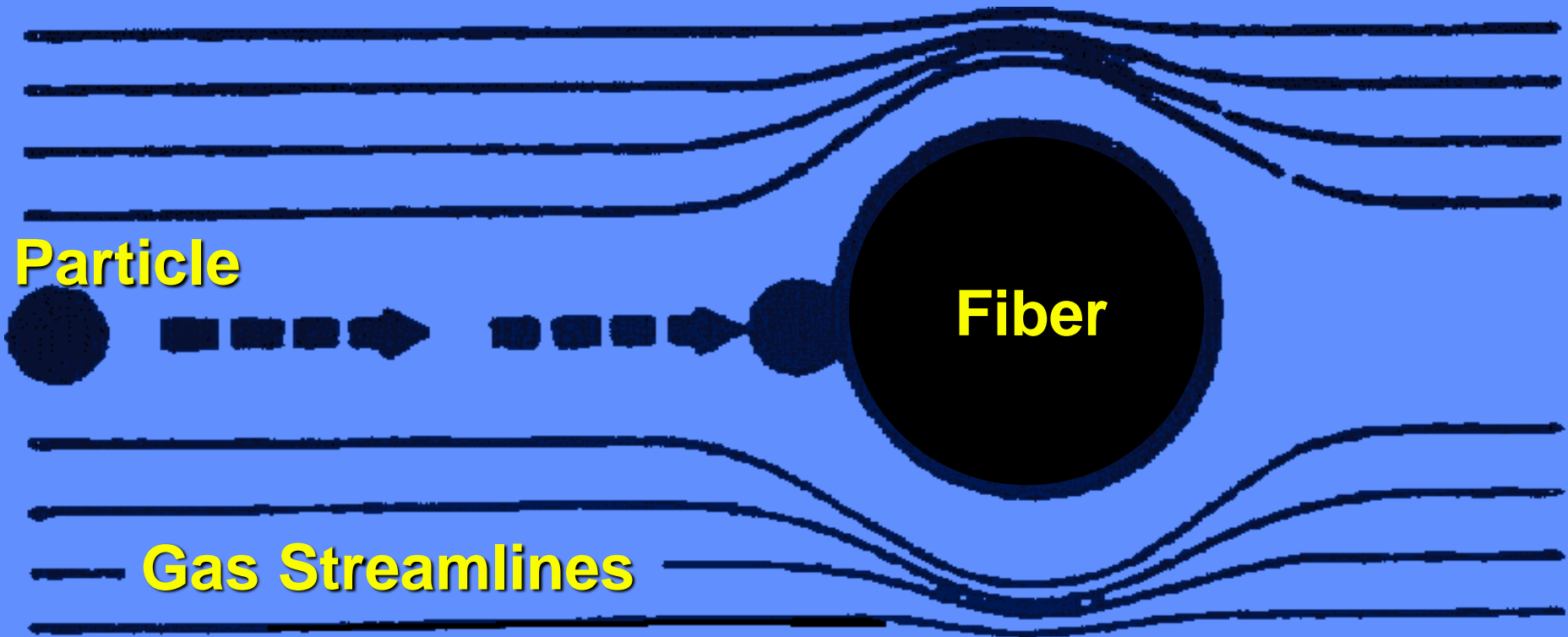


Particle Collection Mechanisms

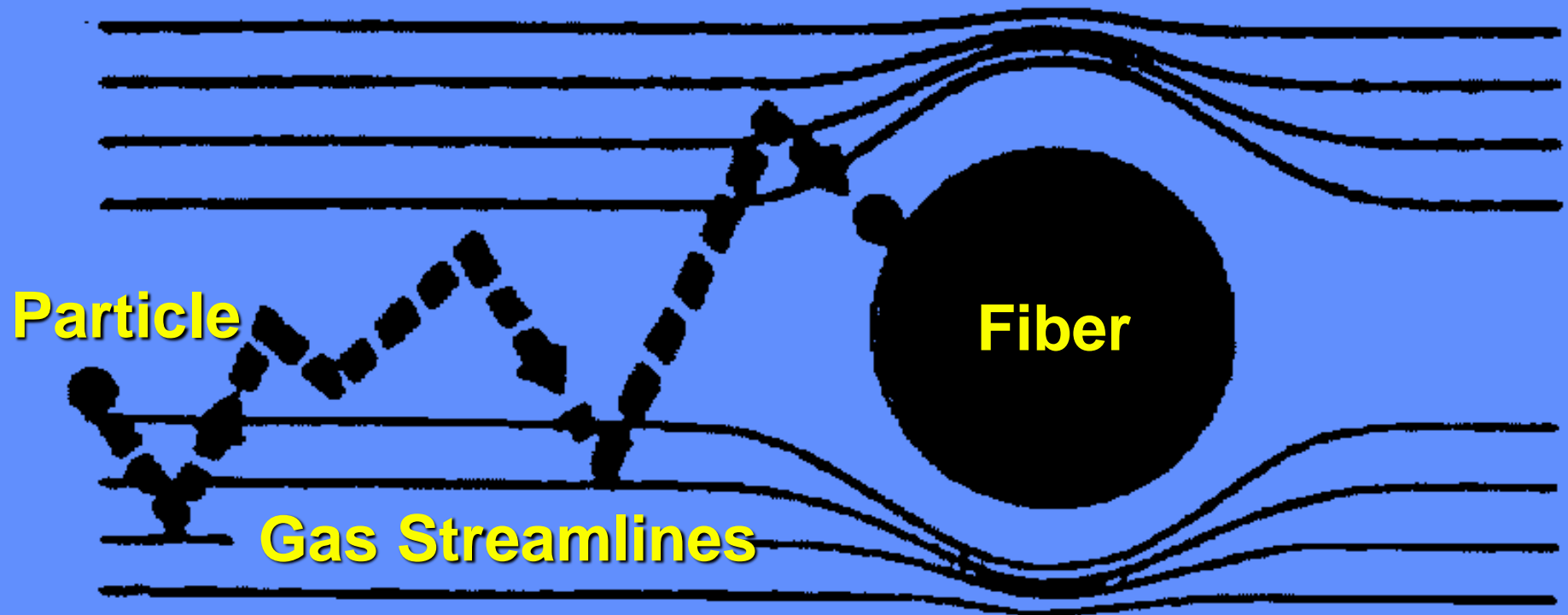
- **Direct interception**
- **Impaction**
- **Diffusion**
- **Gravitational settling**
- **Agglomeration**
- **Electrostatic attraction**



Direct Interception

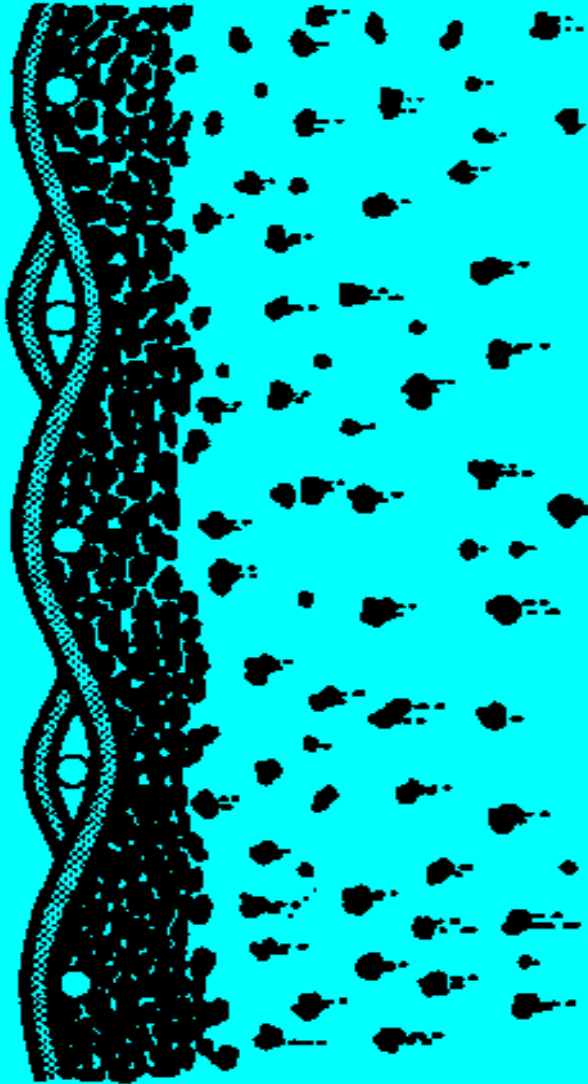


Impaction

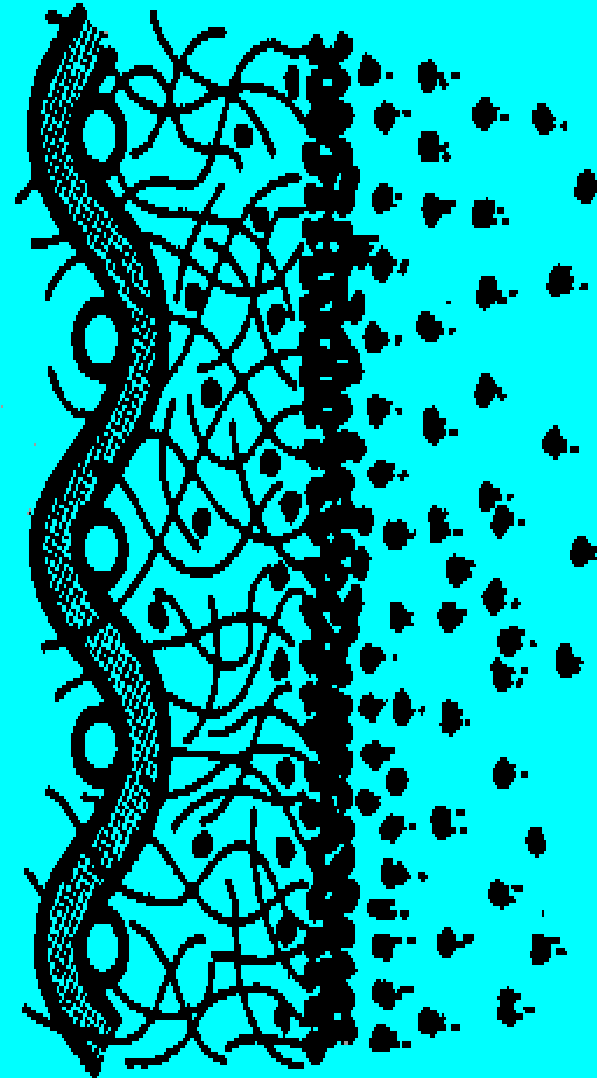


Diffusion

Sieving on Woven Fabric



Sieving on Felted Fabric



Other Mechanisms

- **Gravitational settling**
- **Agglomeration**
- **Electrostatic attraction**

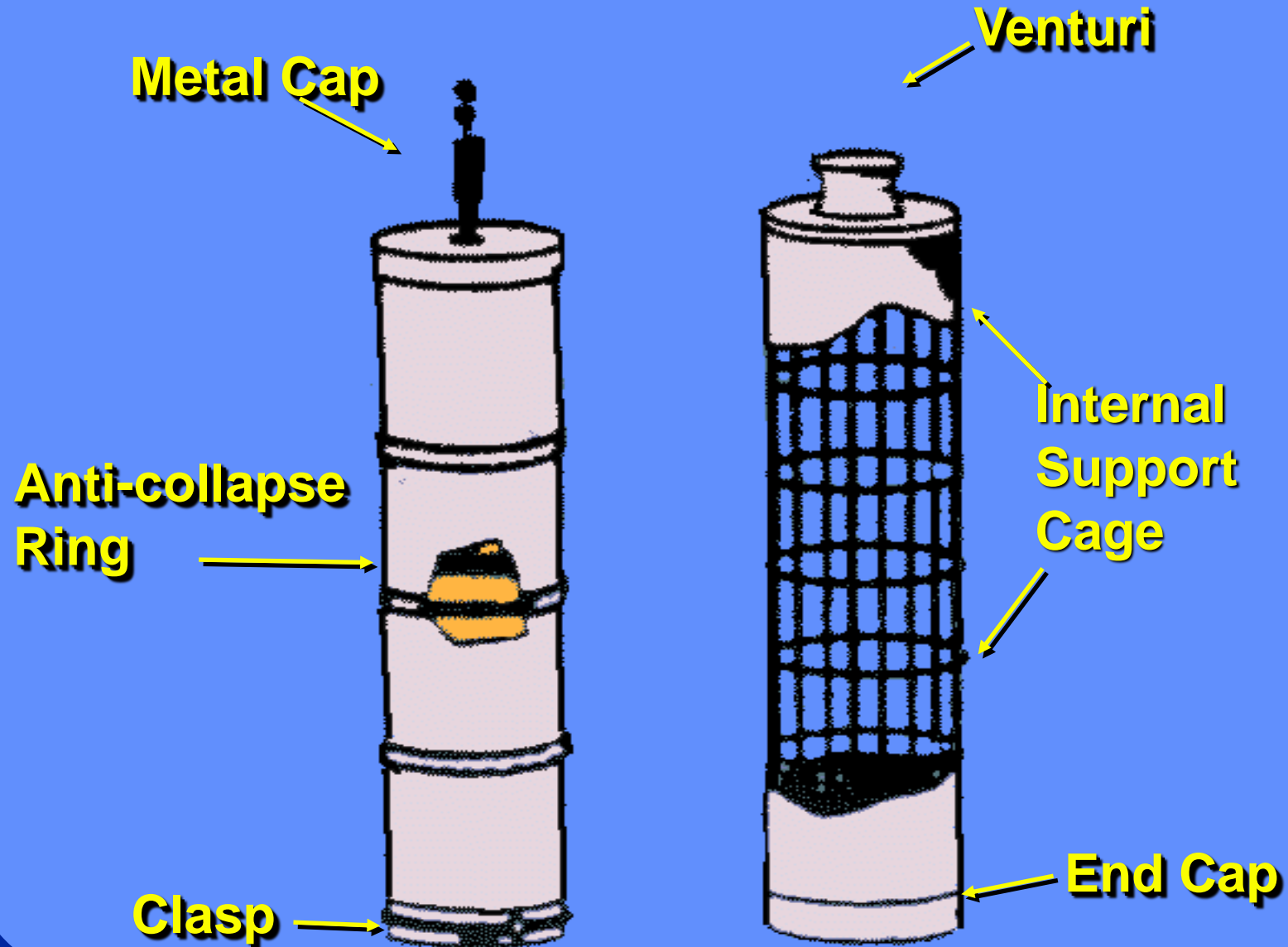
Settling Chamber



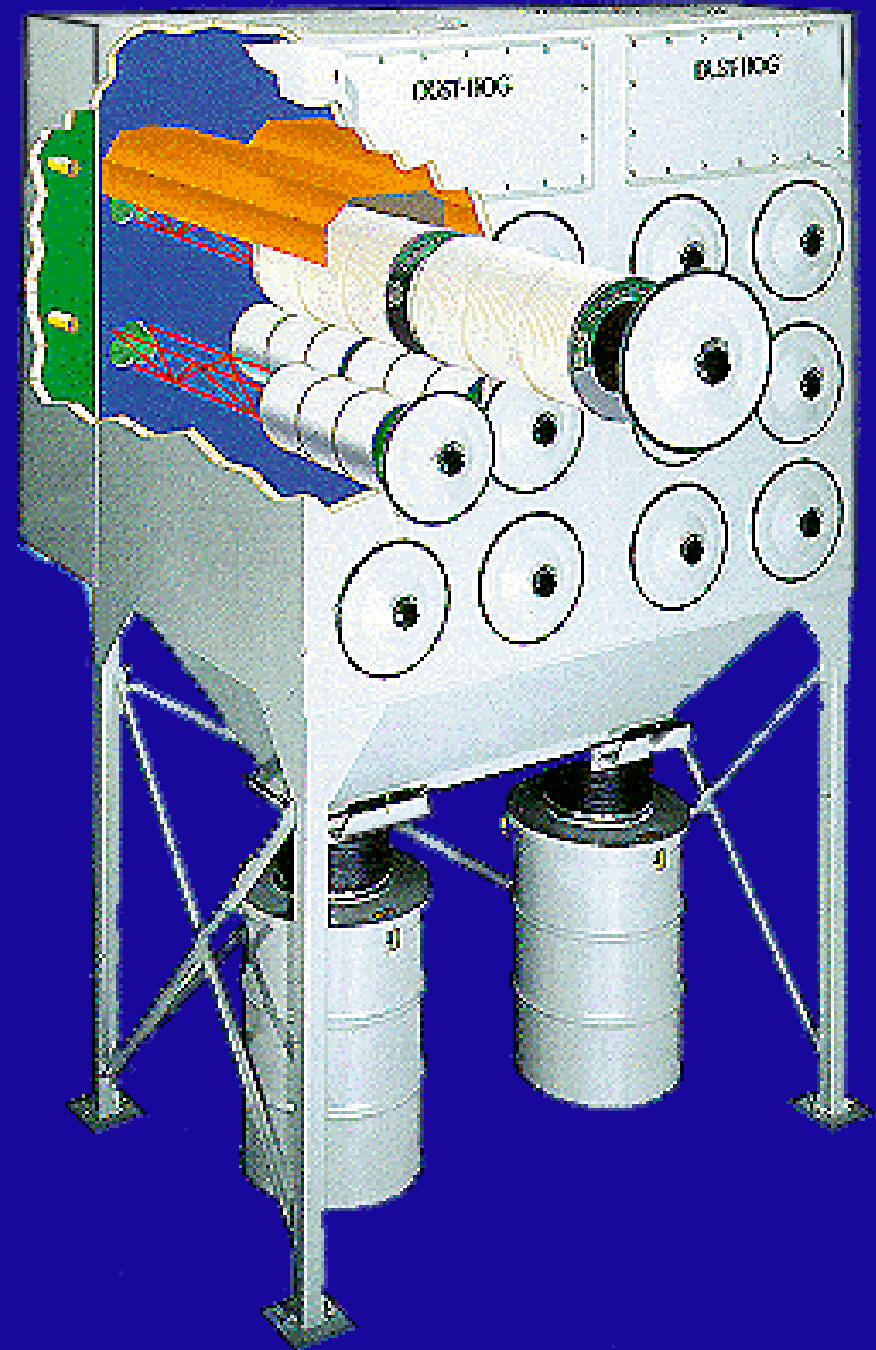


Bag Design

Bags and Support



Cartridge Filter Dust Collector



Filter Cartidges

3/1/2022

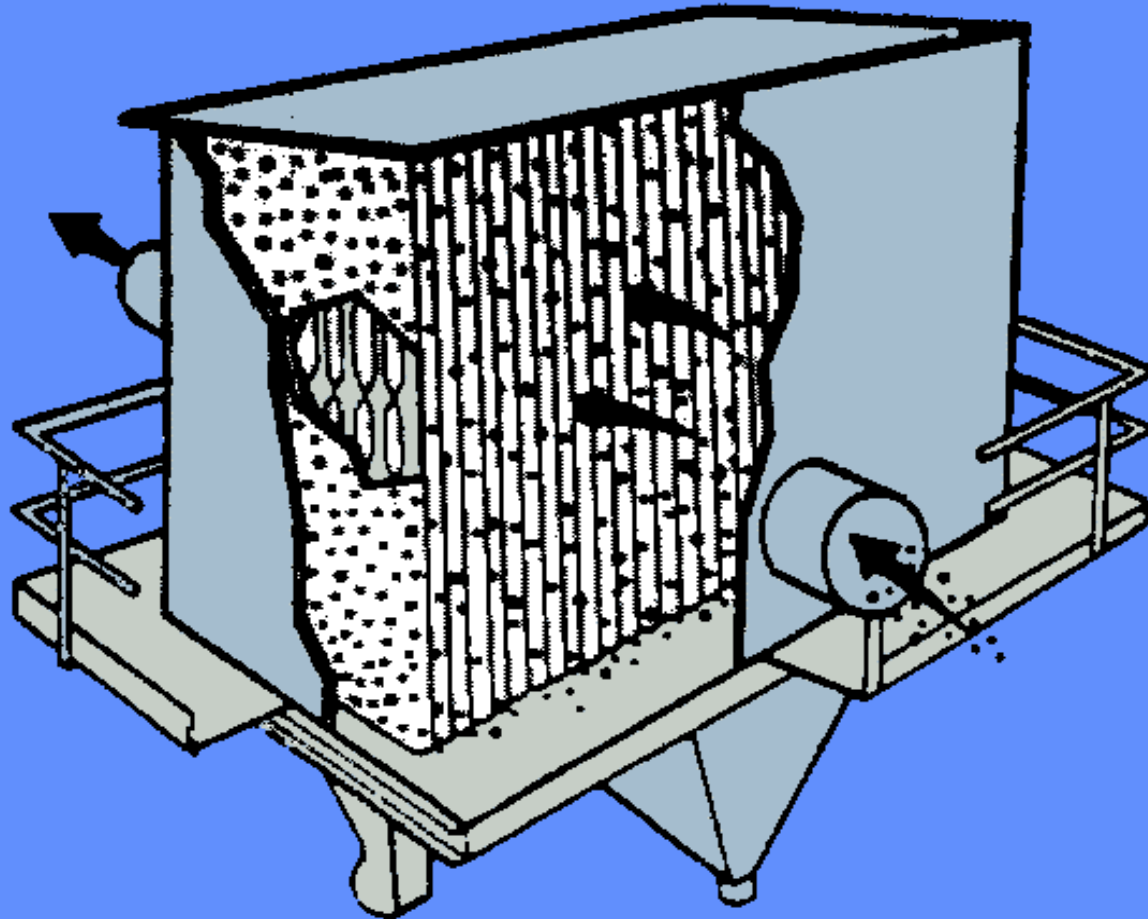
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Cartridge Filter Baghouse

3/1/2022

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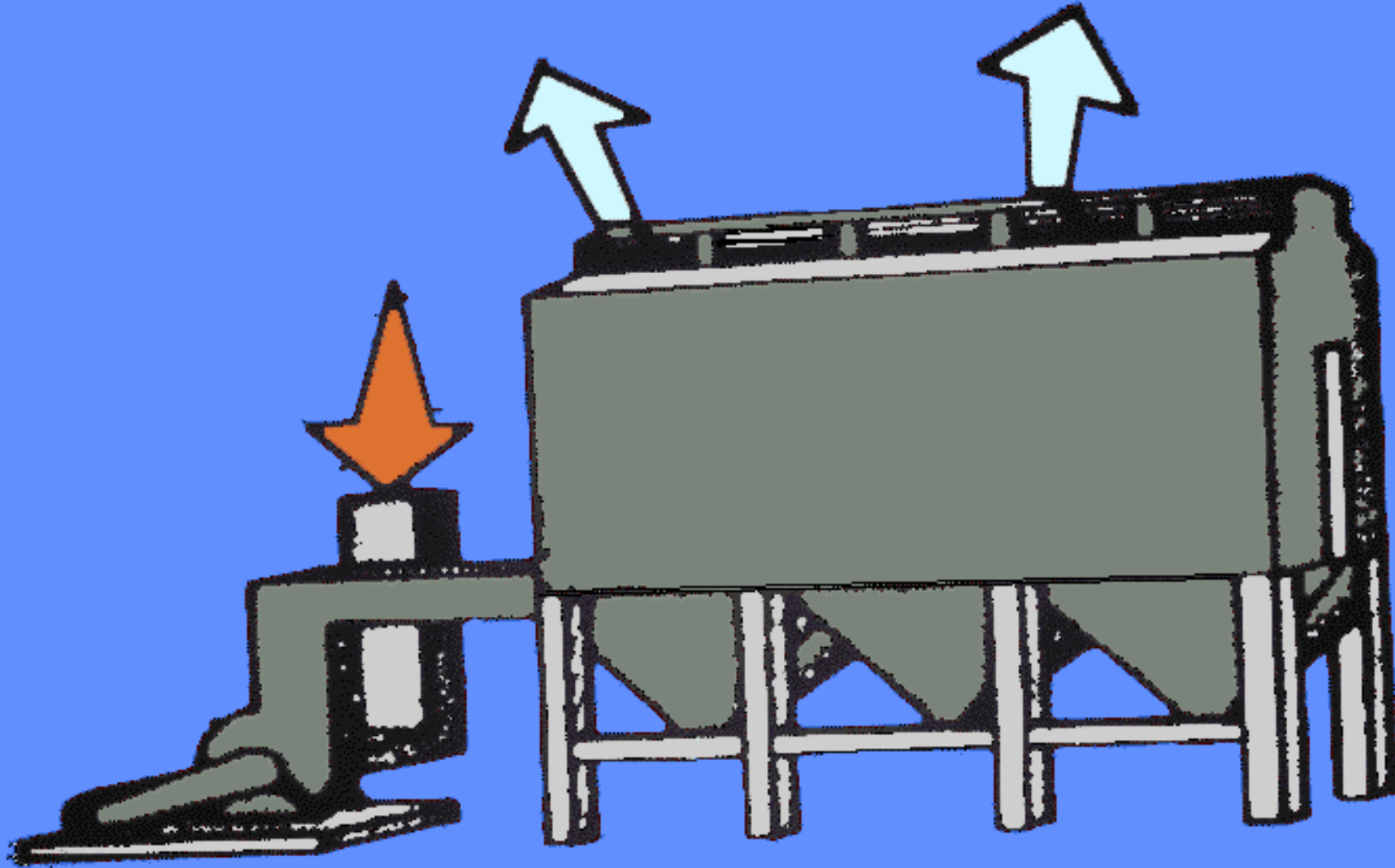
Envelope Filter Baghouse



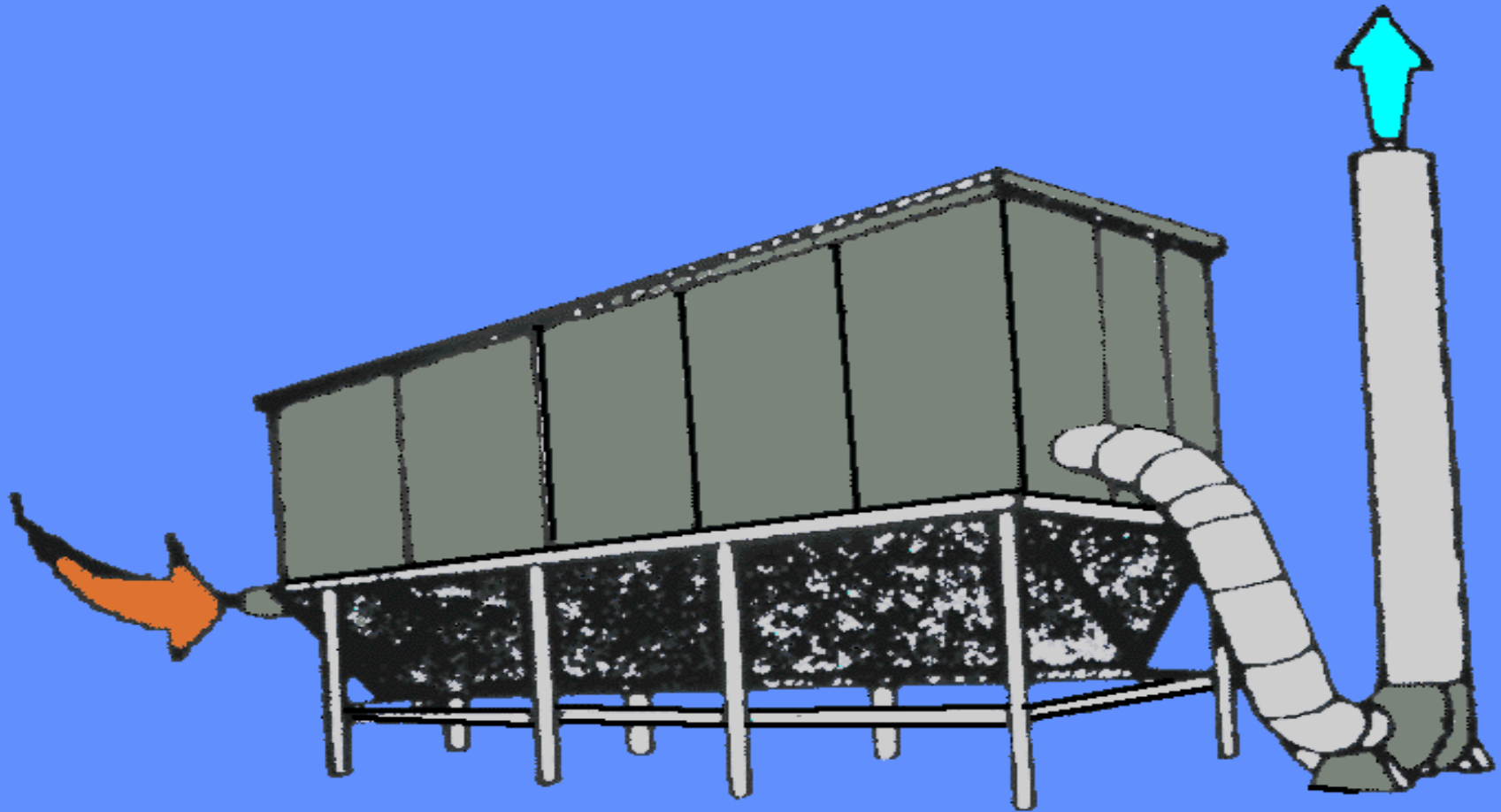


Fan Location

Positive Pressure Baghouse



Negative Pressure Baghouse



Cleaning Mechanism



Methods of Cleaning

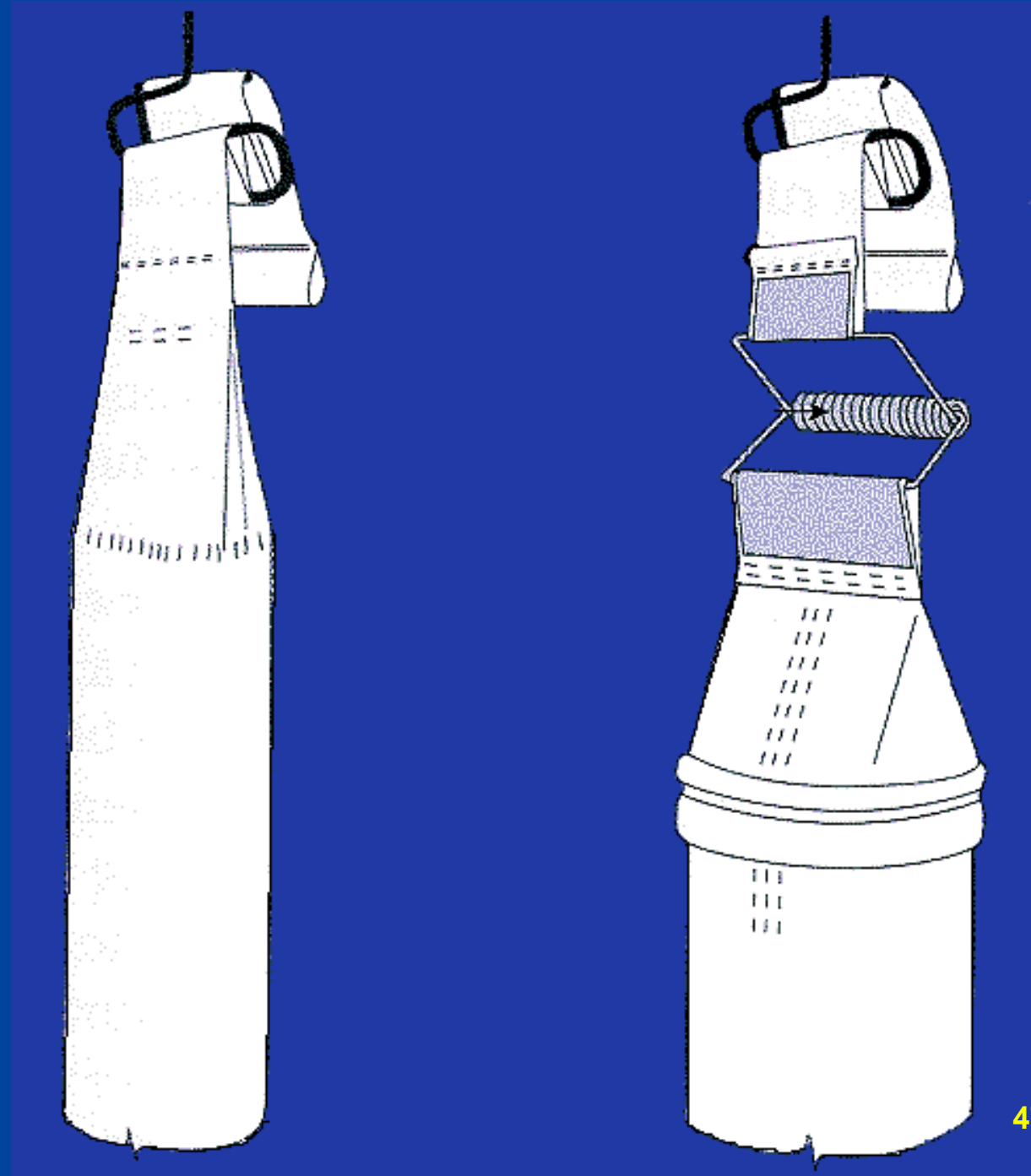
- **Shaking**
- **Reverse Air**
- **Pulse Jet**
- **Sonic**

Shaker Mechanism



Shaker Bag with Torsion Spring

Courtesy BHA



Shaker Motor and Hangers

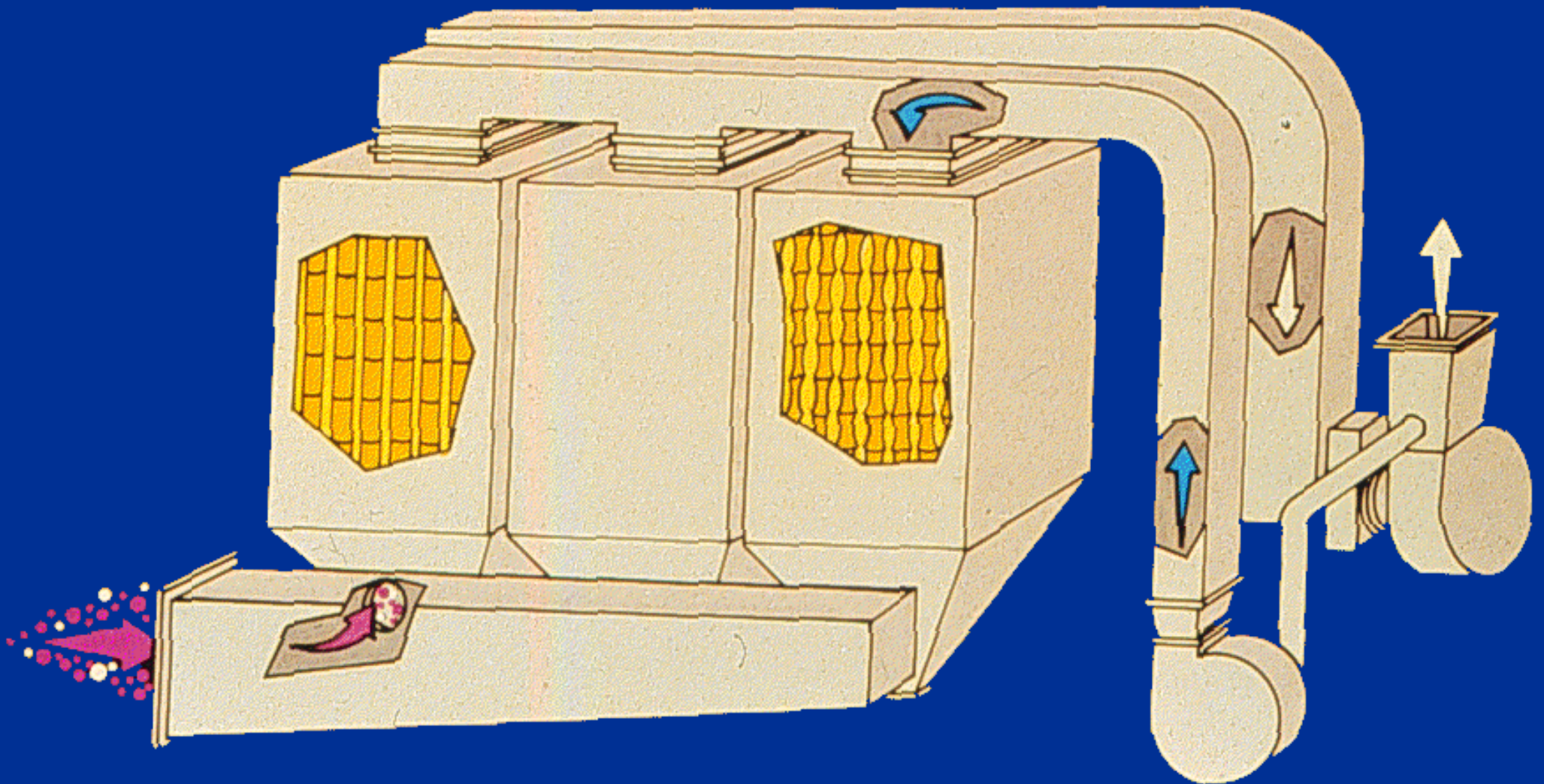


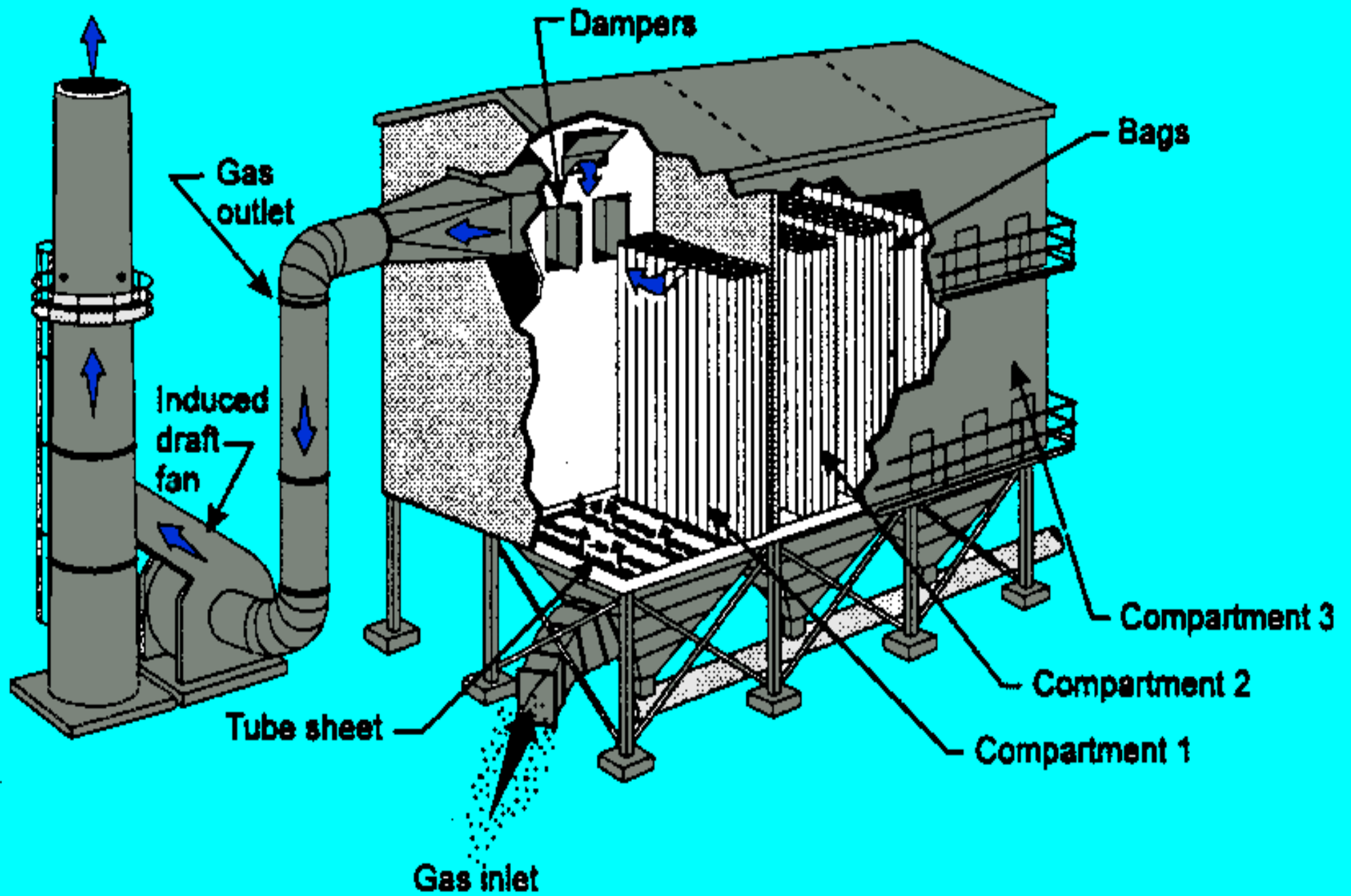
Shaker Cleaning System Problems

(Section 503.9)

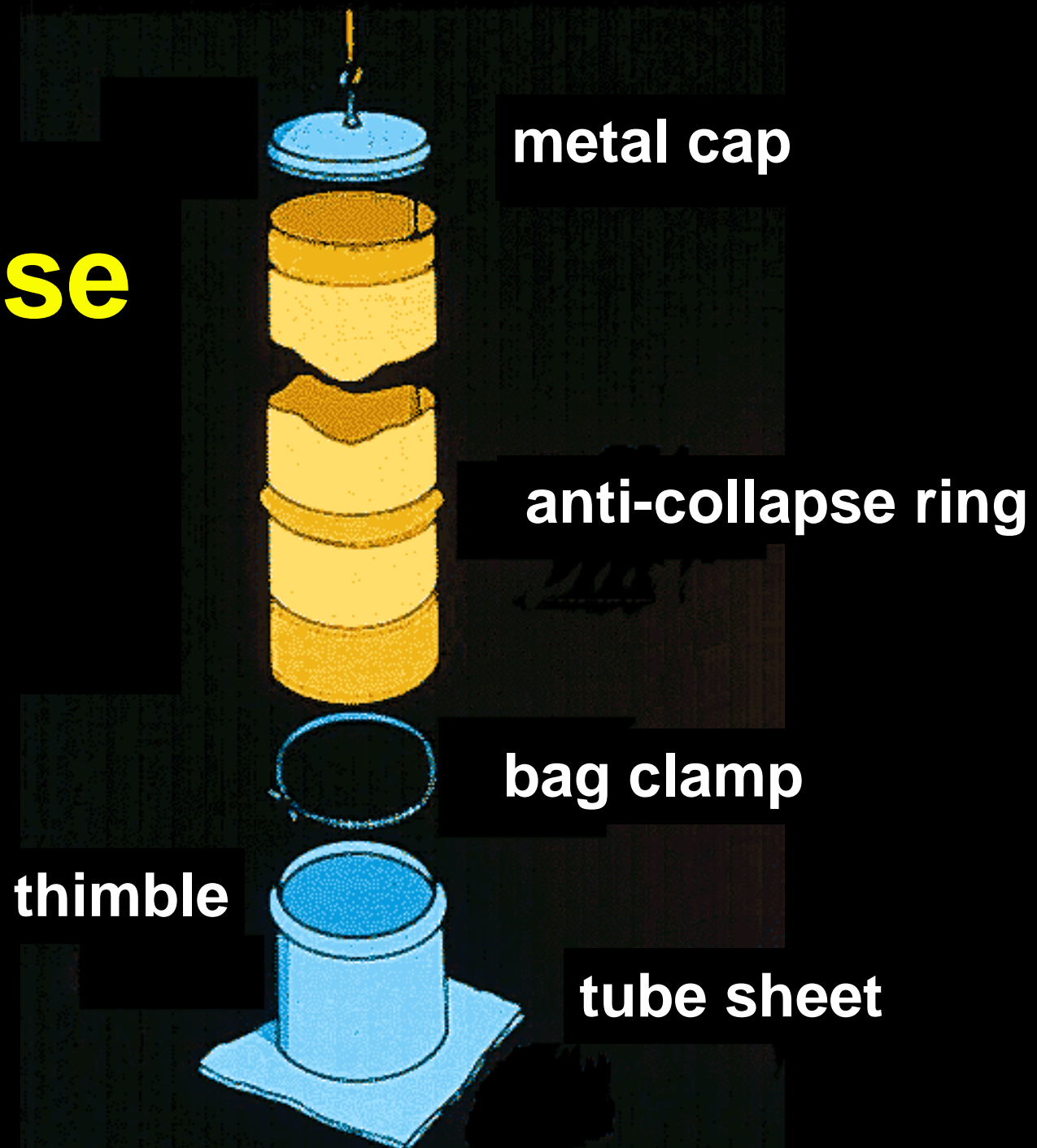
- **Improper operation or failure of motors**
- **Inadequate maintenance of linkages**
- **Improper bag tension**
- **Hanging mechanism problems**

Reverse Air Baghouse

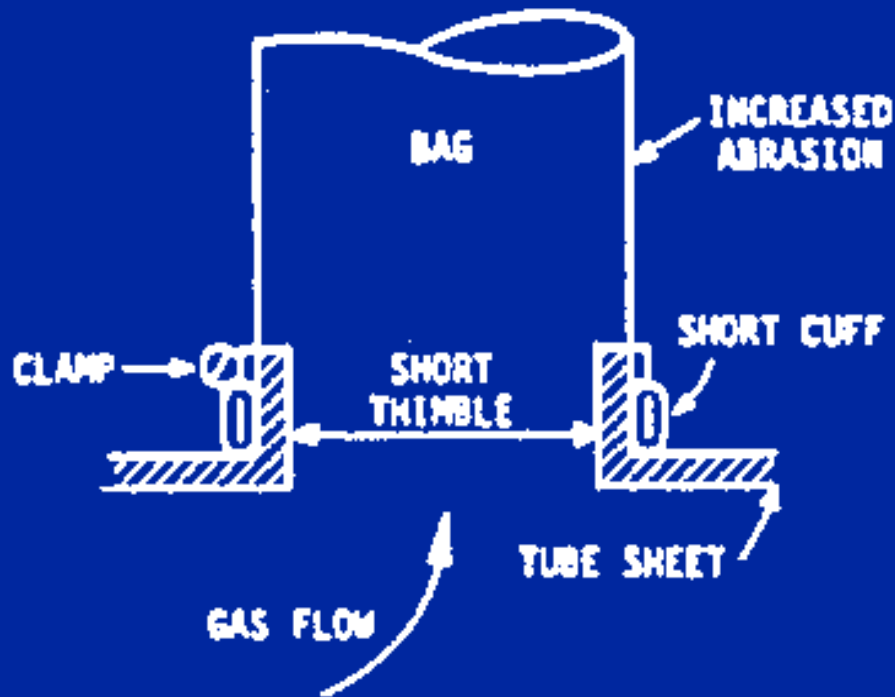




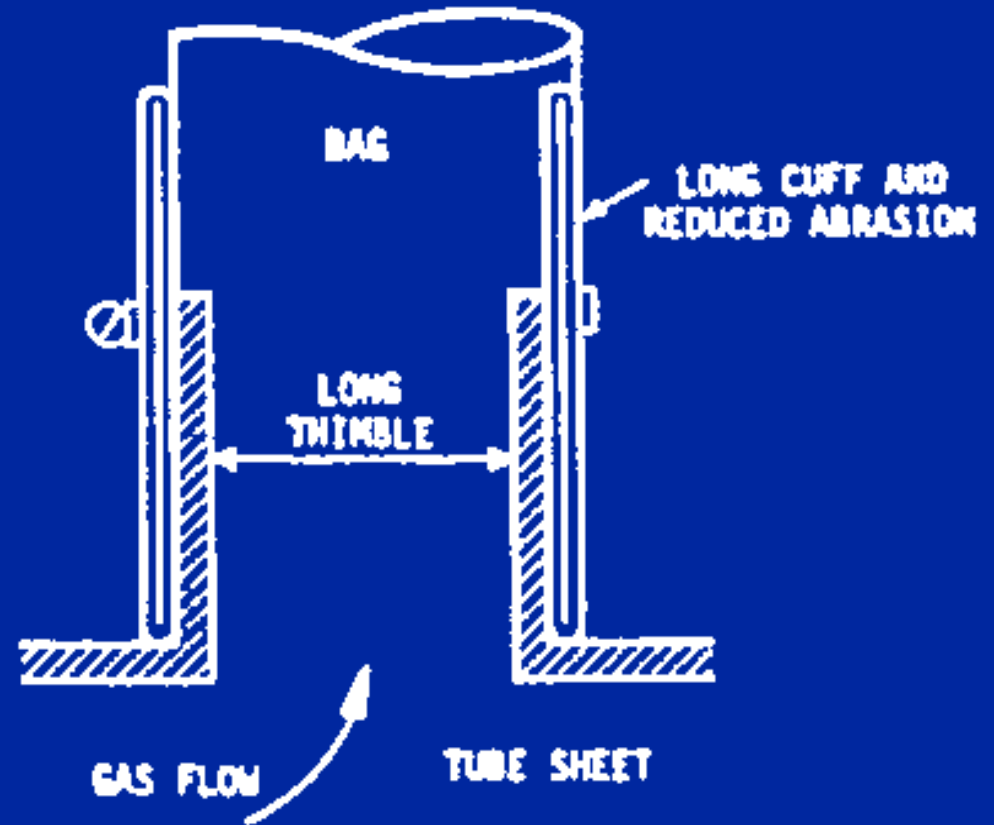
Reverse Air Bag



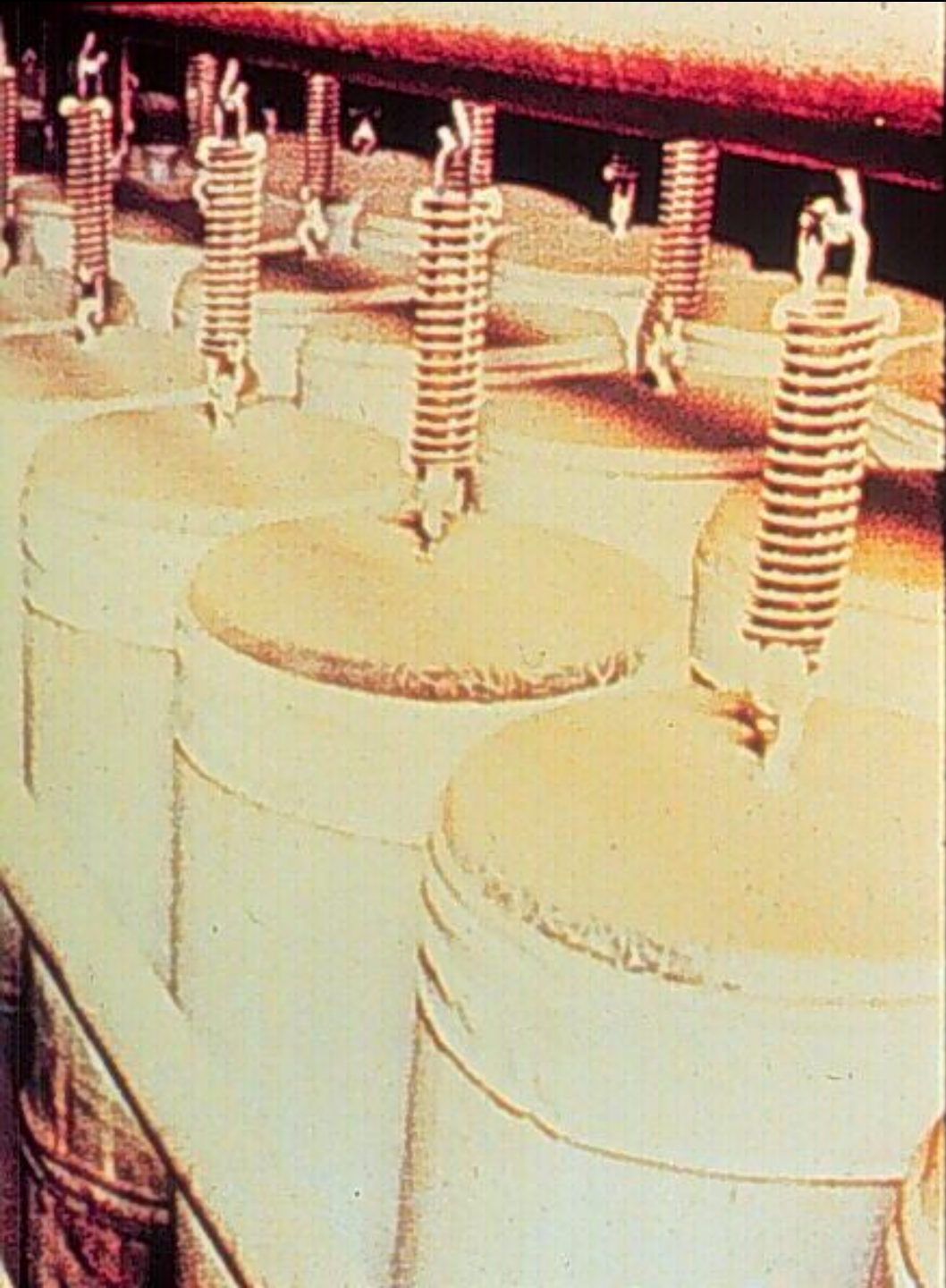
Thimble Design



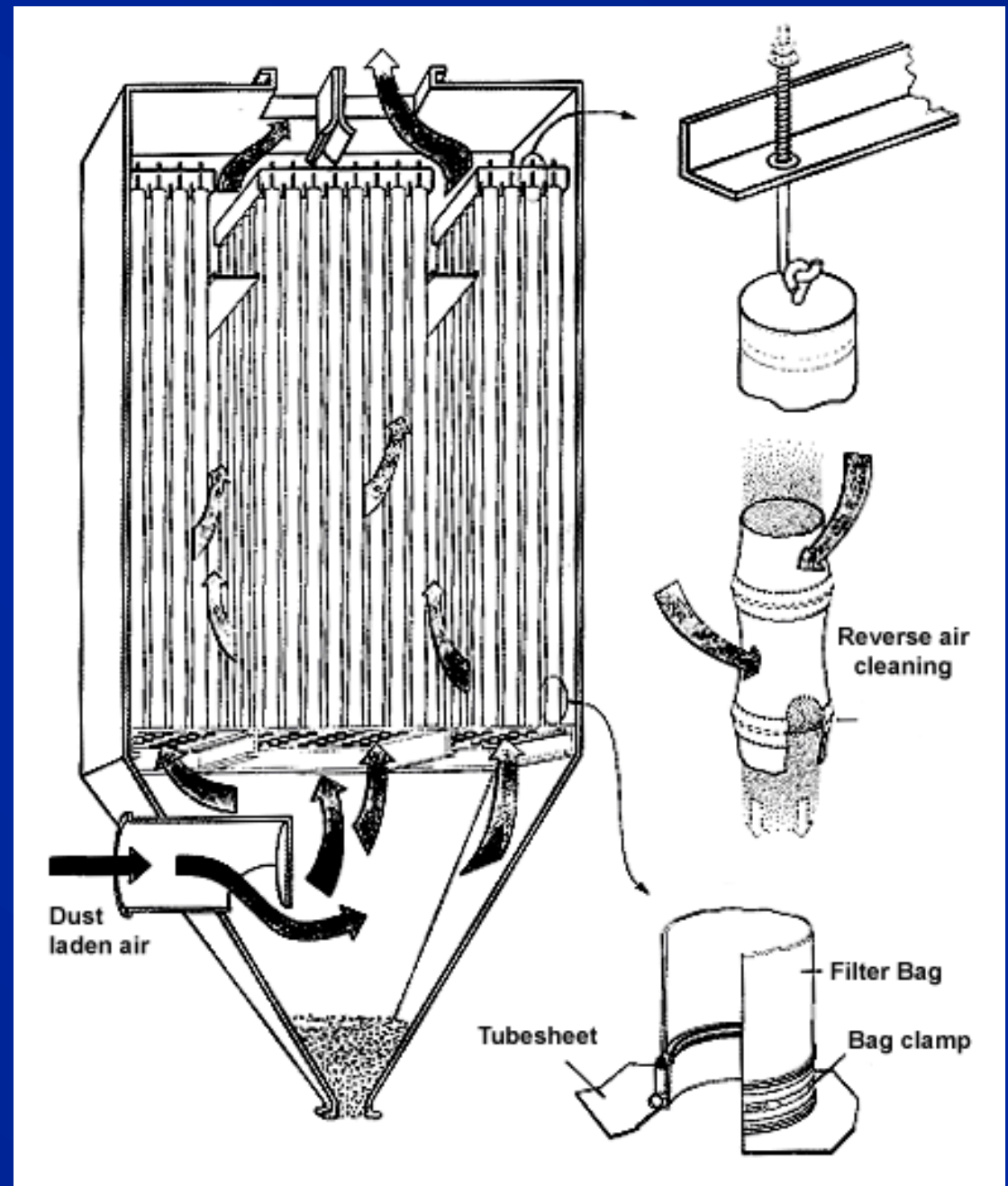
OK



Better



Reverse Air Baghouse





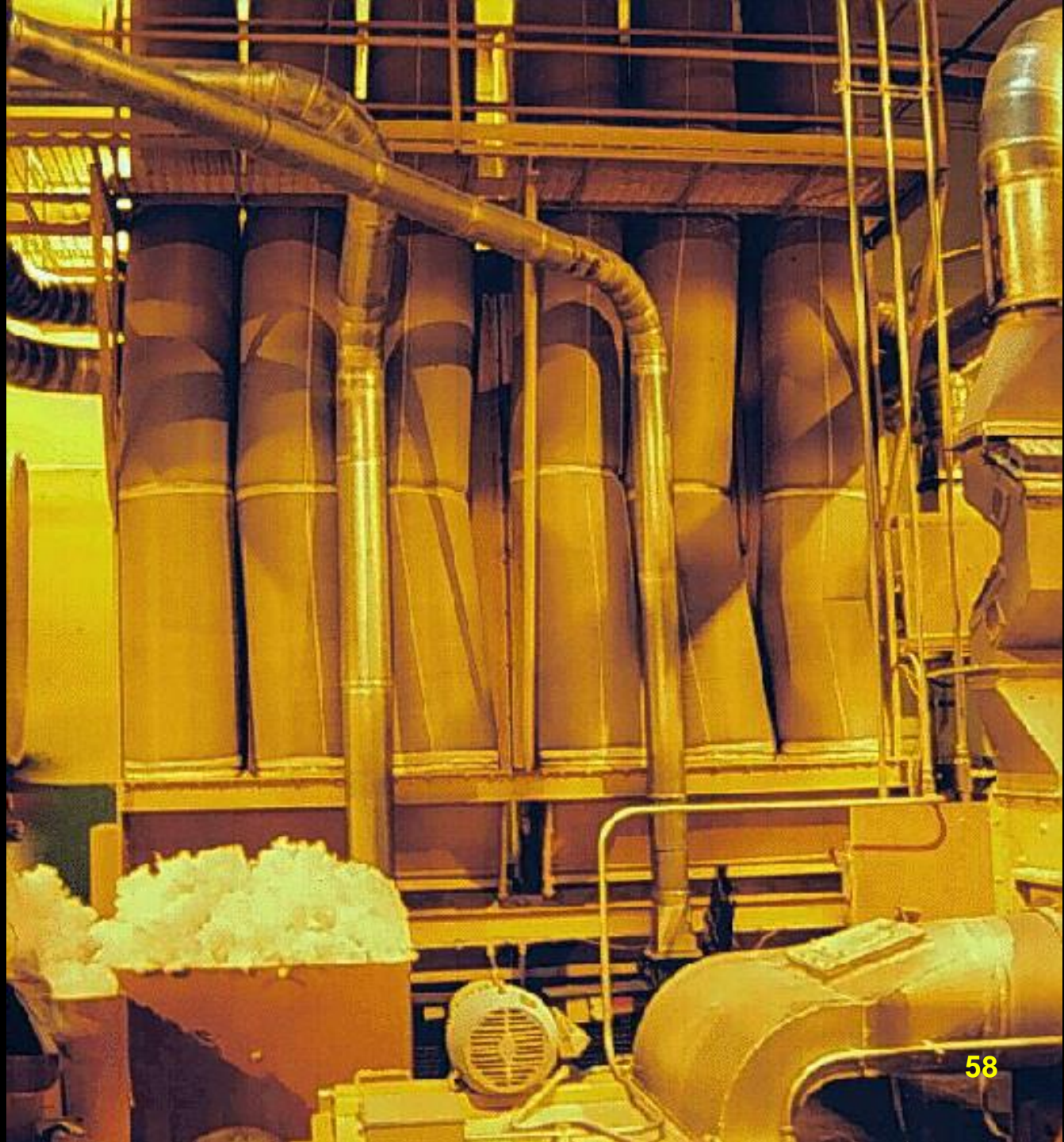
Reverse air baghouse at lumber mill



3/1/2022

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Reverse Air Cleaning System



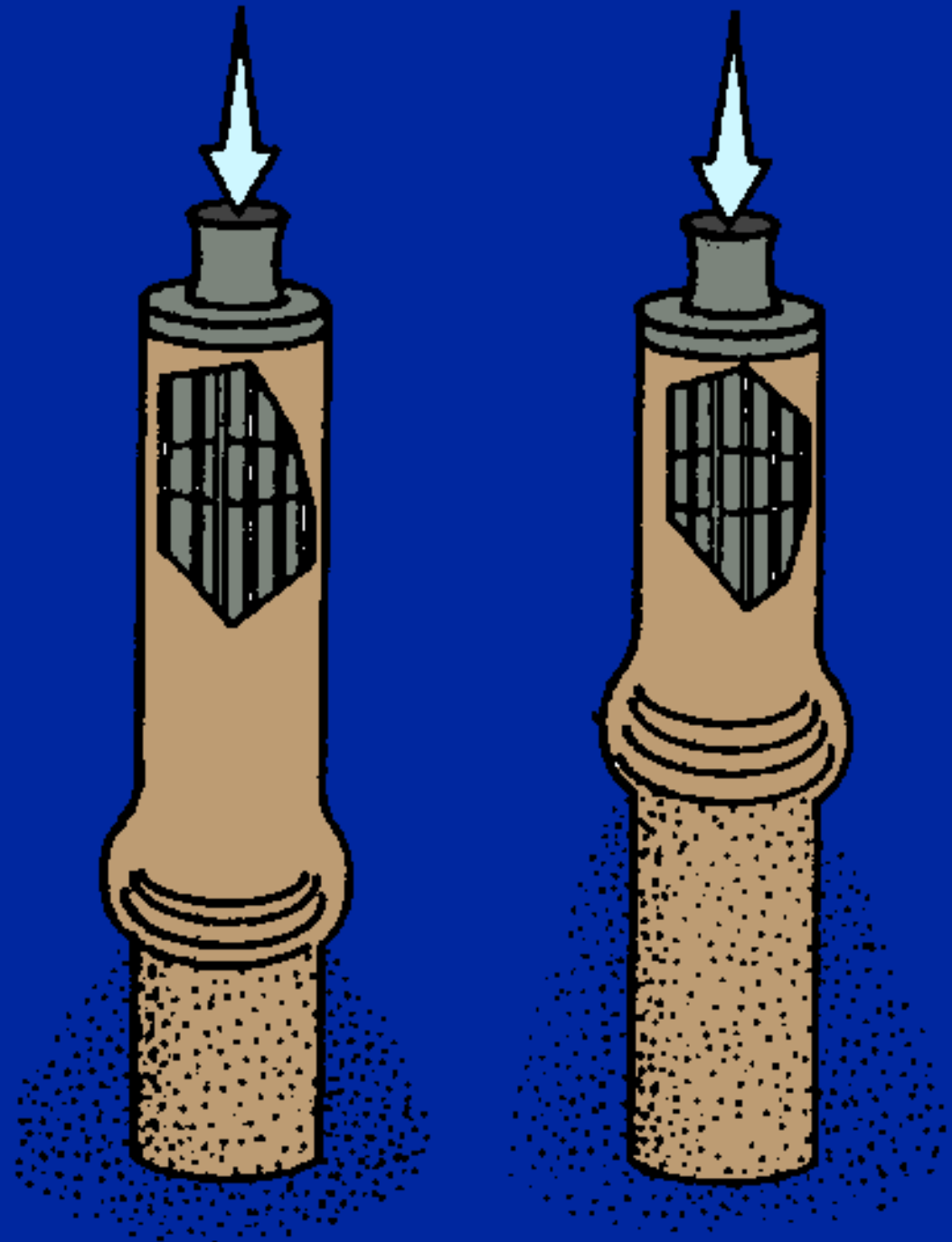
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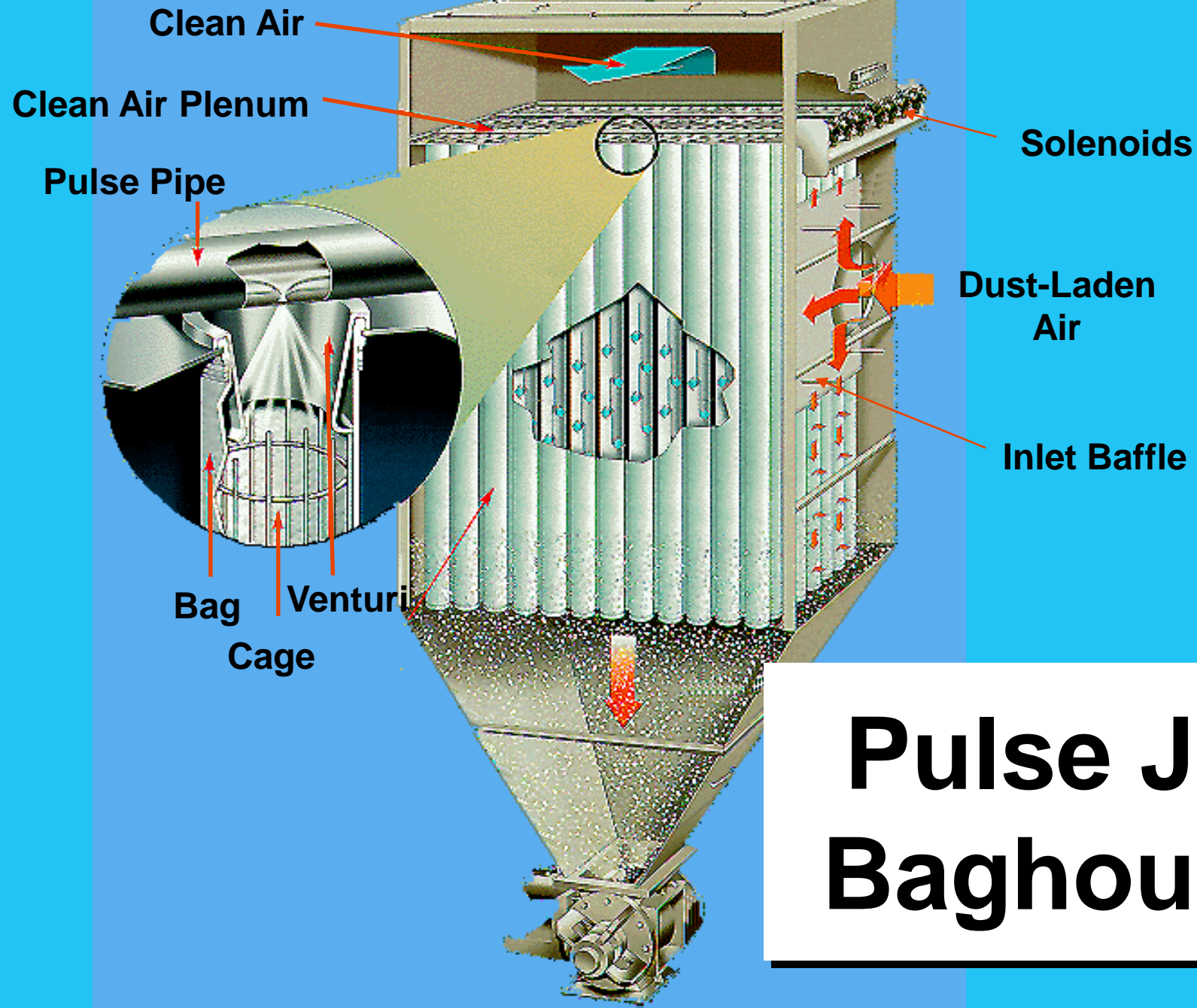
Reverse Air Cleaning System Problems

(Section 503.10)

- **Inadequate reverse air flow**
- **Leakage through poorly sealed dampers**
- **Improper bag tension**
- **Corrosion**

Pulse Jet Cleaning

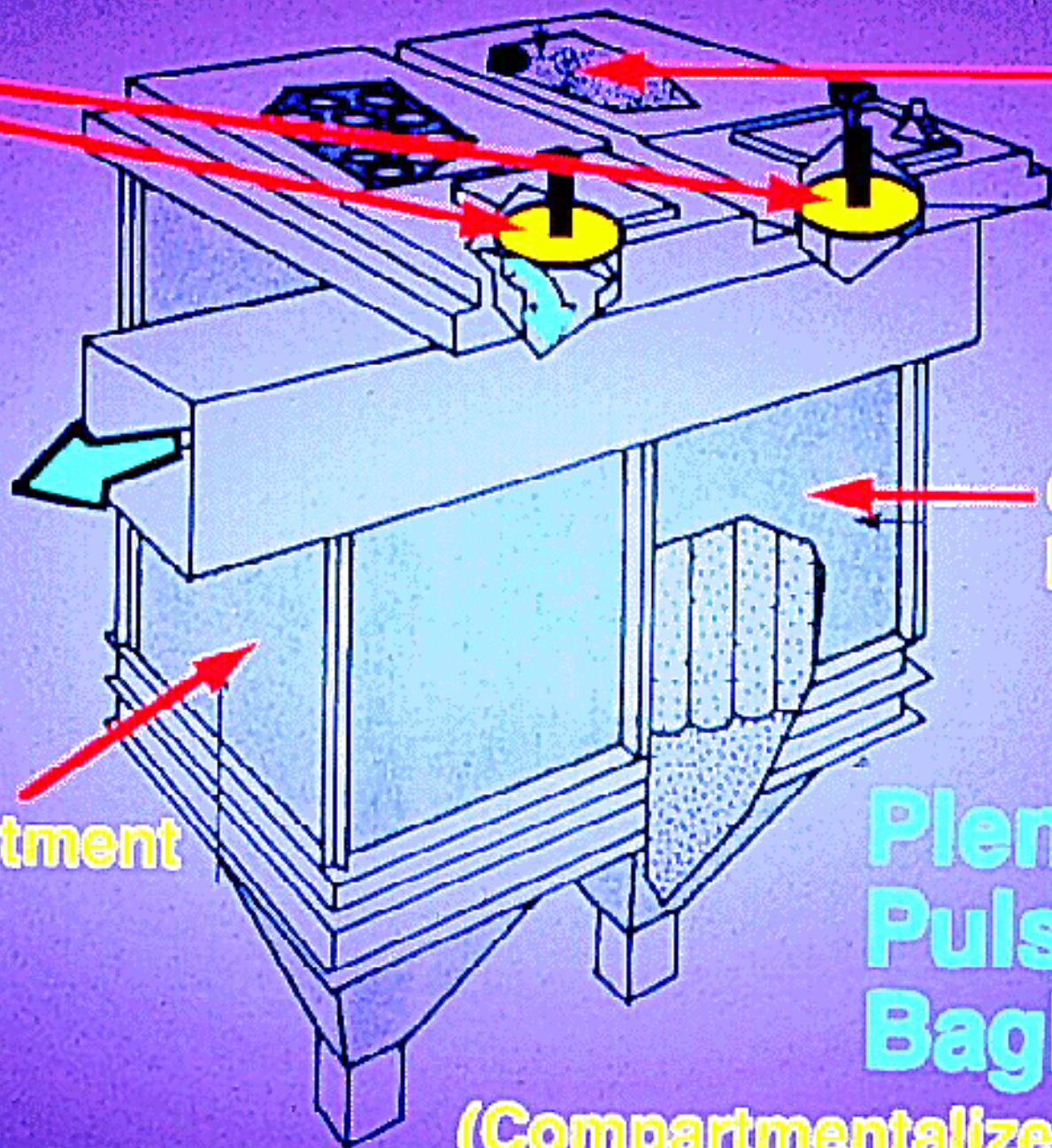




Pulse Jet Baghouse

Poppet valves

Burst of cleaning air



Compartment being cleaned

Compartment filtering

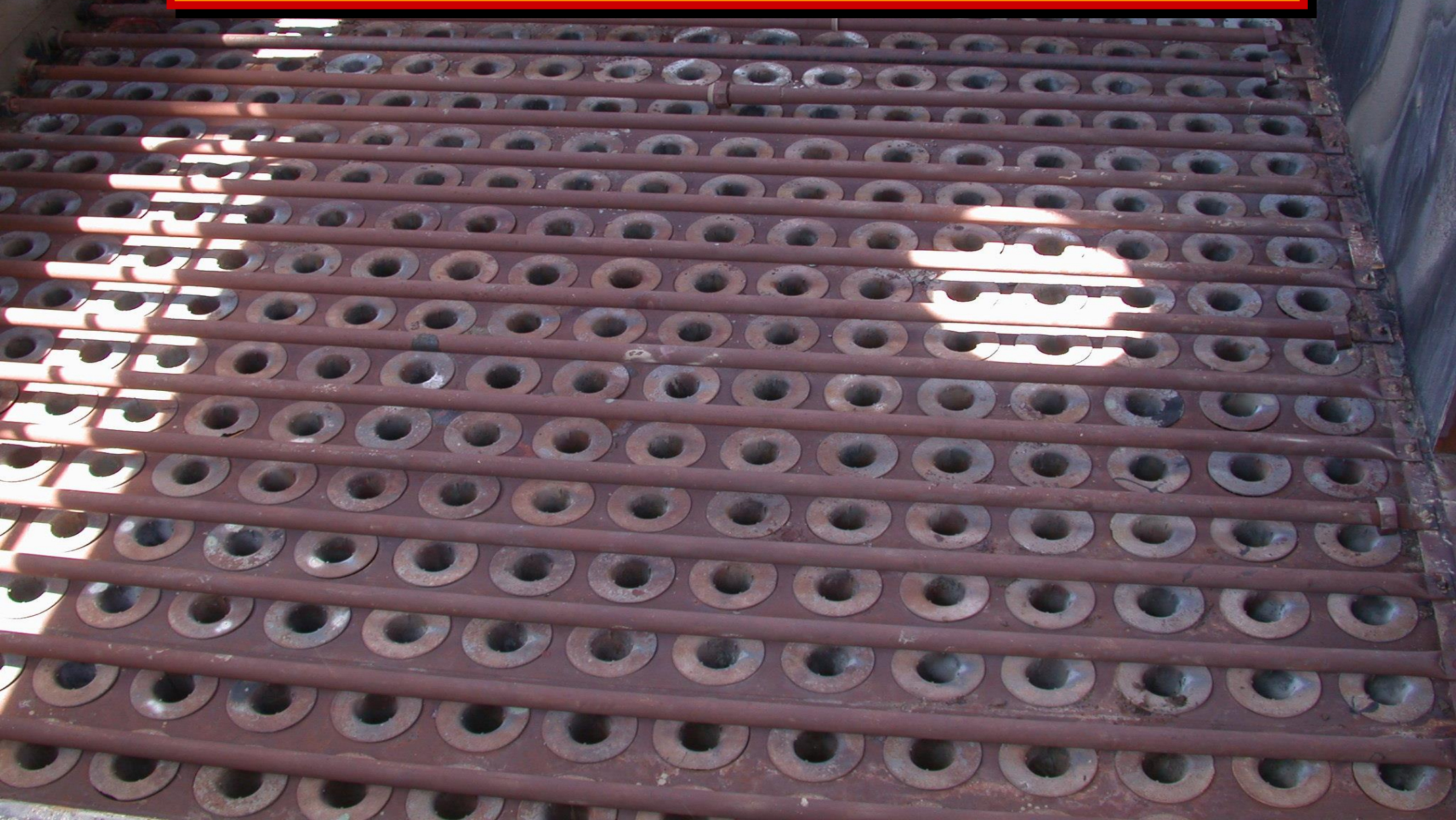
**Plenum
Pulse
Baghouse**

(Compartmentalized Pulse Jet)

Pulse Jet Baghouse



Inside a Pulse Jet Baghouse



Pulse Jet Bag



Pulse Air Distribution System





Snap Ring

Pulse Jet Cleaning System Problems

(Section 503.11)

- **Cage/bag misalignment**
- **Low compressed air pressure**
- **Contaminated compressed air**
- **Diaphragm valve leakage or freezing**
- **Loose, misaligned pulse pipe**
- **Timer or differential pressure sensor failure**
- **Excessive cleaning frequency**

Sonic Cleaning



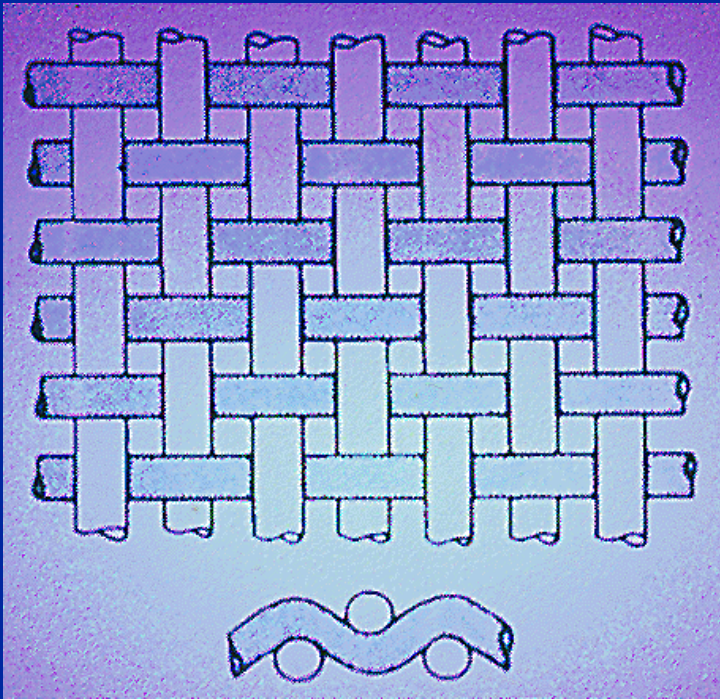
Acoustic Horn



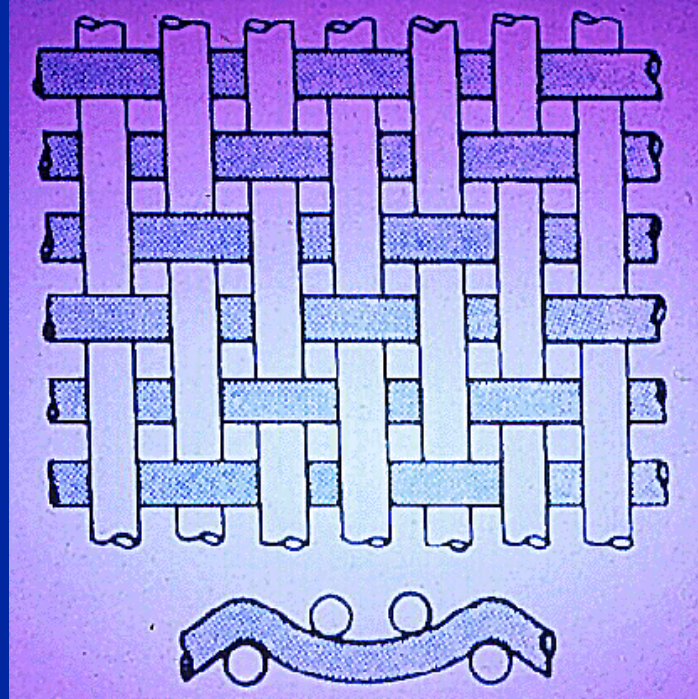
Filter Media

- **Woven**
- **Felted**
- **Membrane**
- **Sintered metal**
- **Ceramic**

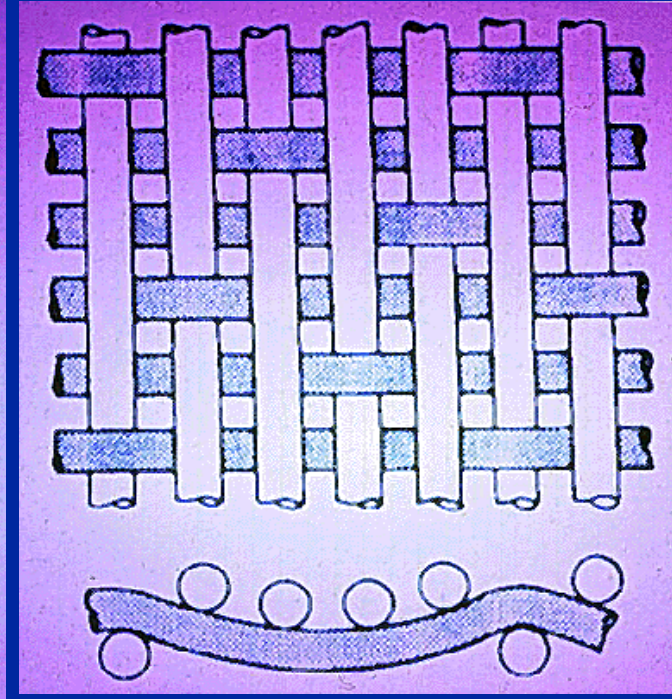
Fabric Weaves



Plain

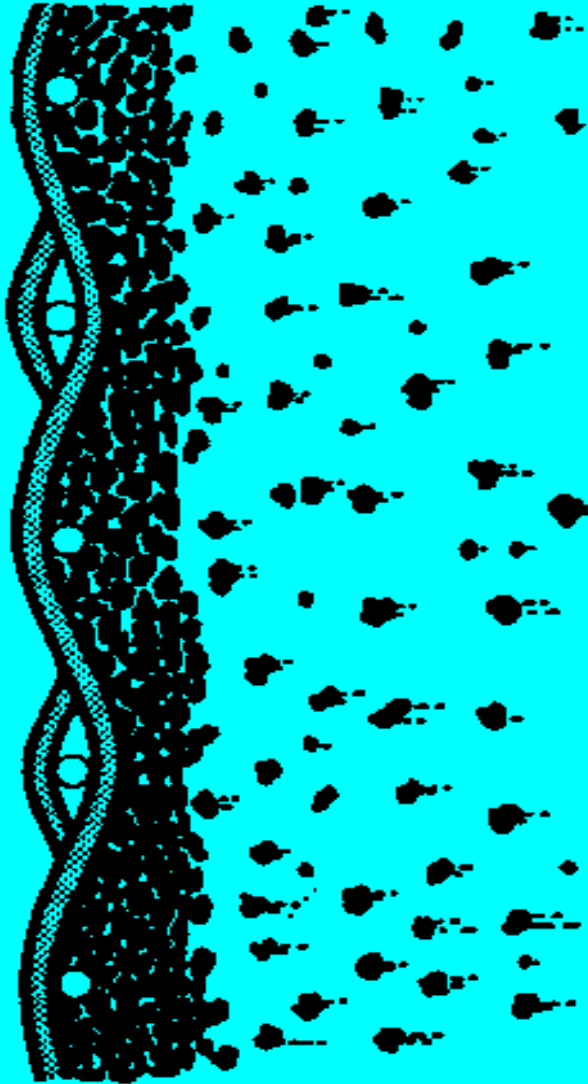


Twill

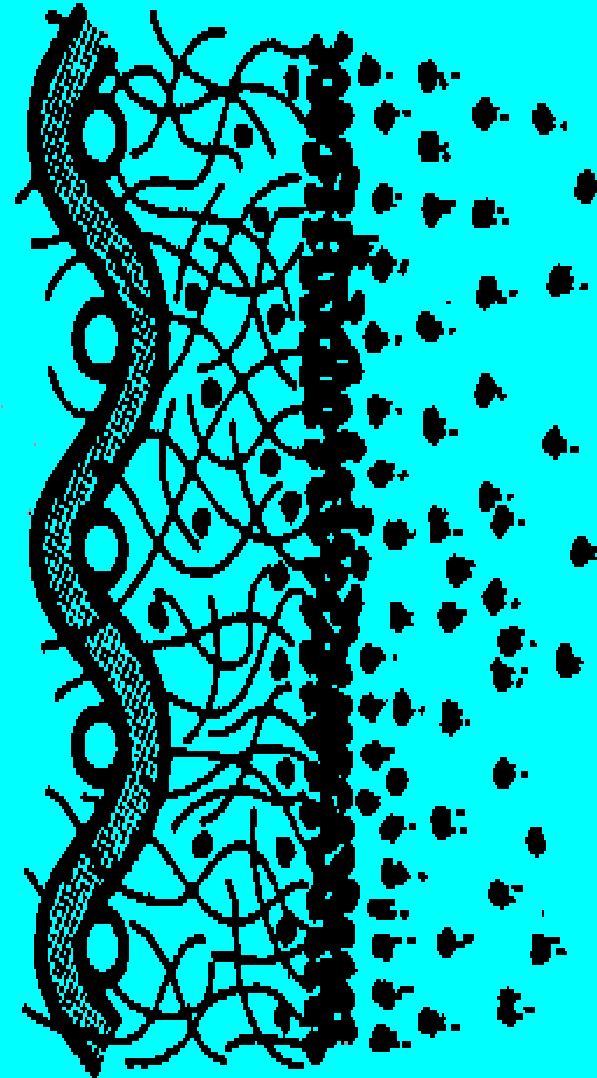


Sateen

Sieving on Woven Fabric



Sieving on Felted Fabric



Fabric Selection Factors

- **Maximum Operating Temperature**
- **Melting Temperature**
- **Resistance to Corrosive Chemicals**
- **Flex and Abrasion Resistance**
- **Permeability (vs. blinding)**
- **Type of dust**

Fabric Treatment Processes

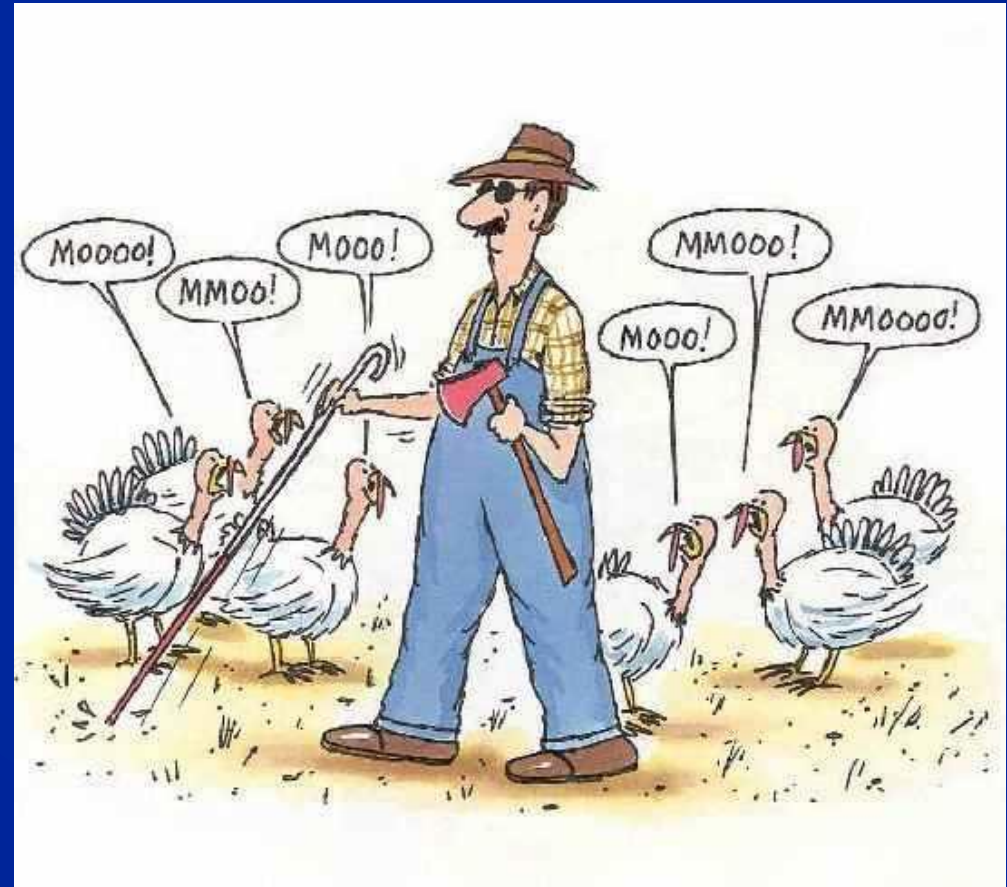
- **Calendaring**
- **Napping**
- **Singeing**
- **Glazing**
- **Coating**
- **Precoating**

Applications for Different Types of Fabrics

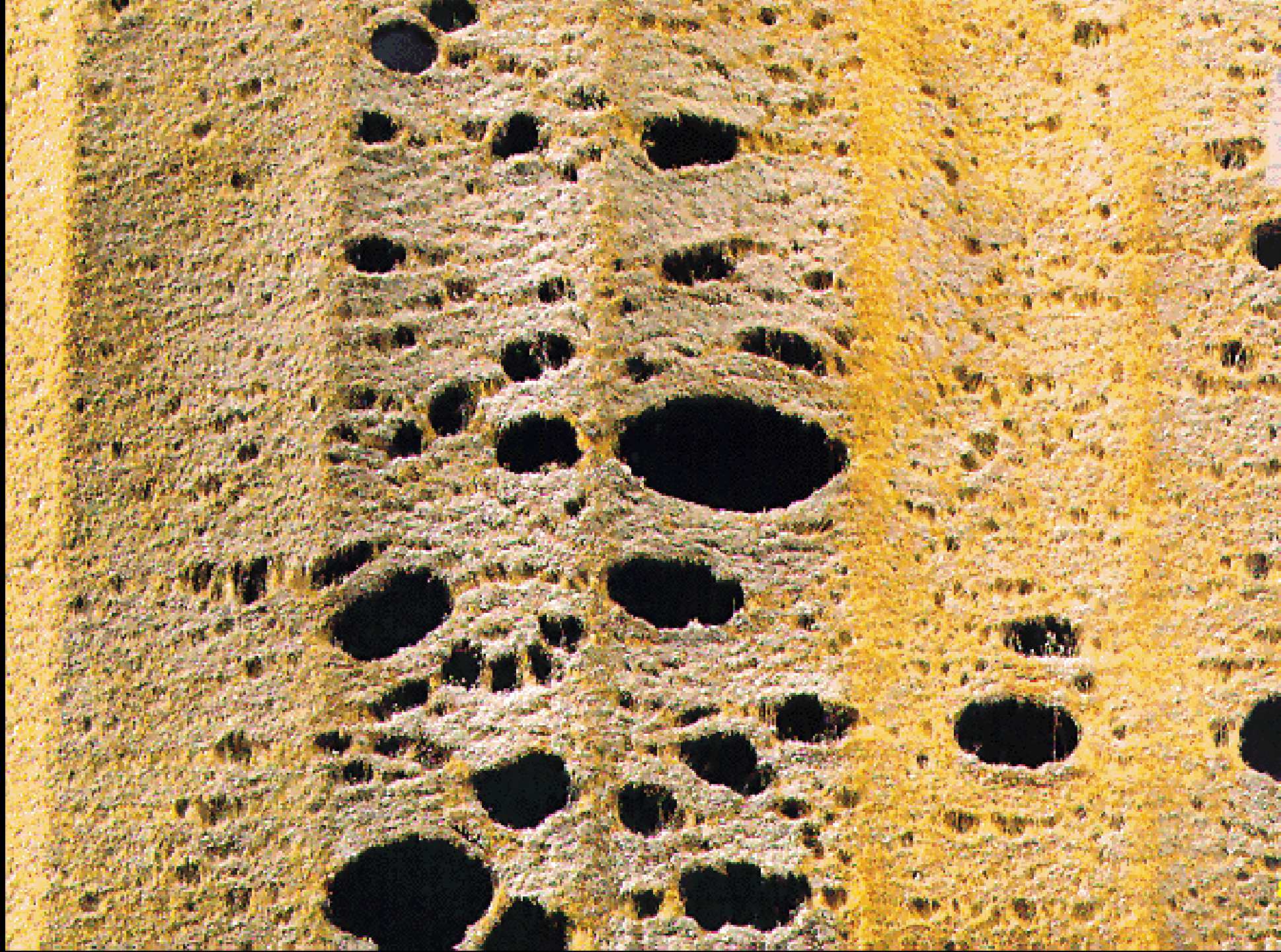
- **Cotton - Simple applications**
- **Nylon - Abrasive dusts**
- **Polyester - Metal industries**
- **Nomex - Asphalt batch plants**
- **Teflon - Coal-fired boilers**

Fabric Blinding

- **Moisture in dust cake**
- **Lubricating oil (pulse jet)**
- **Submicron particles**







What Is Going Into Your Baghouse?

- **Dust Properties**
- **Gas Flow Rate**
- **Gas Temperature**
- **Chemical Composition**

A photograph of an industrial facility with a large plume of dust or steam rising from a conveyor system. In the background, a building has a sign that reads "FALCON ENGINE ASSOCIATES".

Dust Properties

- Mass Loading
- Abrasive Particles
- Size Distribution

Design Considerations

- **Pressure Drop**
- **Air-To-Cloth Ratio**
- **Collection Efficiency**
- **Fabric Type**
- **Cleaning**
- **Temperature Control**
- **Bag Spacing**
- **Compartment Design**
- **Space and Cost**



Pressure Drop (dp)

- Resistance To Airflow
- Inlet Pressure - Outlet Pressure
- Size of Fan
- Filter & Dust Cake



INCHES OF WATER

0 10 20 30 40

MAGNEHELIC

MAX. PRESSURE 15 PSIG

DWYDAR INSTRUMENTS INC.

CAT. NO. 7048

PAT. 3,091,823

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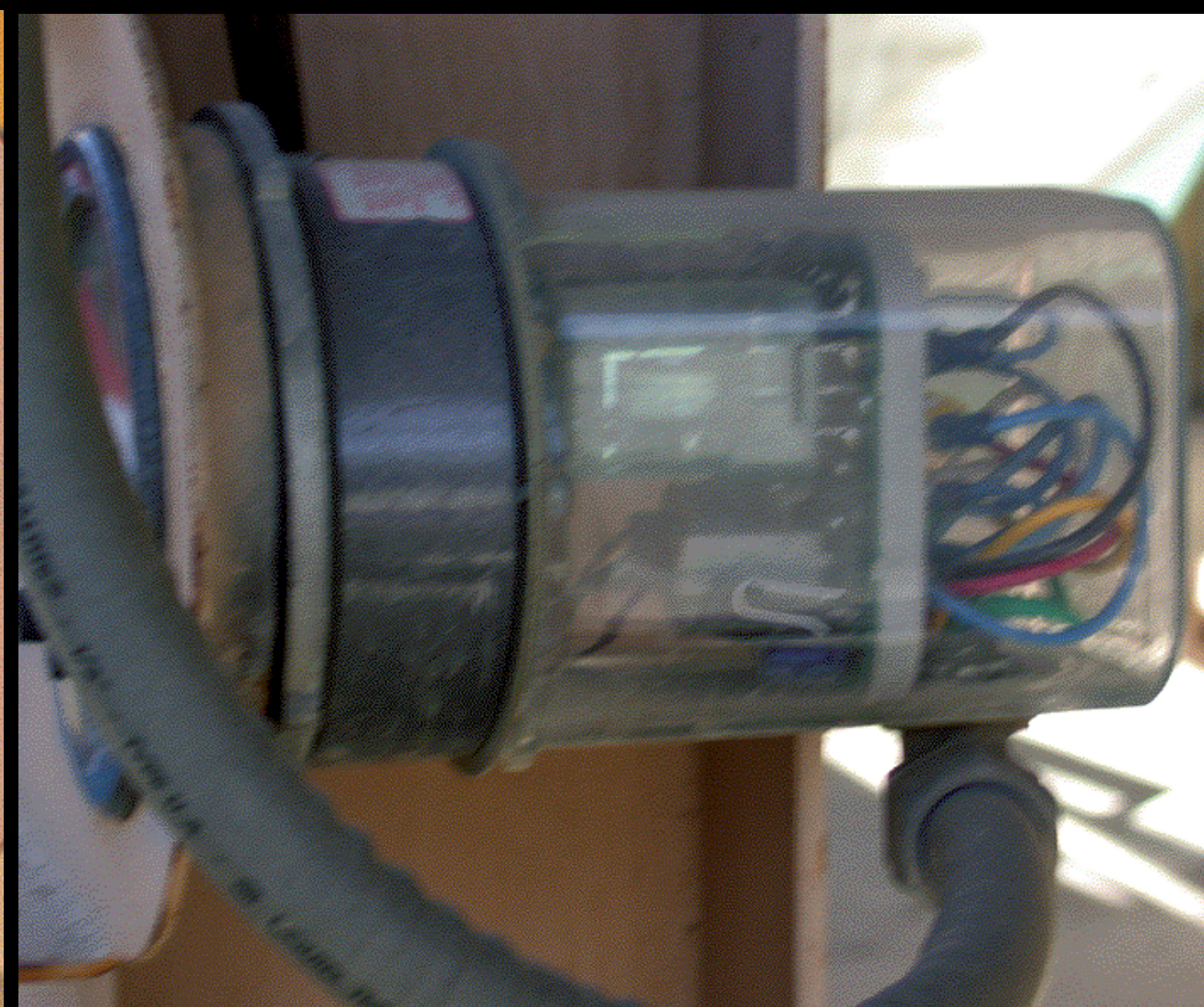
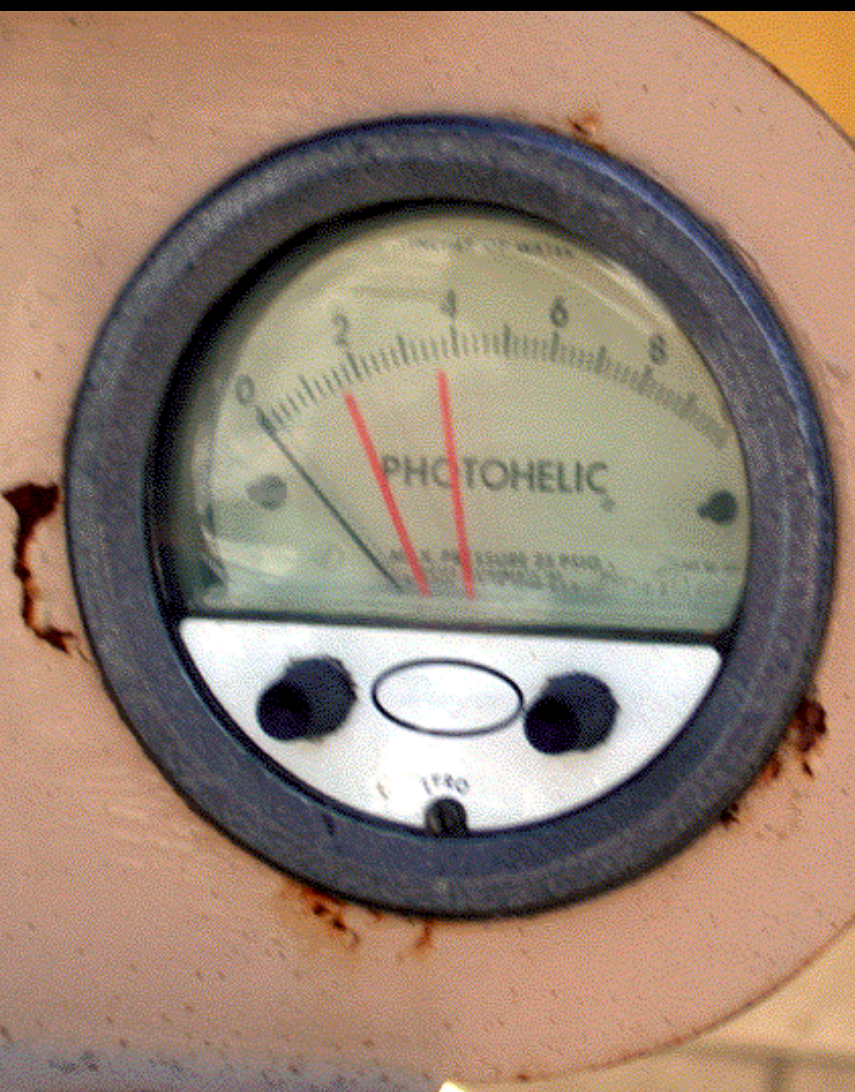
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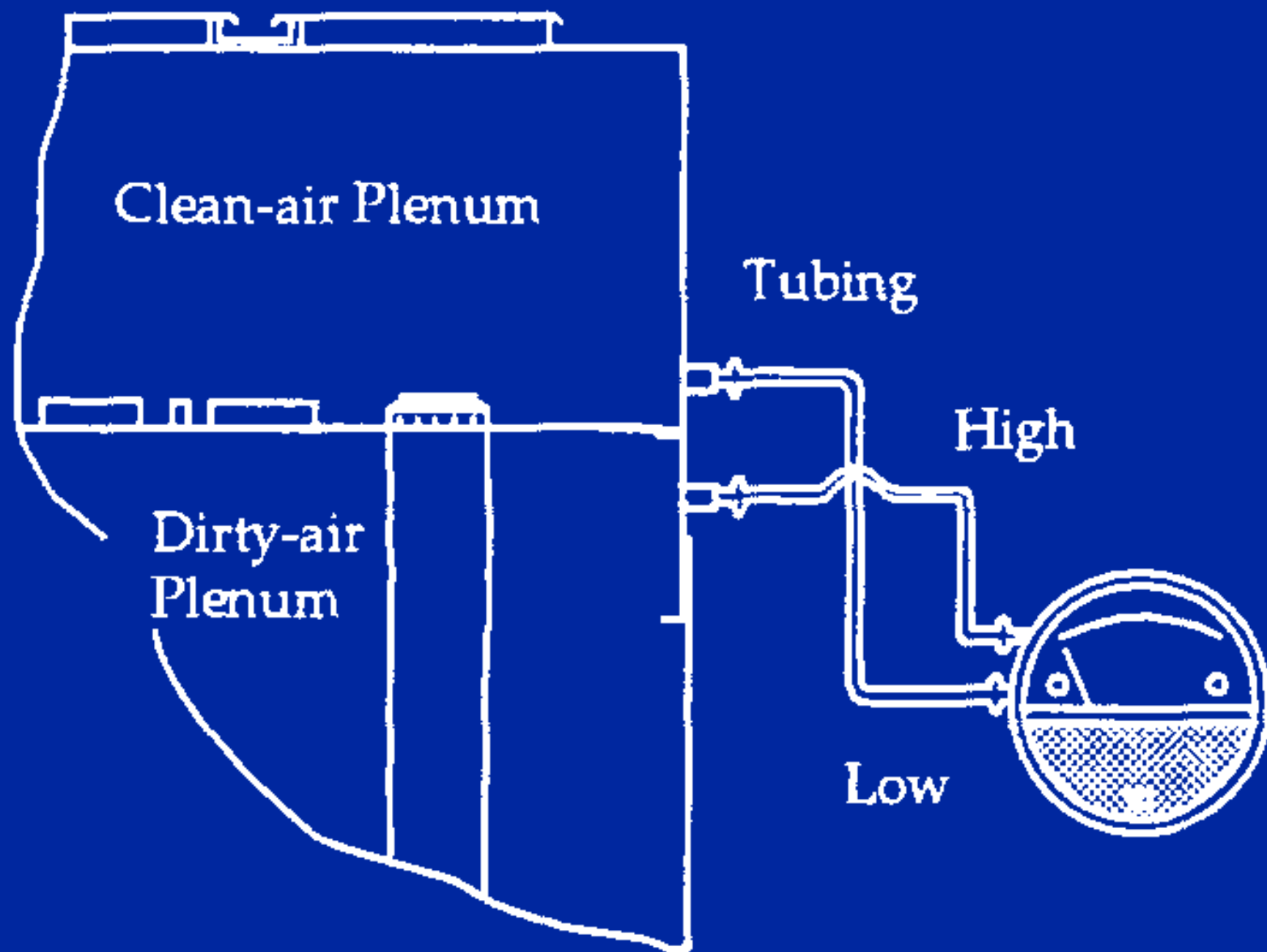
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Pressure Drop Across Filter

$$dp_f = k_1 v_f$$

dp_f = dp across clean fabric

k_1 = fabric resistance

v_f = filtration velocity

Pressure Drop Across Dust Cake

$$dp_c = k_2 c_i v_f^2 t$$

dp_c = dp across dust cake

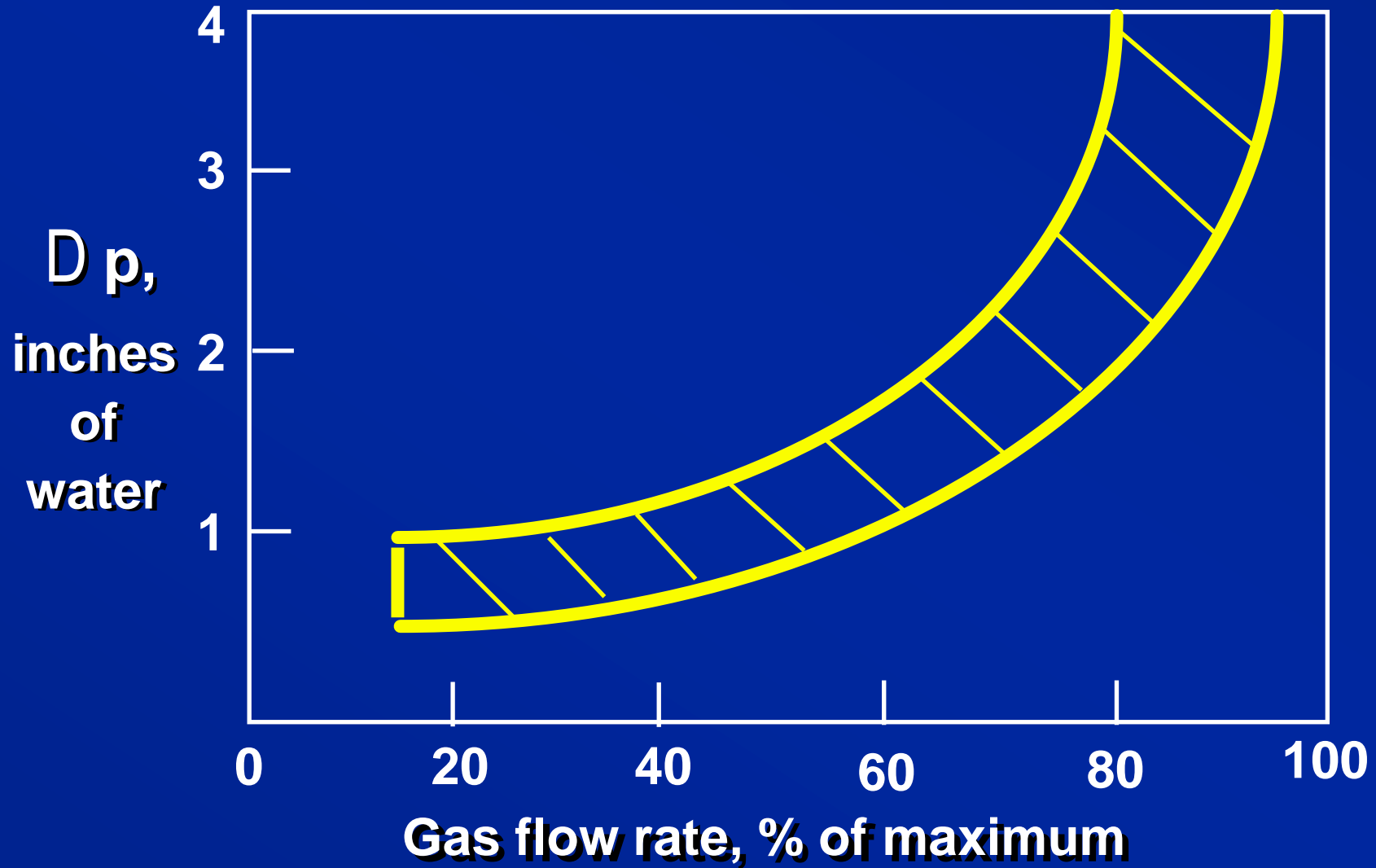
k_2 = resistance of dust cake

v_f = filtration velocity

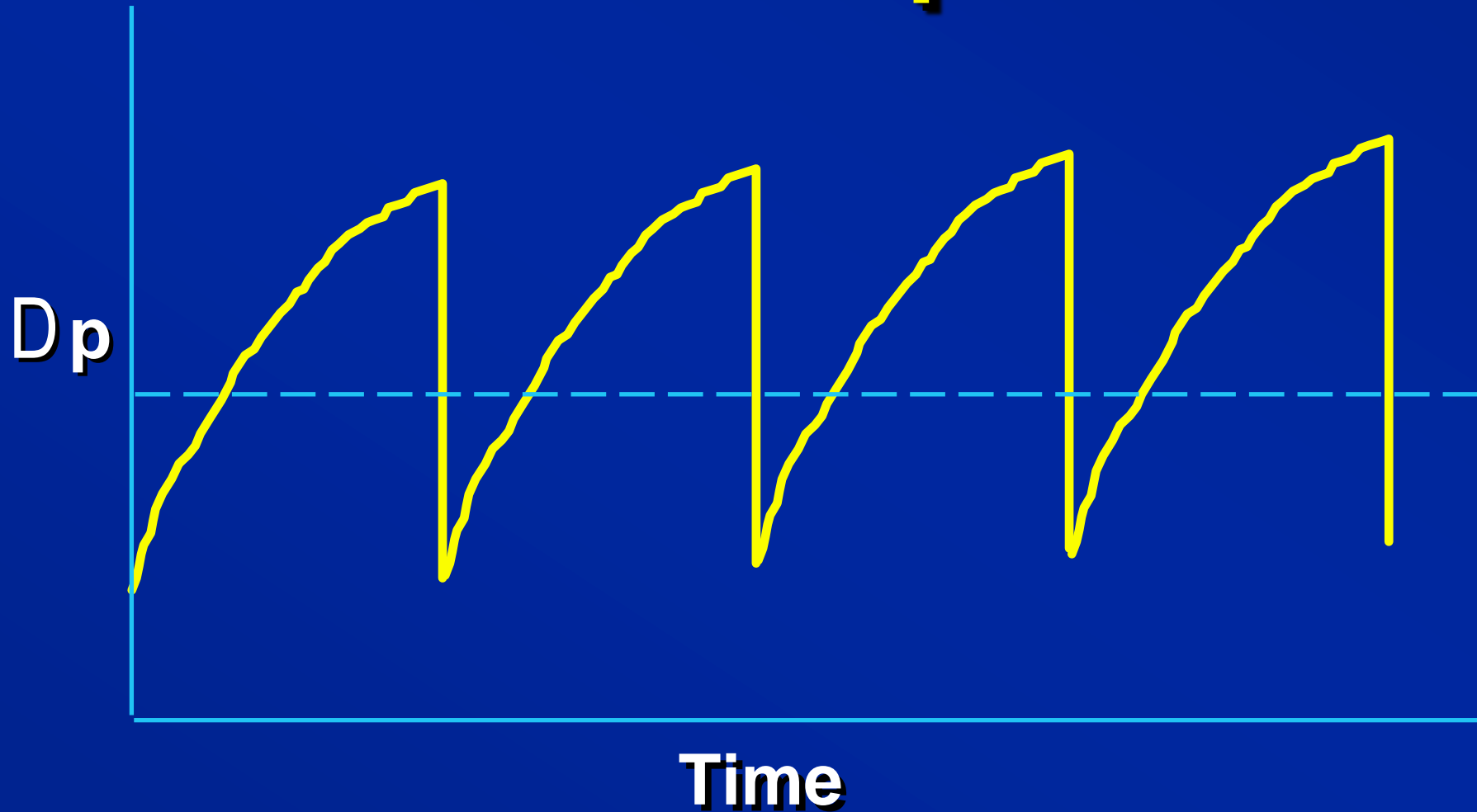
c_i = dust concentration loading

t = filtration time

Static Pressure Drop vs. Gas Flow Rate



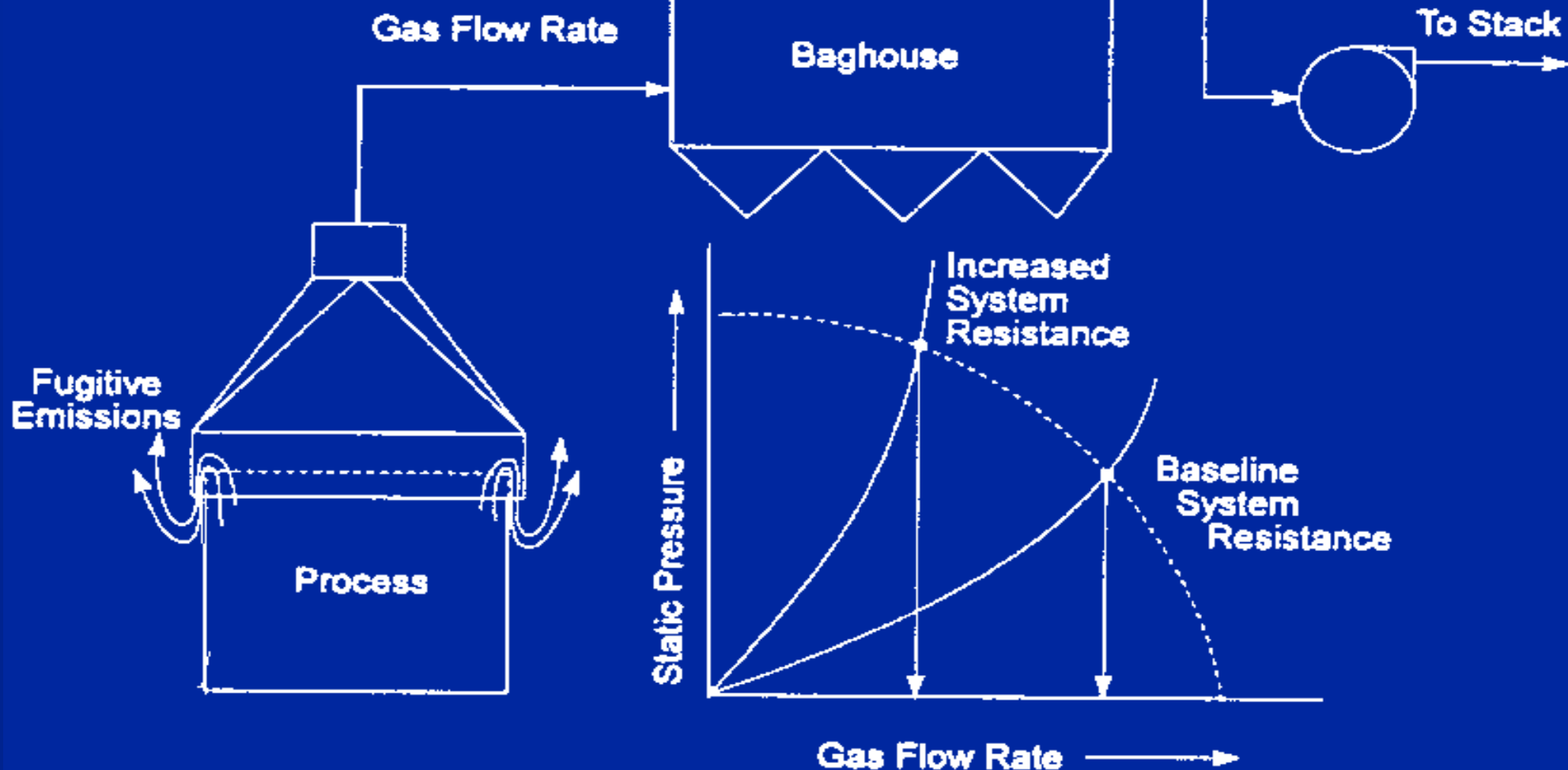
Pressure Drop Profile



Problems Related to Pressure Drop

- ***Pressure Drop Too High =***
 - bag blinding, blockage
 - increase in gas flow rate
 - fugitive emissions
- ***Pressure Drop Too Low =***
 - bag failure
 - inleakage

Fugitive emissions due to excessive pressure drop



Air-to-Cloth Ratio

$$v_f = Q/A$$

v_f = filtration velocity

Q = volumetric air flow rate

A = area of cloth filter

Cleaning Method	Air-To-Cloth Ratio	
	(cm³/sec)/cm²	(ft³/min)/ft²
Shaker	< 3:1	< 6:1
Reverse Air	< 2:1	< 4:1
Pulse Jet	2.5:1 to 7.5:1	<15:1

Importance of A/C Ratio

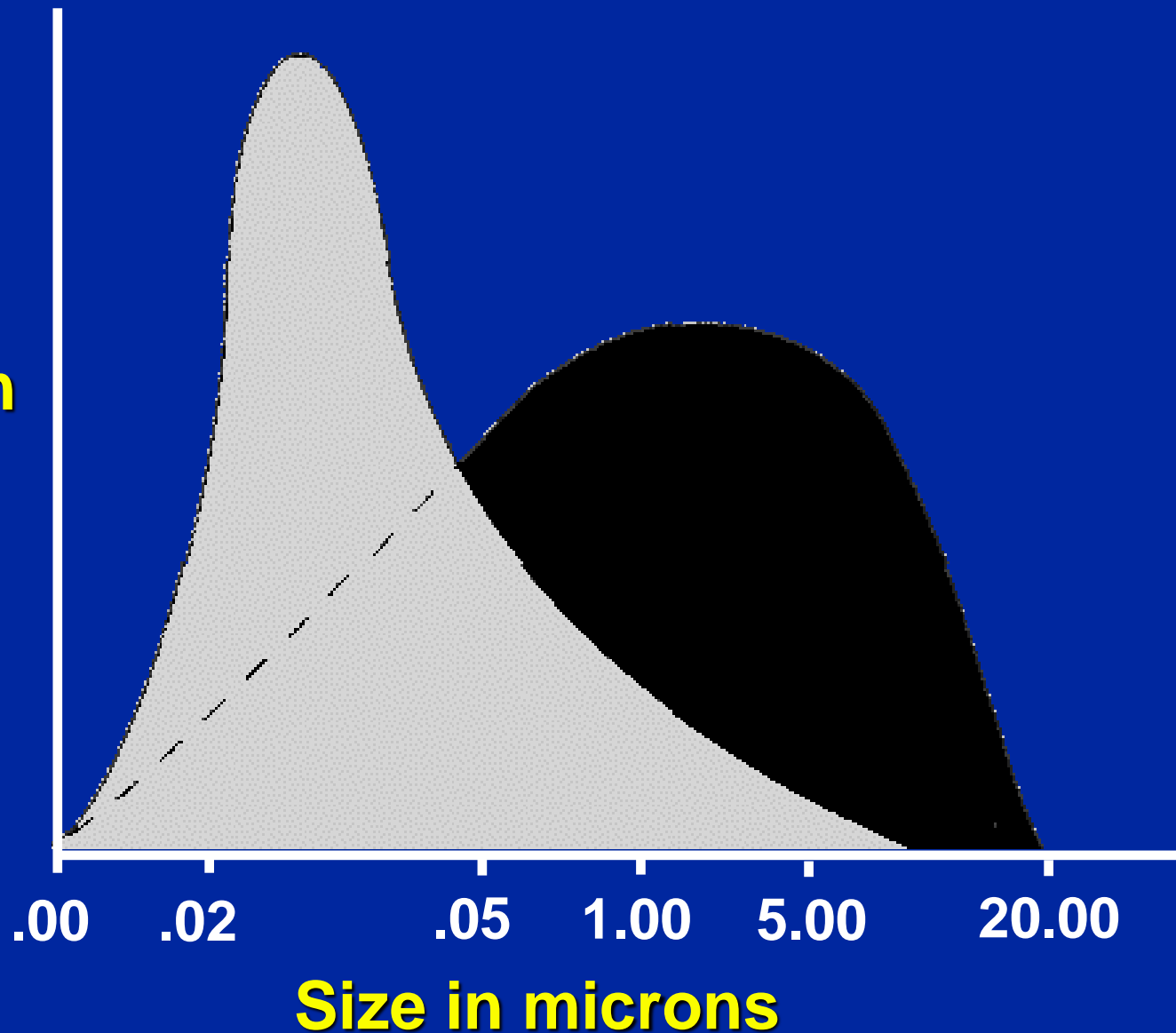
- ***A/C Too High:***
 - fan works harder
 - increased abrasion
 - blinding
 - breakdown of dust cake
- ***A/C Too Low:***
 - smaller BH required

Controlling Gas Entry

- **Precleaner**
- **Baffle Plate**
- **Inlet Diffuser**
- **Inlet Location**
- **Thimble Design**
- **Bypass**

Effects of Primary Collection

Relative
distribution
of
particles



Cyclones





Baghouse with Cyclonic Inlet

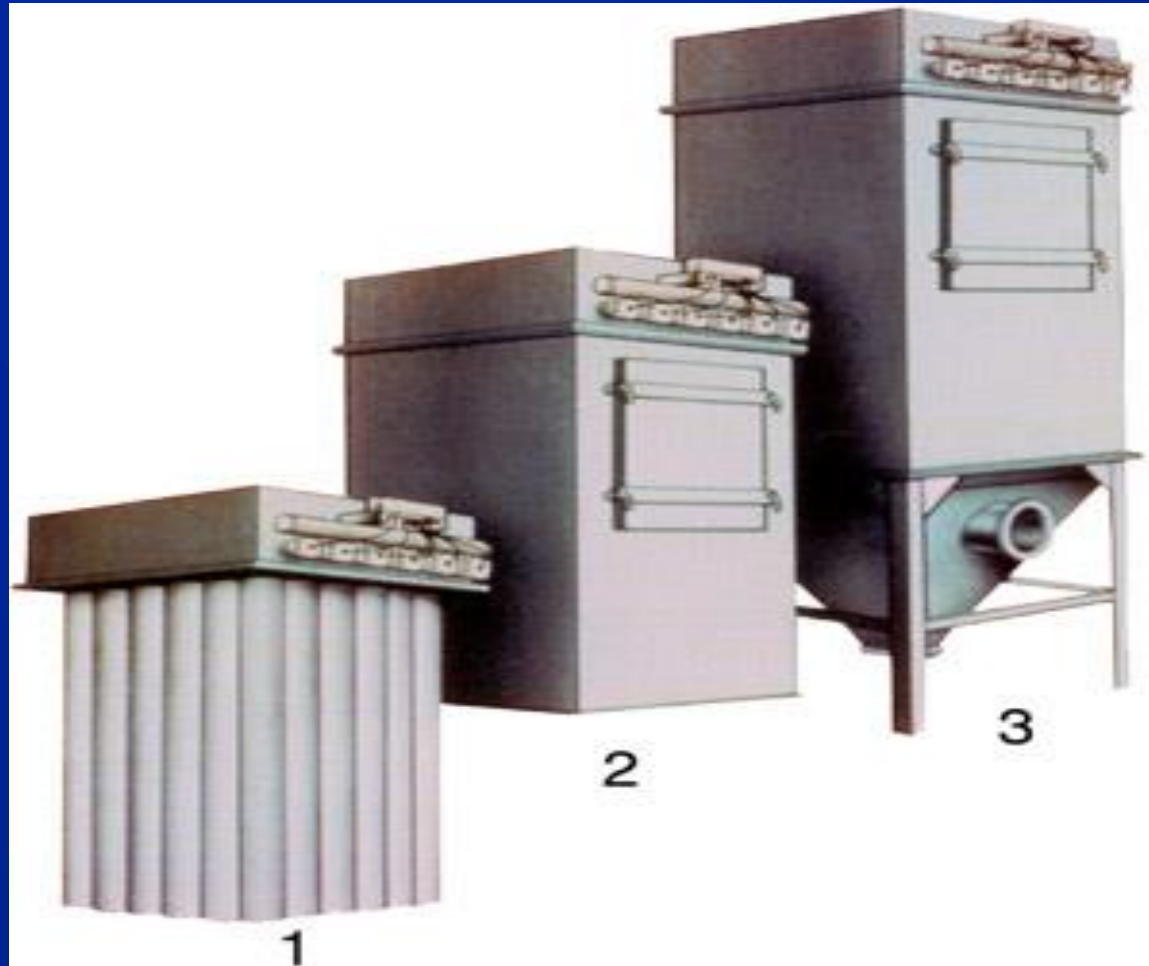
Industry Description

Bin Vent Filter

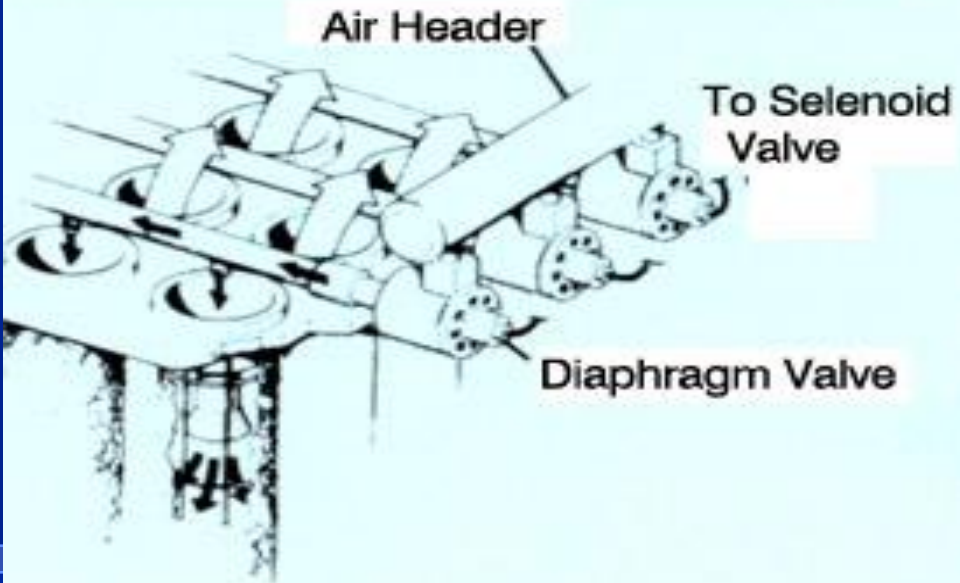
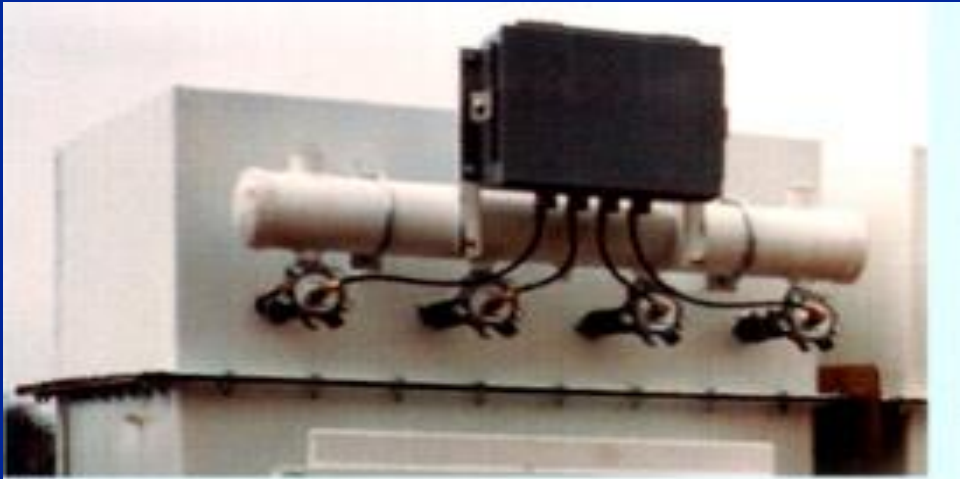


Industry Description

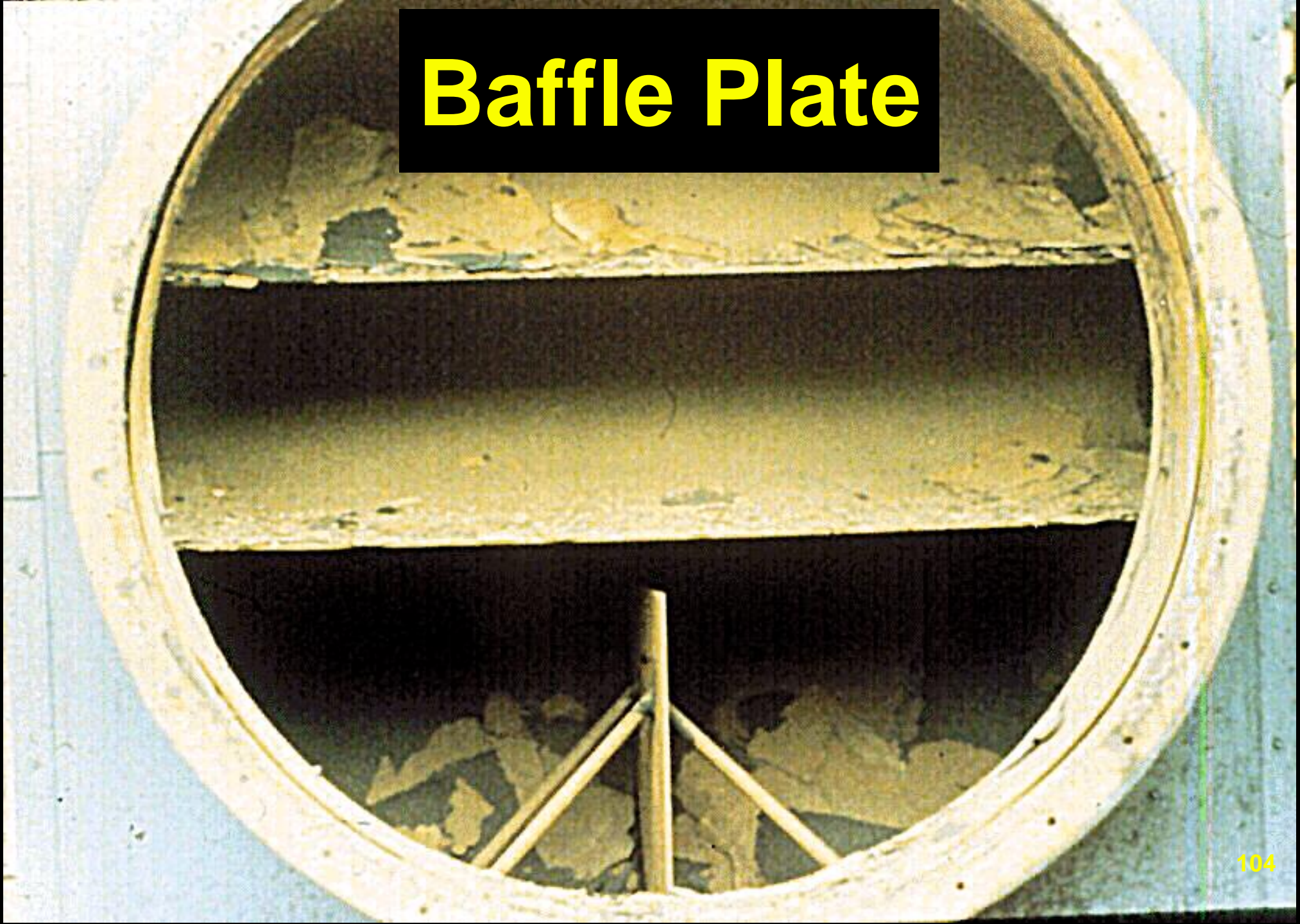
Bin Vent Filter



Bin Vent Filter



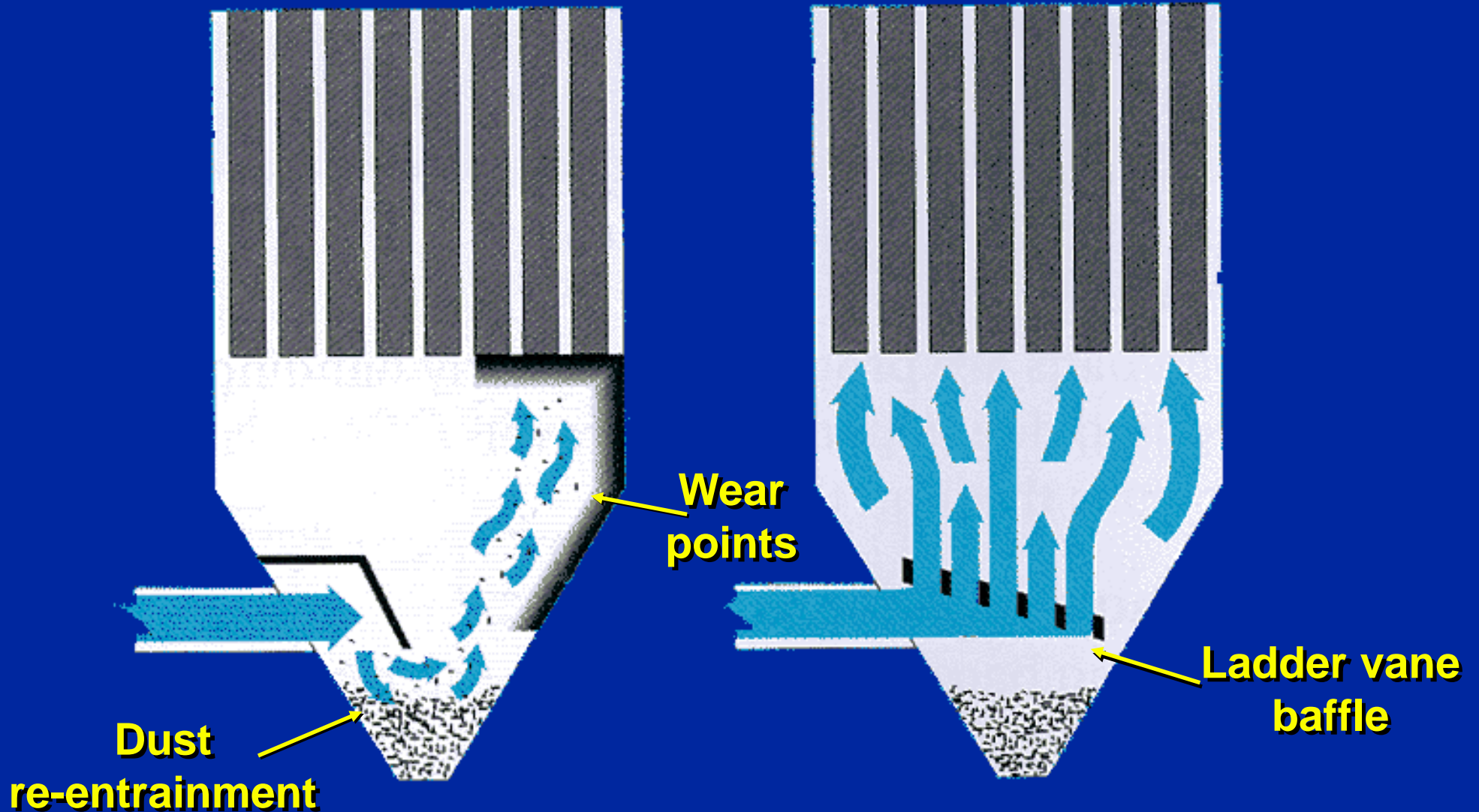
Baffle Plate



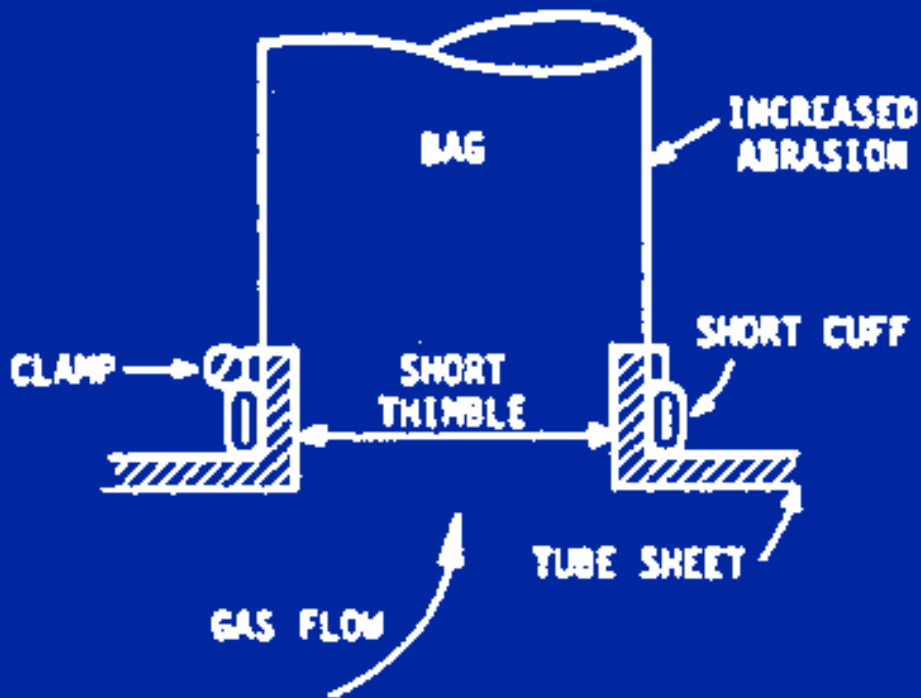
A close-up photograph of a circular inlet diffuser. The diffuser is made of a dark, perforated metal plate with a grid of small, circular holes. A central pipe or rod is visible, extending from the center of the diffuser towards the top right. The lighting is bright, highlighting the texture of the metal and the pattern of the holes.

Inlet Diffuser

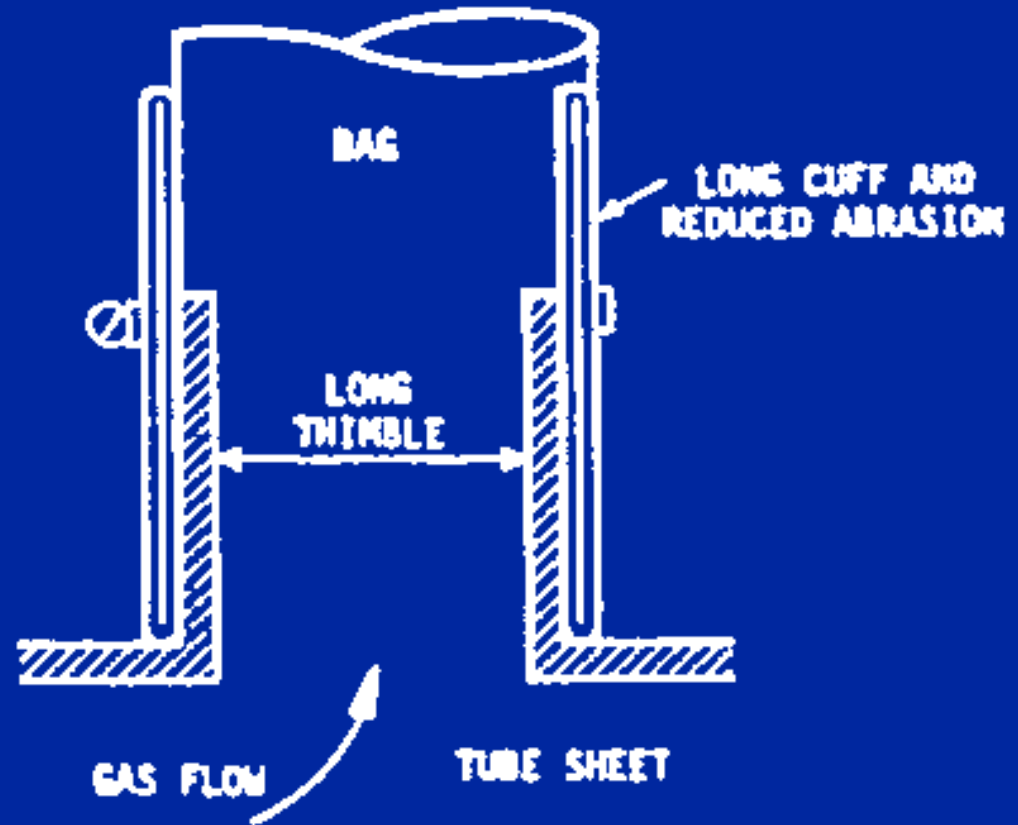
Inlet Air Dispersion



Thimble Design

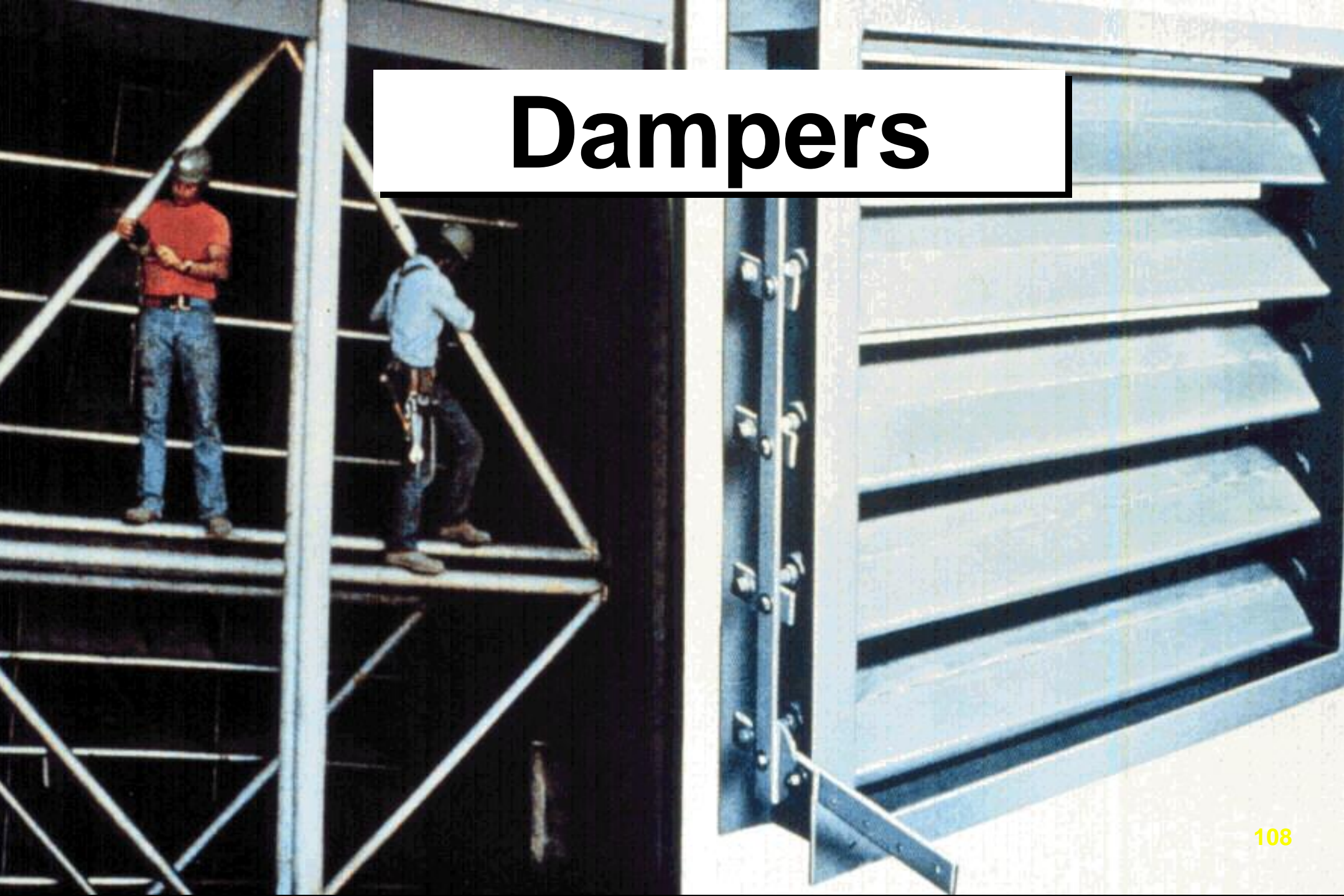


OK



Better

Dampers



Gas Temperature Effects

- ***High Operating Temp. =***
 - fabric breakdown
- ***Low Operating Temp. =***
 - condensation
 - blinding, chemical attack
- ***Inlet - Outlet Temp. Too High =***
 - inleakage

Temperature Control

- **Gas Cooling**
 - **Dilution**
 - **Radiation**
 - **Evaporative Cooling**
- **Preheating**
- **Insulation**
- **Minimize Inleakage**

Insulated Baghouses





Radiation Cooling



500°F

TYPICAL STARTUP

**NORMAL
OPERATION RANGE**

TYPICAL SHUTDOWN

Acid dewpoint range

**DAMAGE
RANGE**

**DAMAGE
RANGE**

Ambient

TIME →

500°F

RECOMMENDED STARTUP

**NORMAL
OPERATION RANGE**

RECOMMENDED SHUTDOWN

Acid dewpoint range

Preheat collector

**DAMAGE
RANGE**

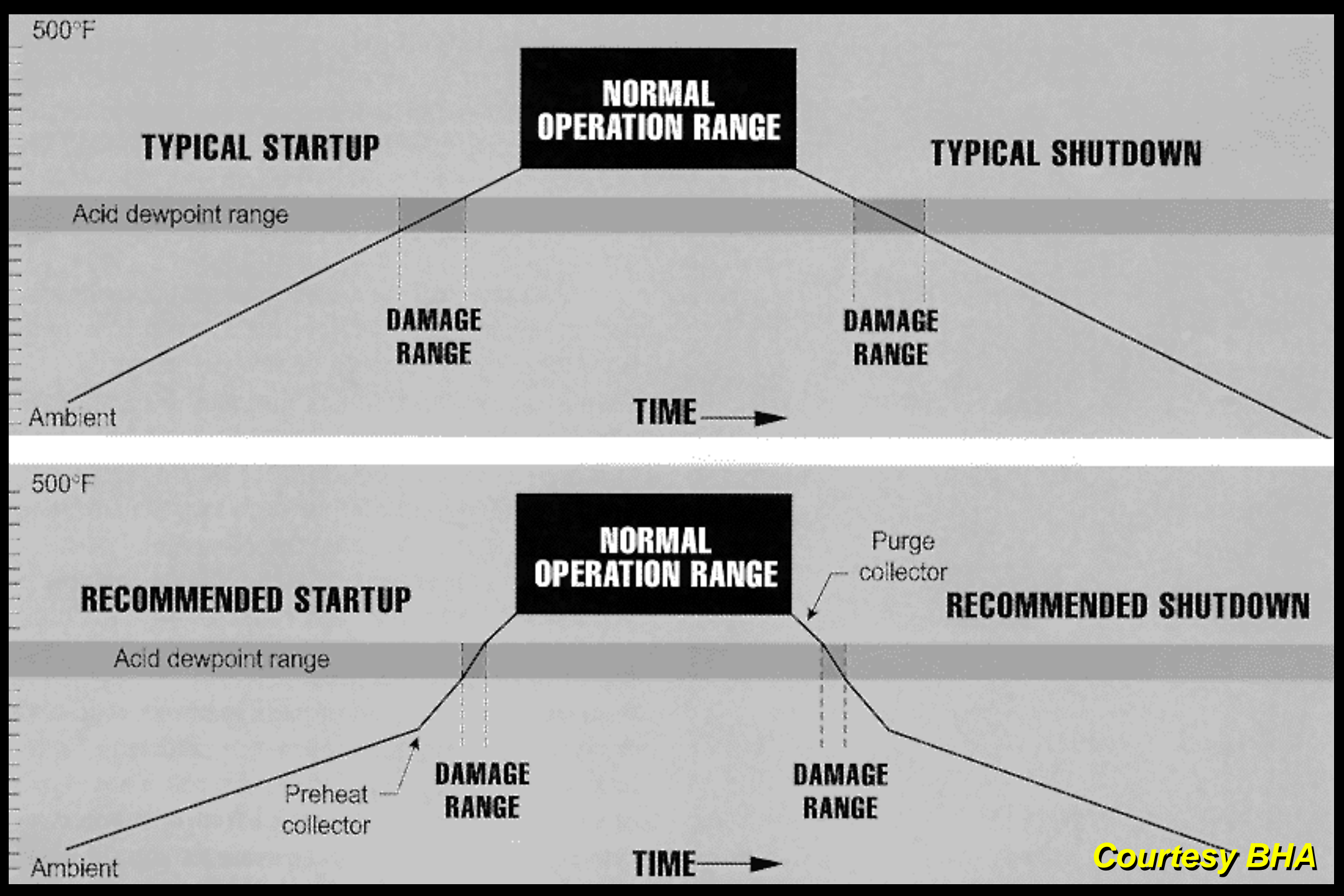
Purge collector

**DAMAGE
RANGE**

Ambient

TIME →

Courtesy BHA



Hoppers and Dust Handling Equipment

(Section 303.5)

Hopper with Strike Plate

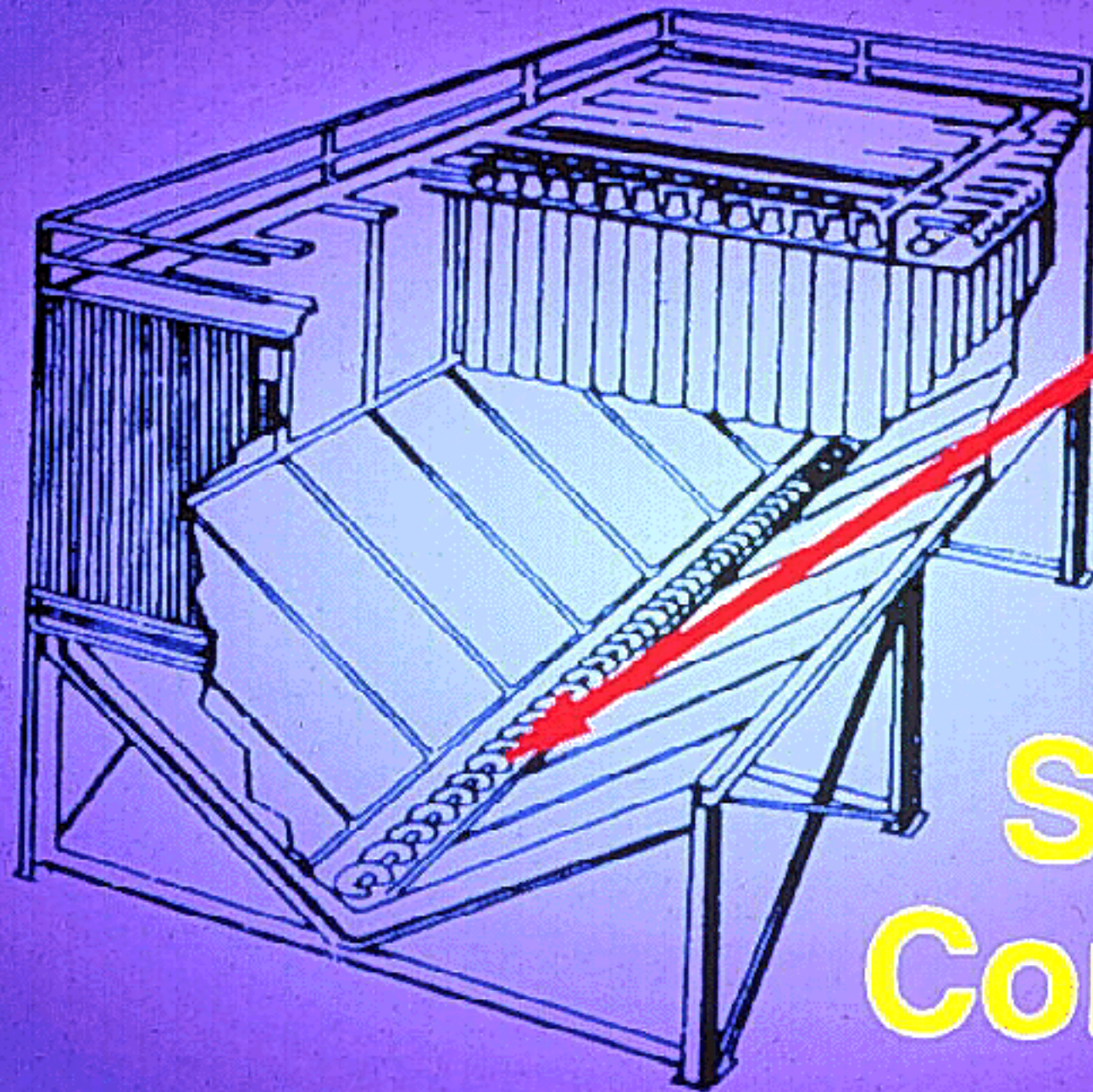


**Hopper with
Compressed
Air Cleaner**



Hopper Level Indicator System

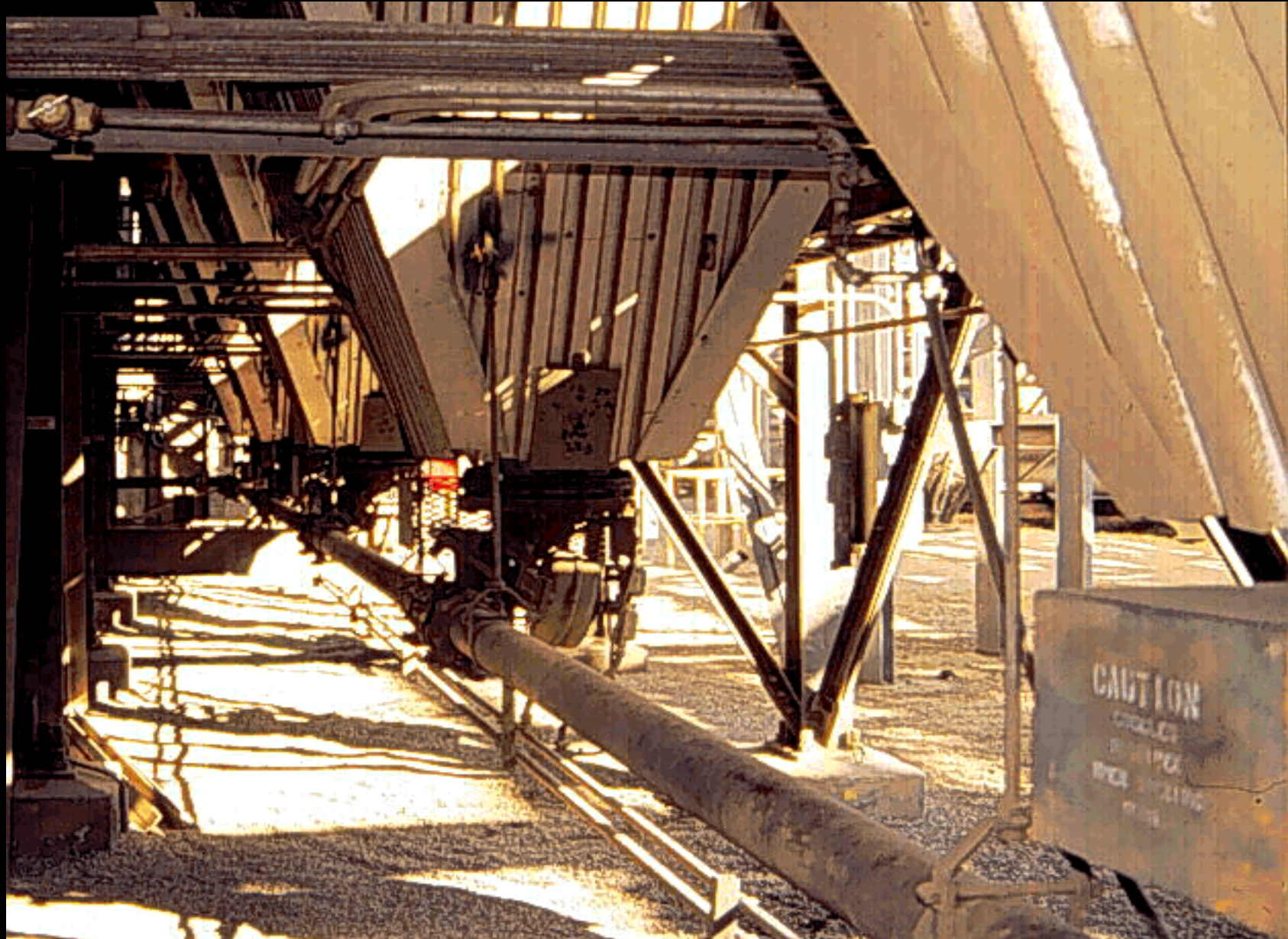




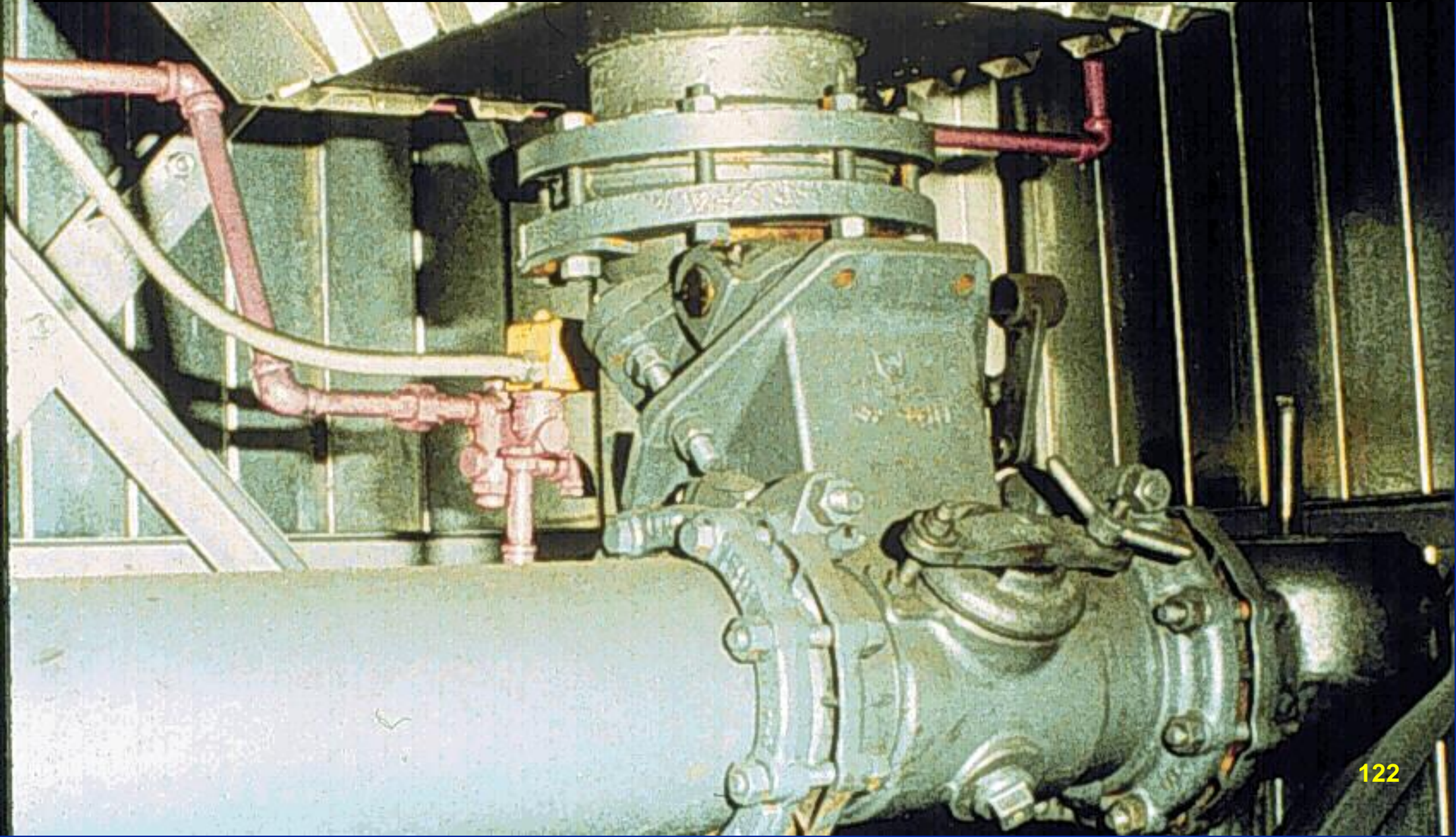
**Rotating
screw**

**Screw
Conveyor**

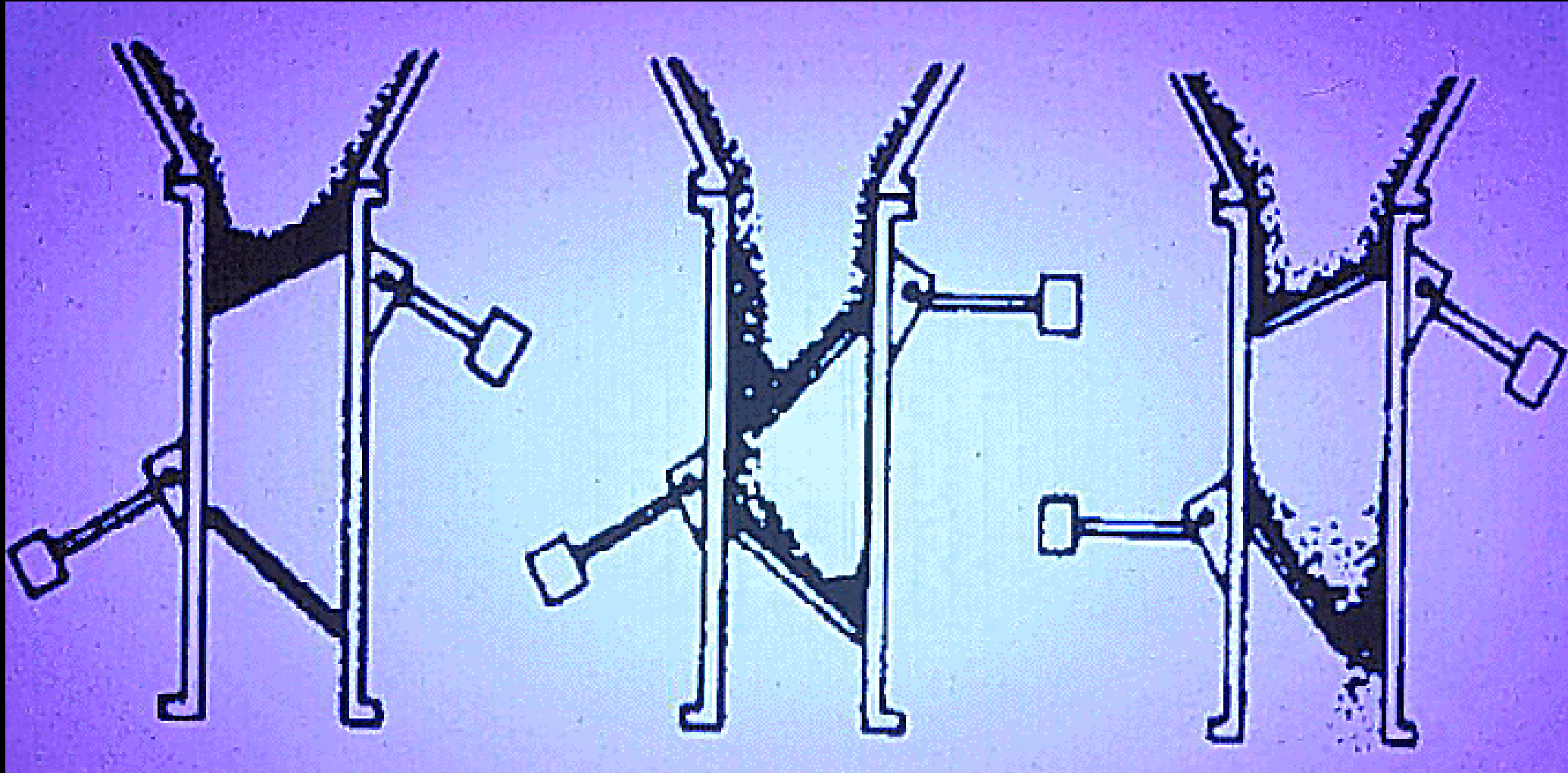
Pneumatic Dust Transport System



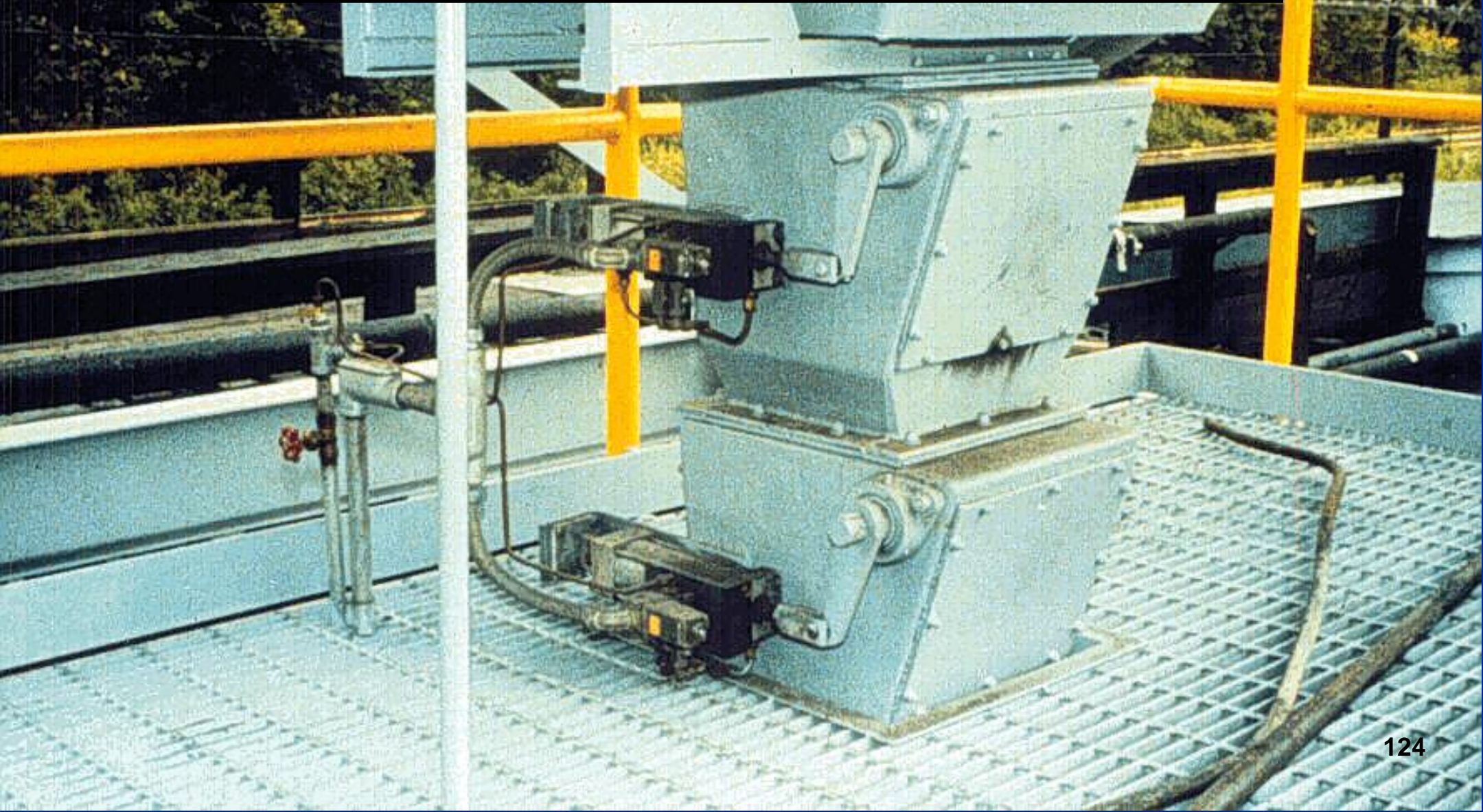
Pneumatic Hopper Valve System



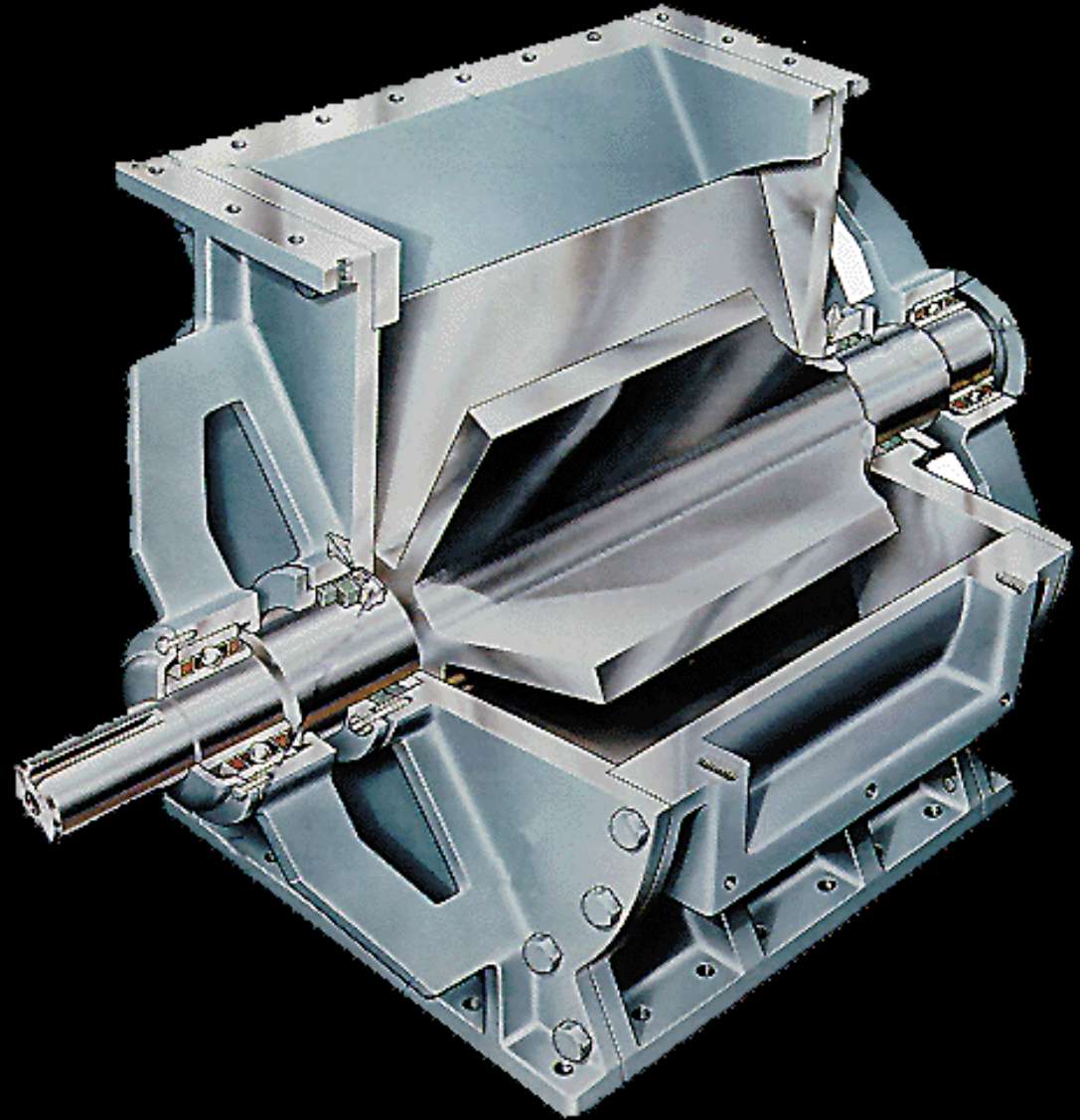
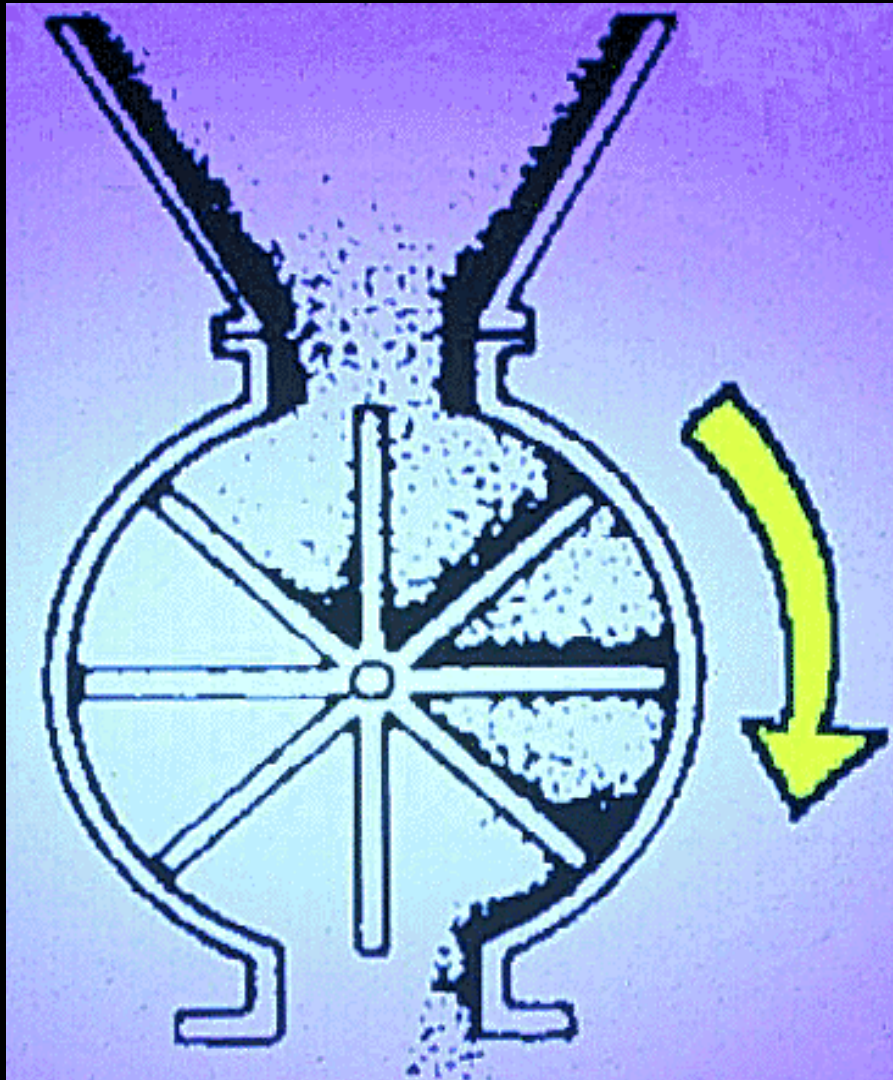
Trickle Valve System



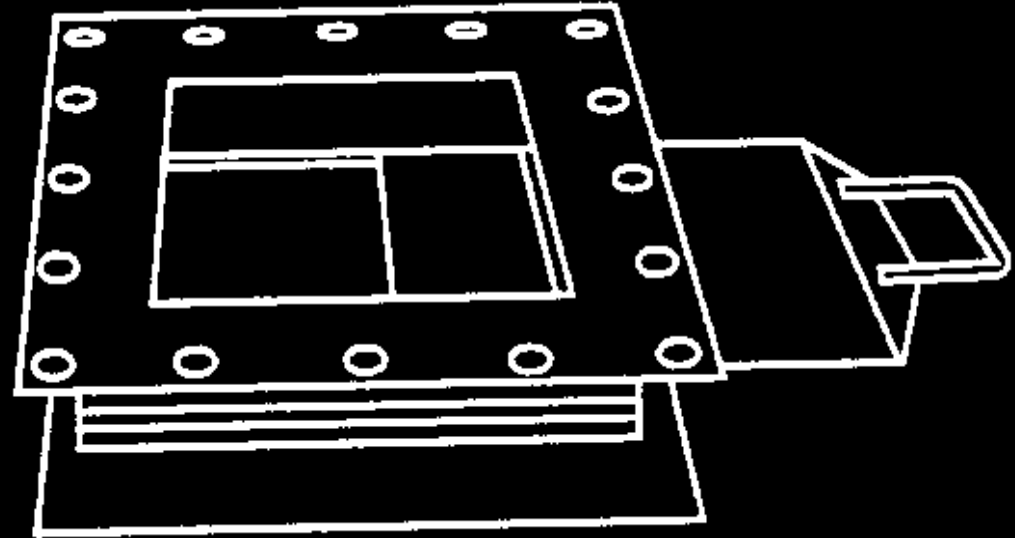
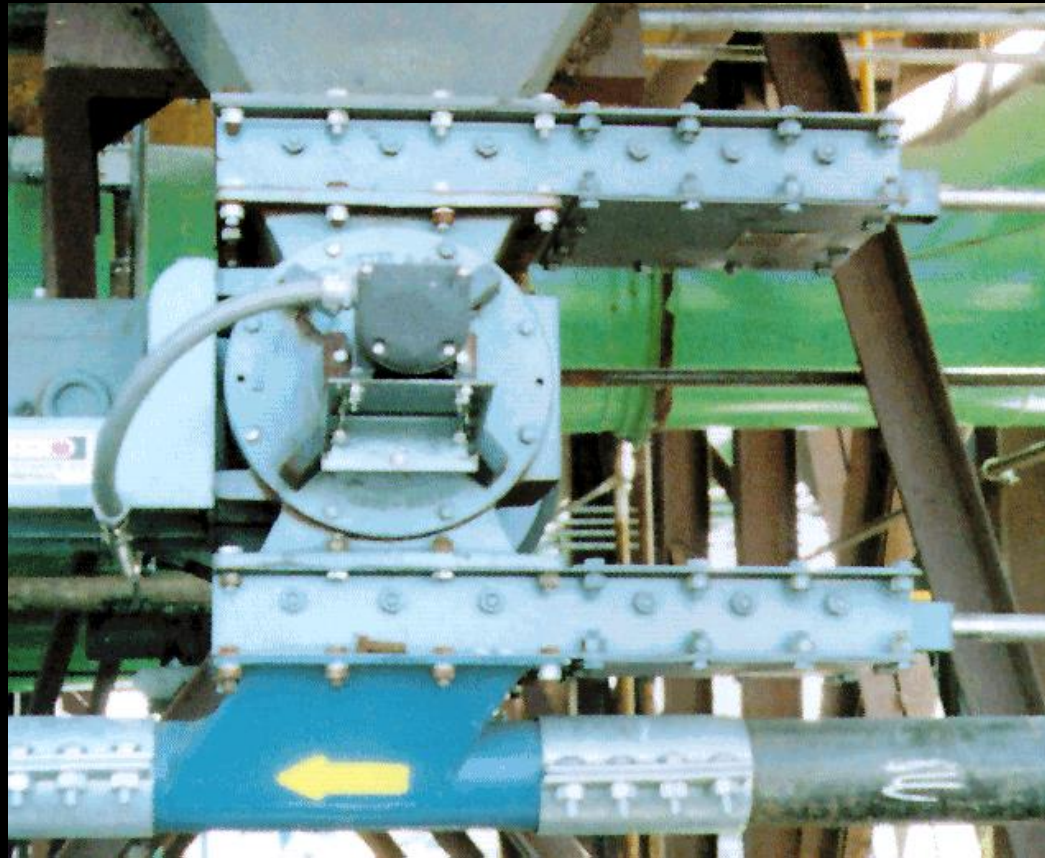
Trickle Valve System



Rotary Airlock Valve



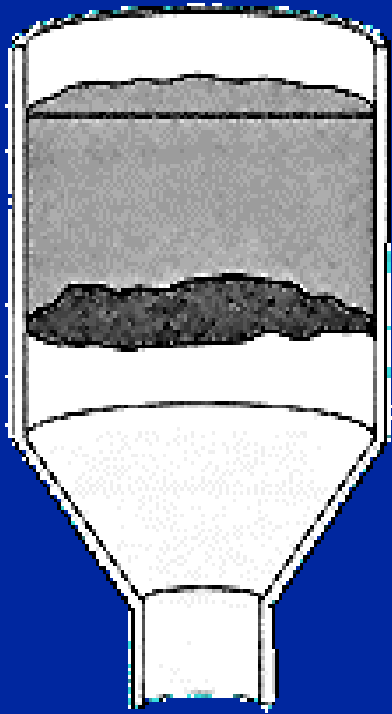
Slide Gates



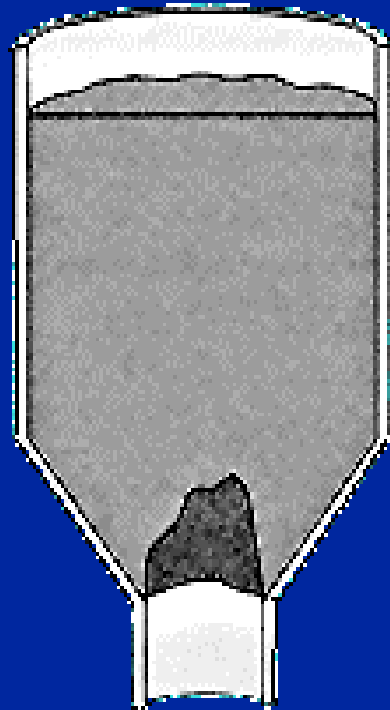
Dust Discharge Problems

- Inleakage
- Corrosion
- Change Process Temp.
- Dust Buildup
- Pluggage
- Fugitive Emissions

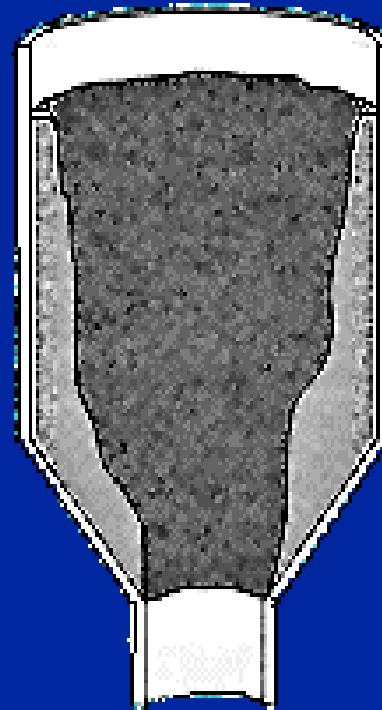
Types of Hopper Blockage



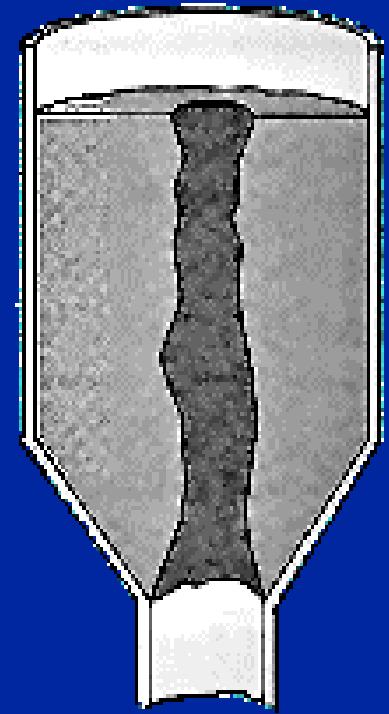
Arching



Bridging



Buildup



Ratholing

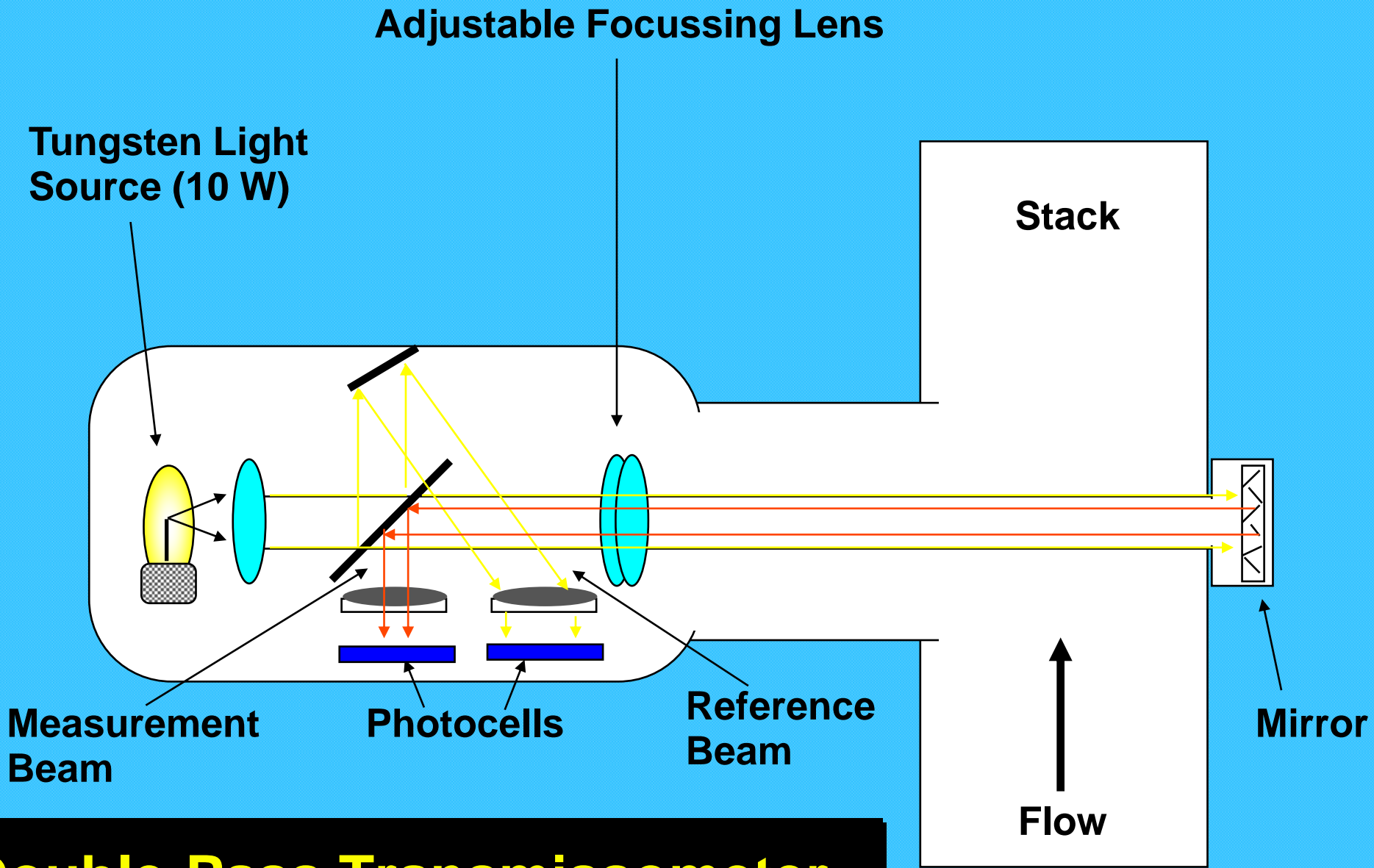


How Do We Monitor Compliance

Performance Monitoring

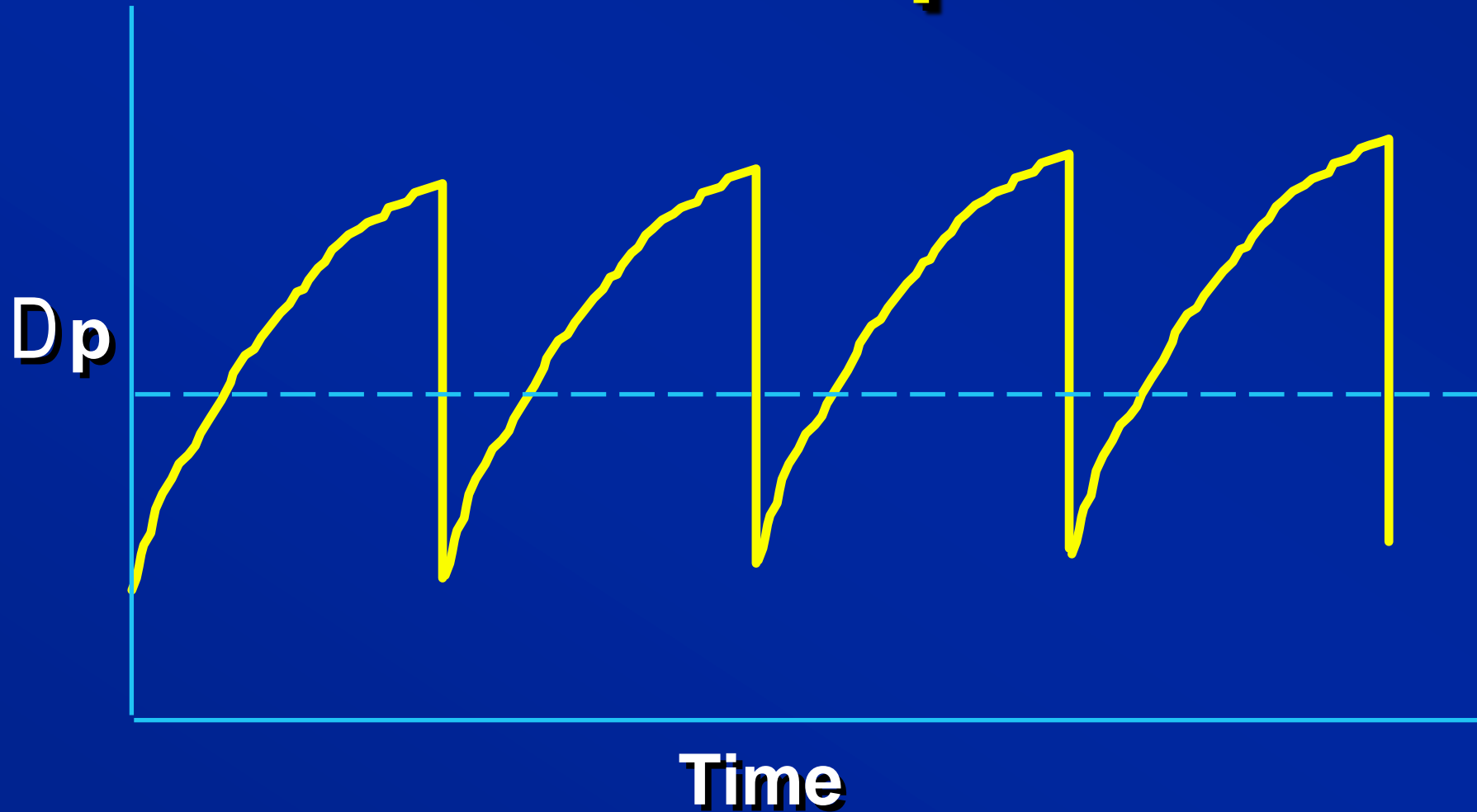
(Section 501, 502)

- **Opacity**
- **Triboelectric & Tribokinetic Devices**
- **Light Modulation**
- **Pressure Drop**
- **Temperature**
- **Bag Failure Patterns**
- **Clean-side deposits**

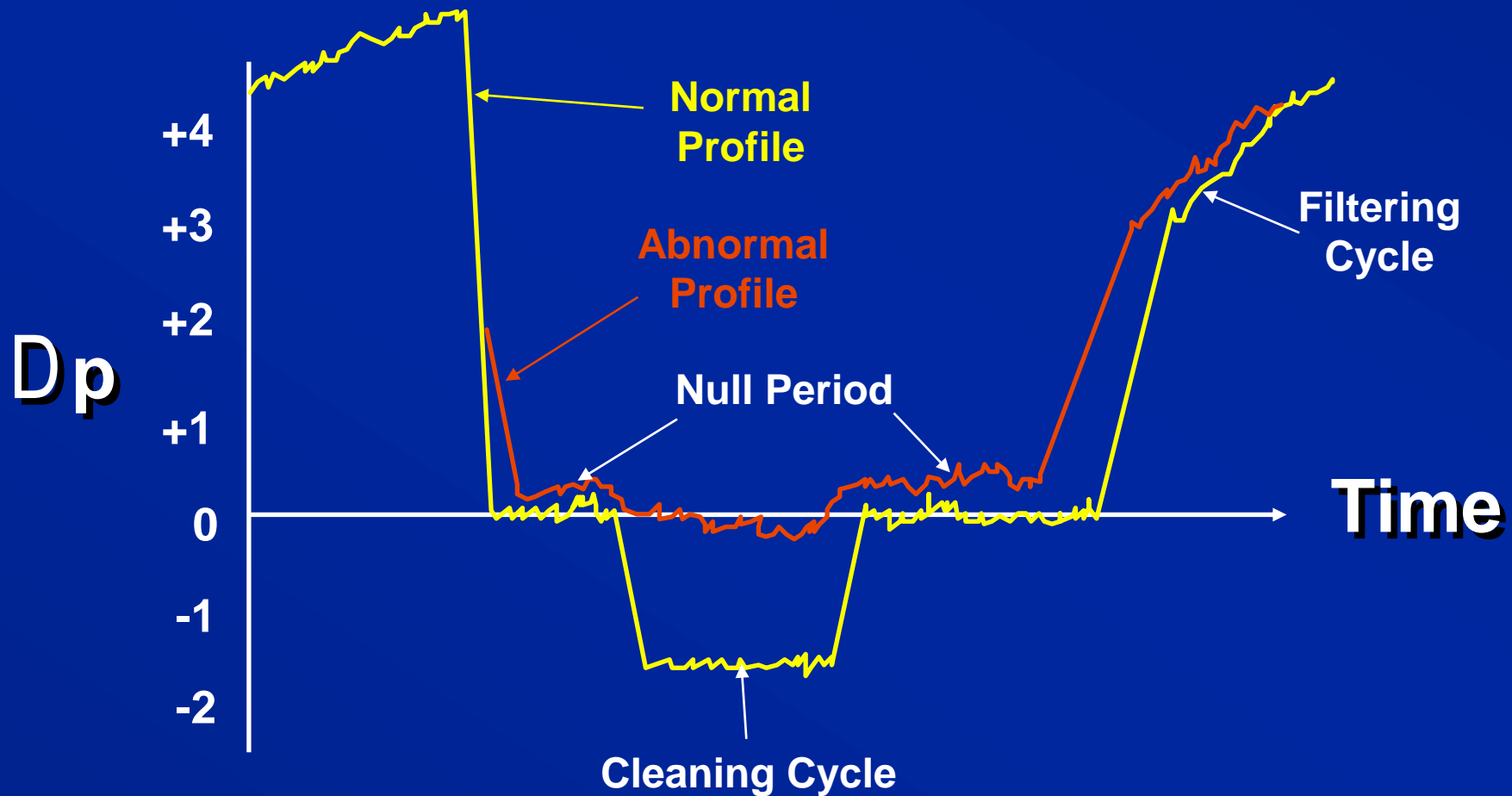


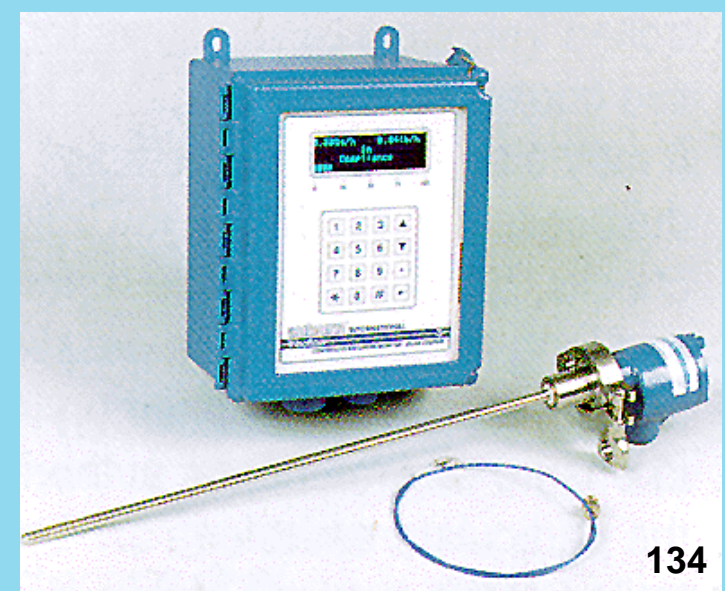
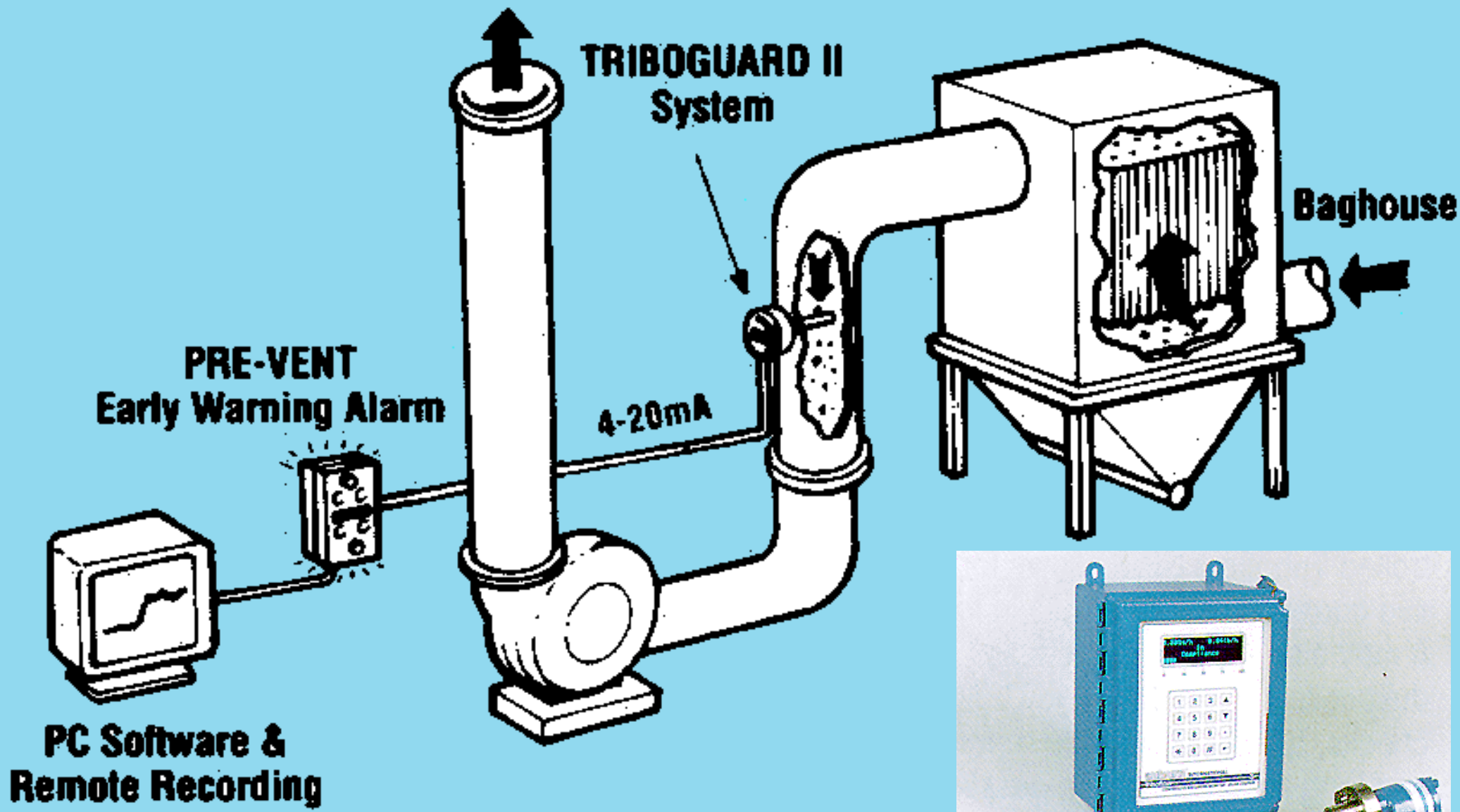
Double-Pass Transmissometer

Pressure Drop Profile

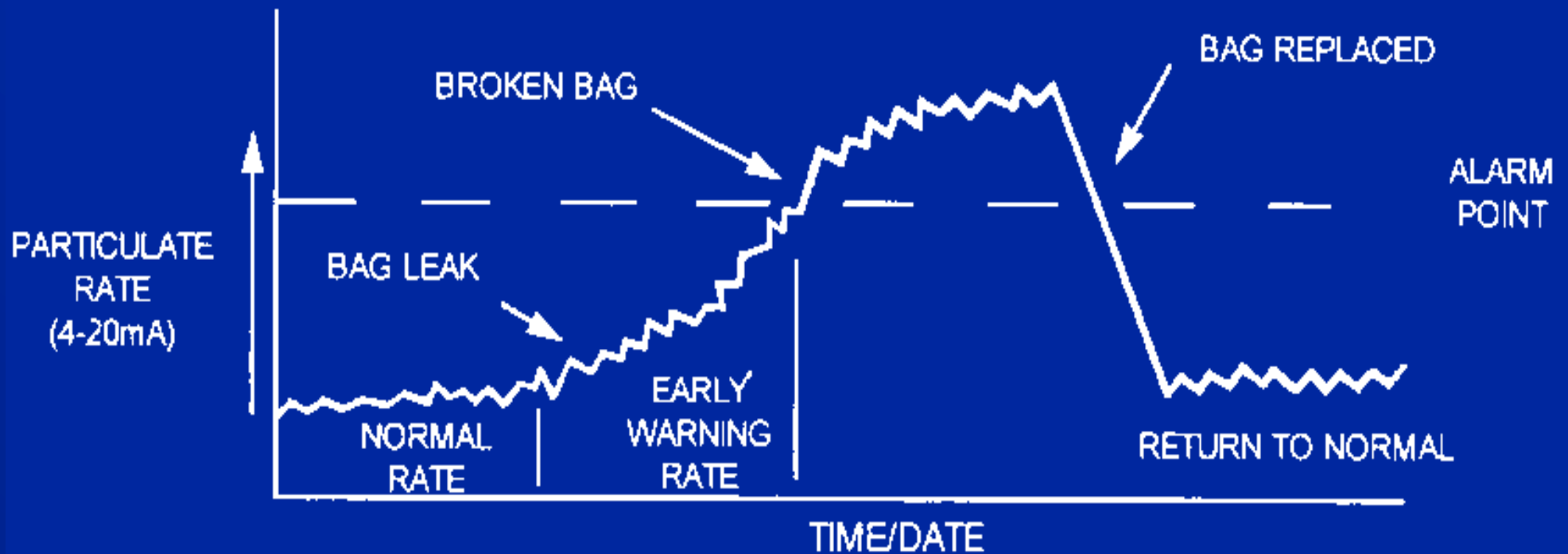


Static Pressure Drop Profiles - Reverse Air Baghouse

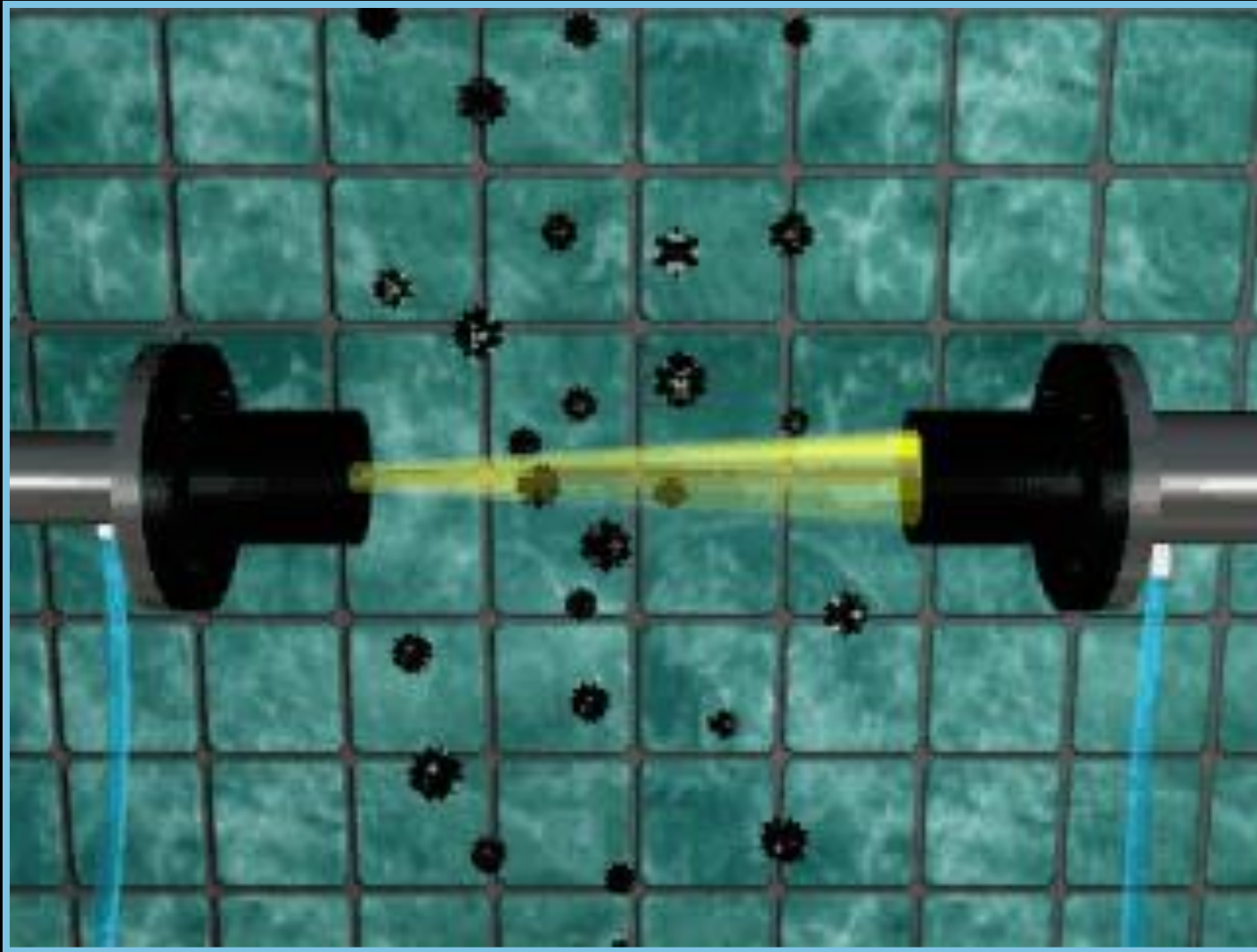




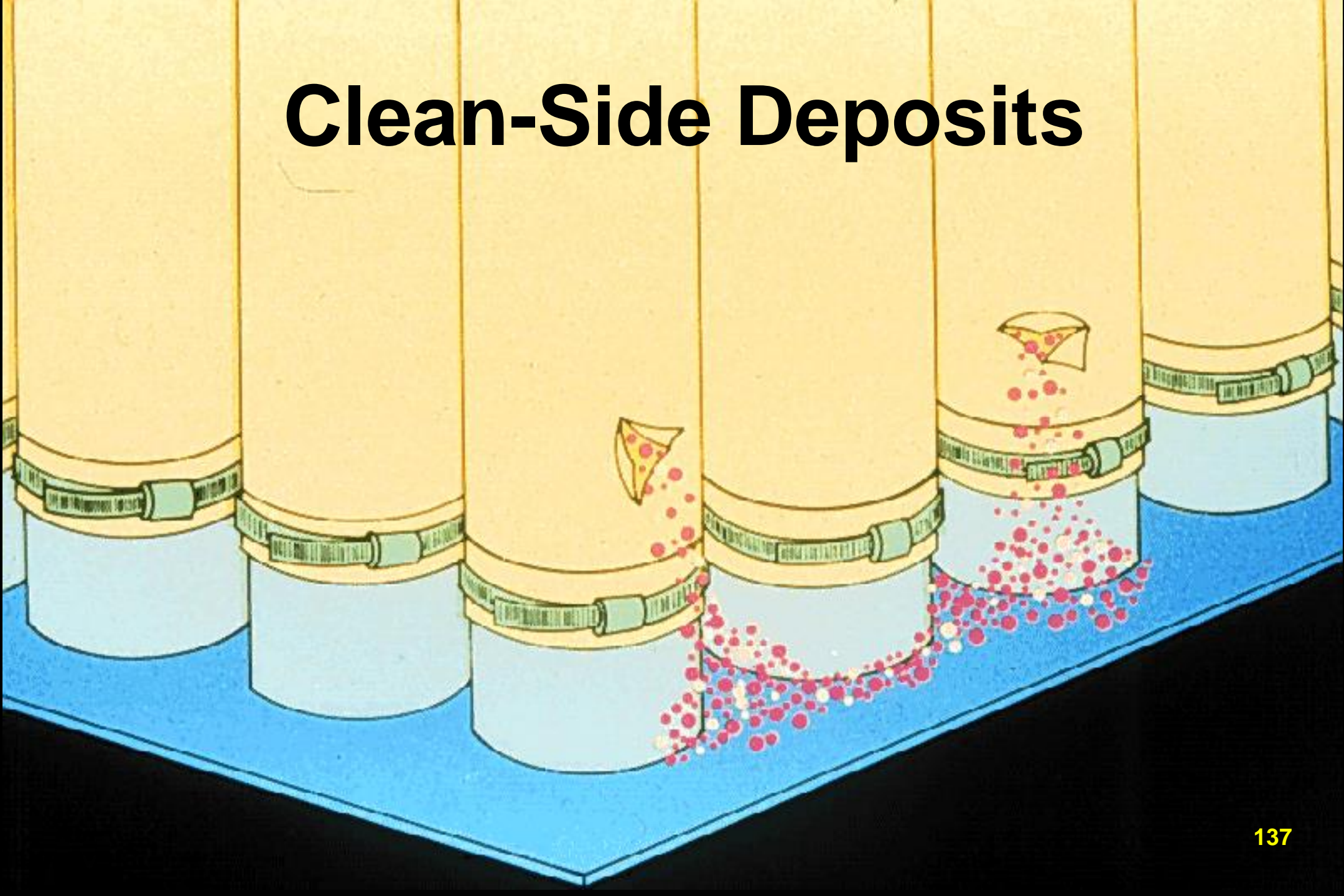
Triboelectric Monitoring

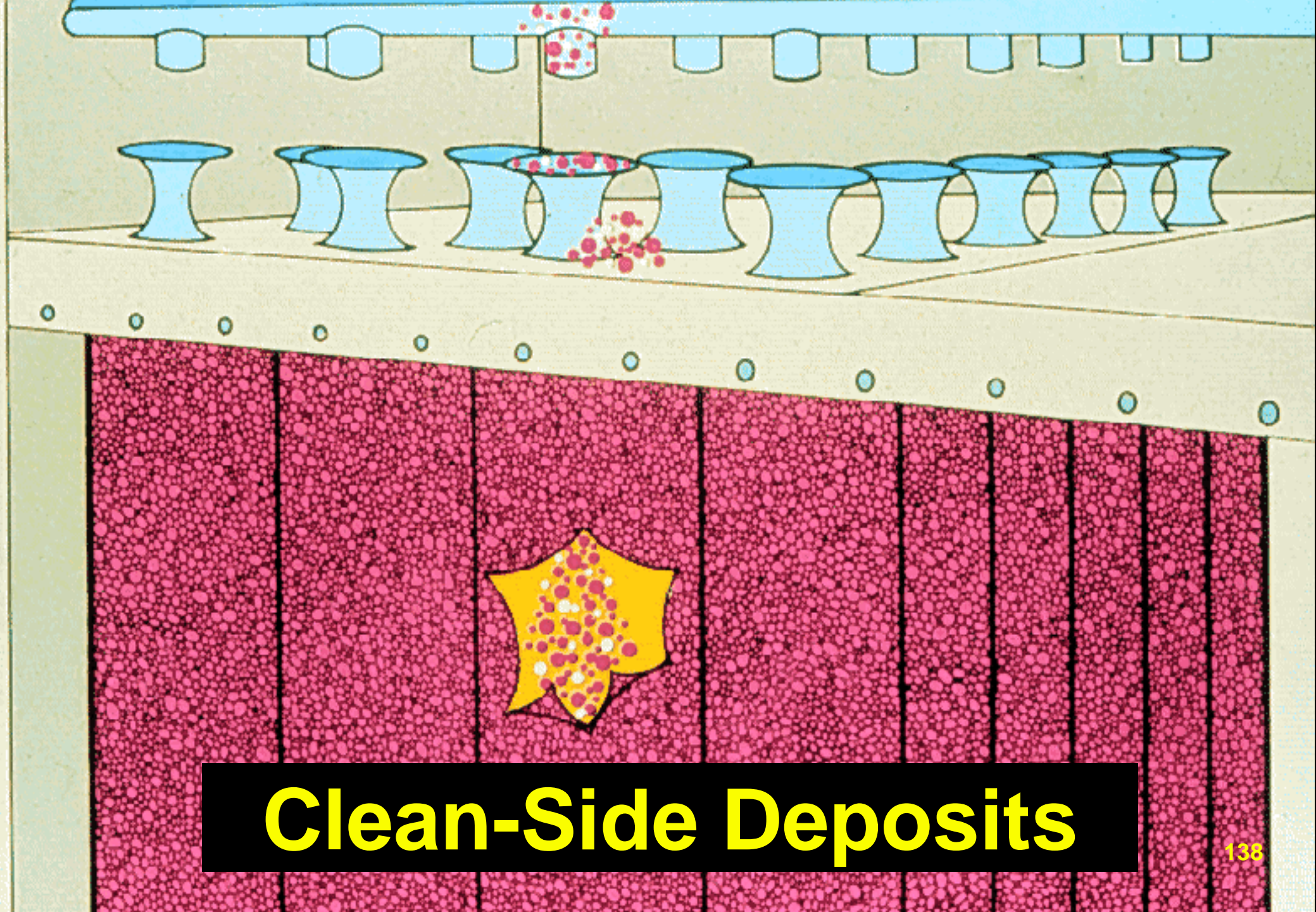


CPM™ Technology



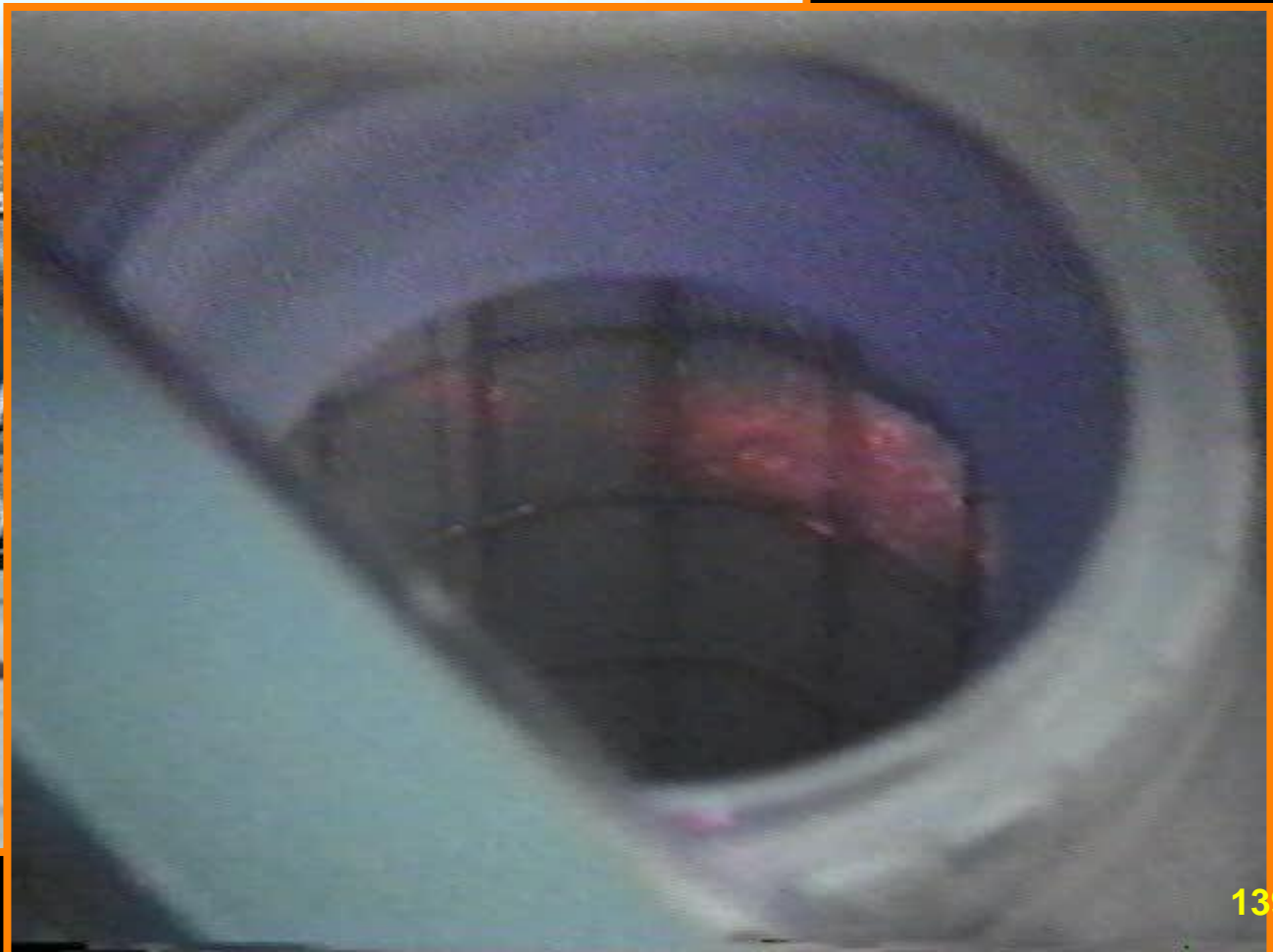
Clean-Side Deposits





Clean-Side Deposits

Fluorescent Dye Leak Detection





Maintenance

- Daily
- Weekly
- Monthly



Inversion Bag Cleaning Device



Spare Cages



Inspection Elements

- **Pre-Inspection**
- **On-Site Inspection**
- **Post-Inspection**

Permit Conditions

- **Opacity Limits**
- **Process Weight Limits**
- **Ranges of Inlet and Outlet Temps.**
- **Process Rate**
- **Recordkeeping Requirements**
- **CEMS Requirements**
- **Minimum / Maximum Pressure Drop**

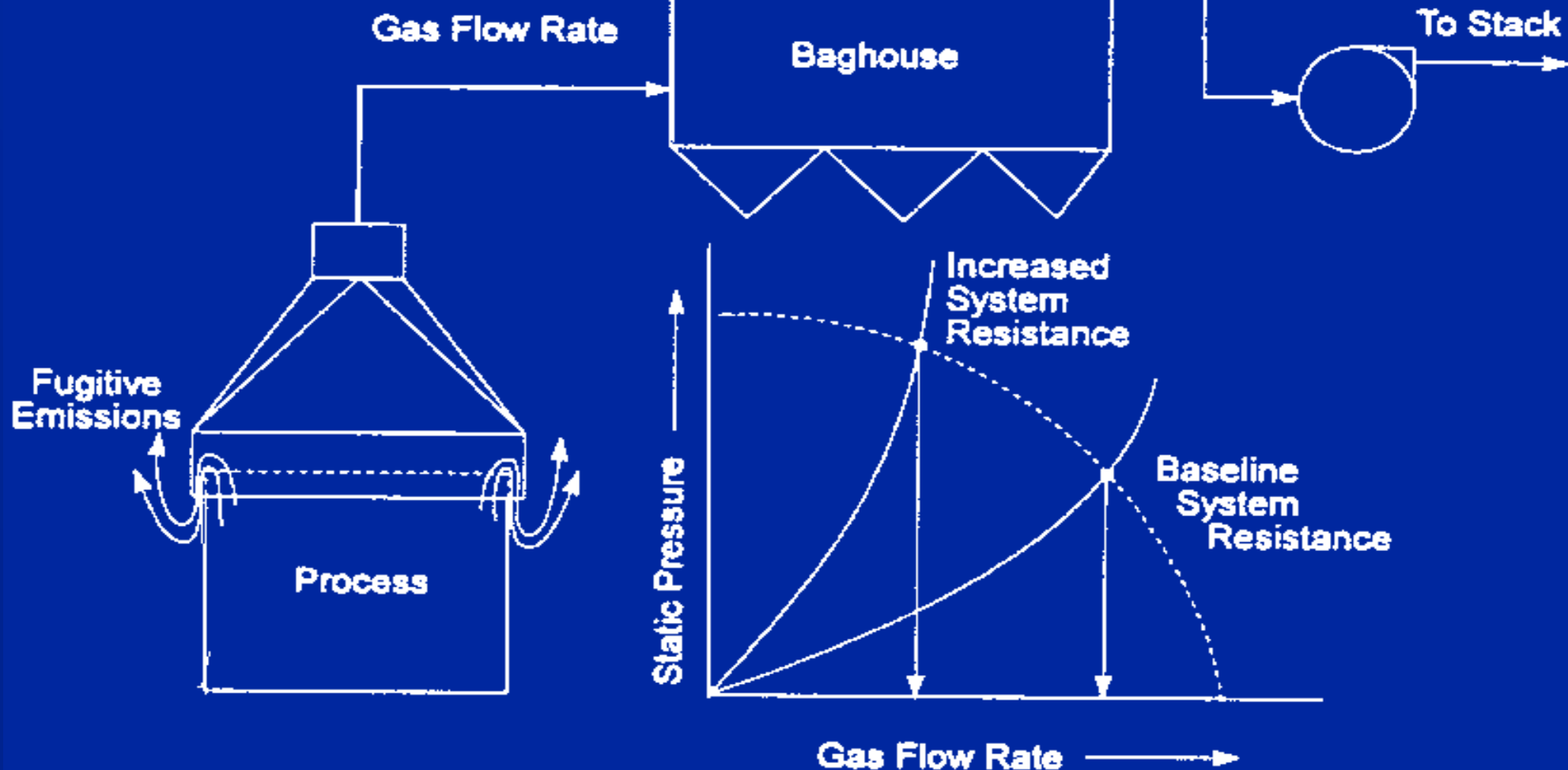
Air Pollution Control System Points of Inspection

- **Capture (System Entrance/Exit)**
- **Transport**
- **Air Mover**
- **Control Device**
- **Instrumentation**
- **Subsystem(s)**
- **Records**

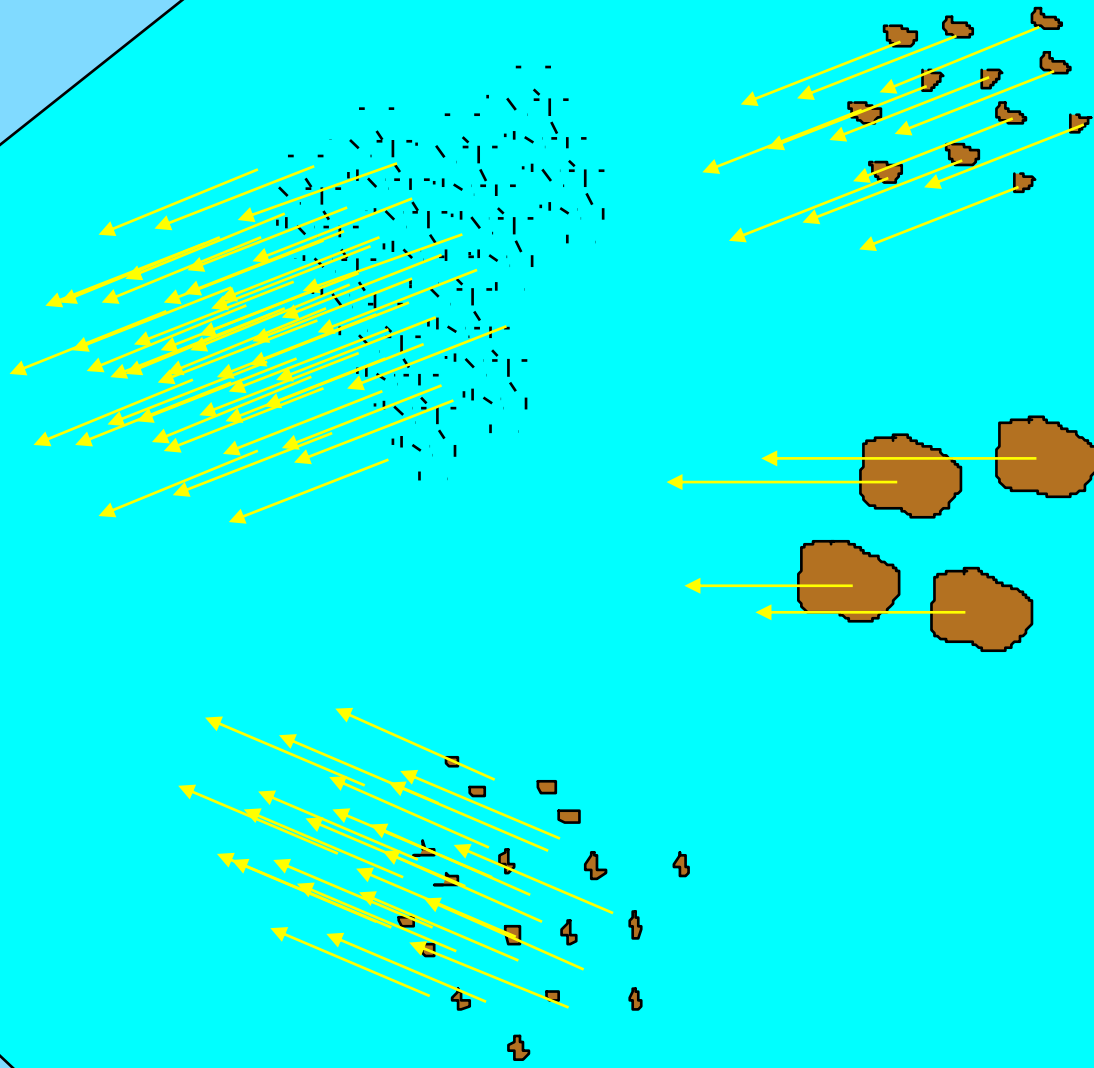




Fugitive emissions due to excessive pressure drop



Beer's Law



As particle size
gets smaller,
reflective surface
area increases











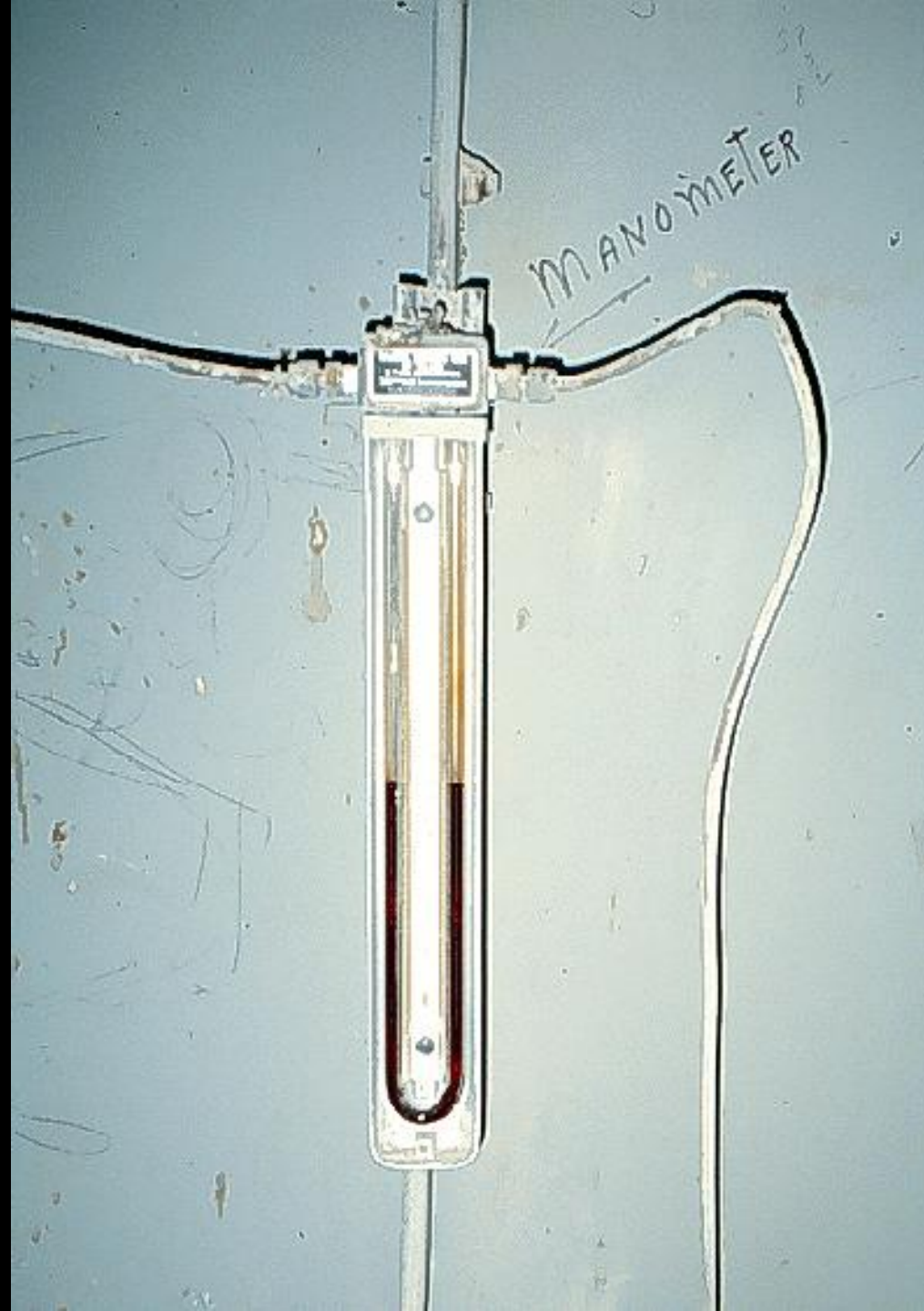






Instrumentation

- **Flow Meters**
- **Thermocouples**
- **Pressure Gauges**
- **Transmissometers / CEMs**
- **Hopper Level Indicators**
- **Compressed Air Pressure Gauges**



GAUGES SHOULD READ BETWEEN
2" & 5" STATIC PRESSURE
CALL ENGINEERING IF
LIMITS ARE NOT MET, EXT. #2825



DAMPER CLOSE

FF PULSE
FF HIGH HOPPER LEVEL

029

FF DAMPER POSITION

MODE PV 288
ALM
INSTA-SET SV 479
MODE RESET

FF INTAKE HIGH TEMP
FF EXHAUST HIGH TEMP

FF DIFF. PRESSURE

MODE PV 339
ALM
INSTA-SET SV 479
MODE RESET

FILTERHOUSE EXHAUST

090

FILTERHOUSE INTAKE

032

F.D. DAMPER POSITION

F.D. DAMPER OPEN
F.D. DAMPER CLOSE

40 50 60 70 80 90 100
0 100
F.D. PULSE

F.D. DIFF. PRESSURE

F.D. PULSE ON
F.D. PULSE OFF

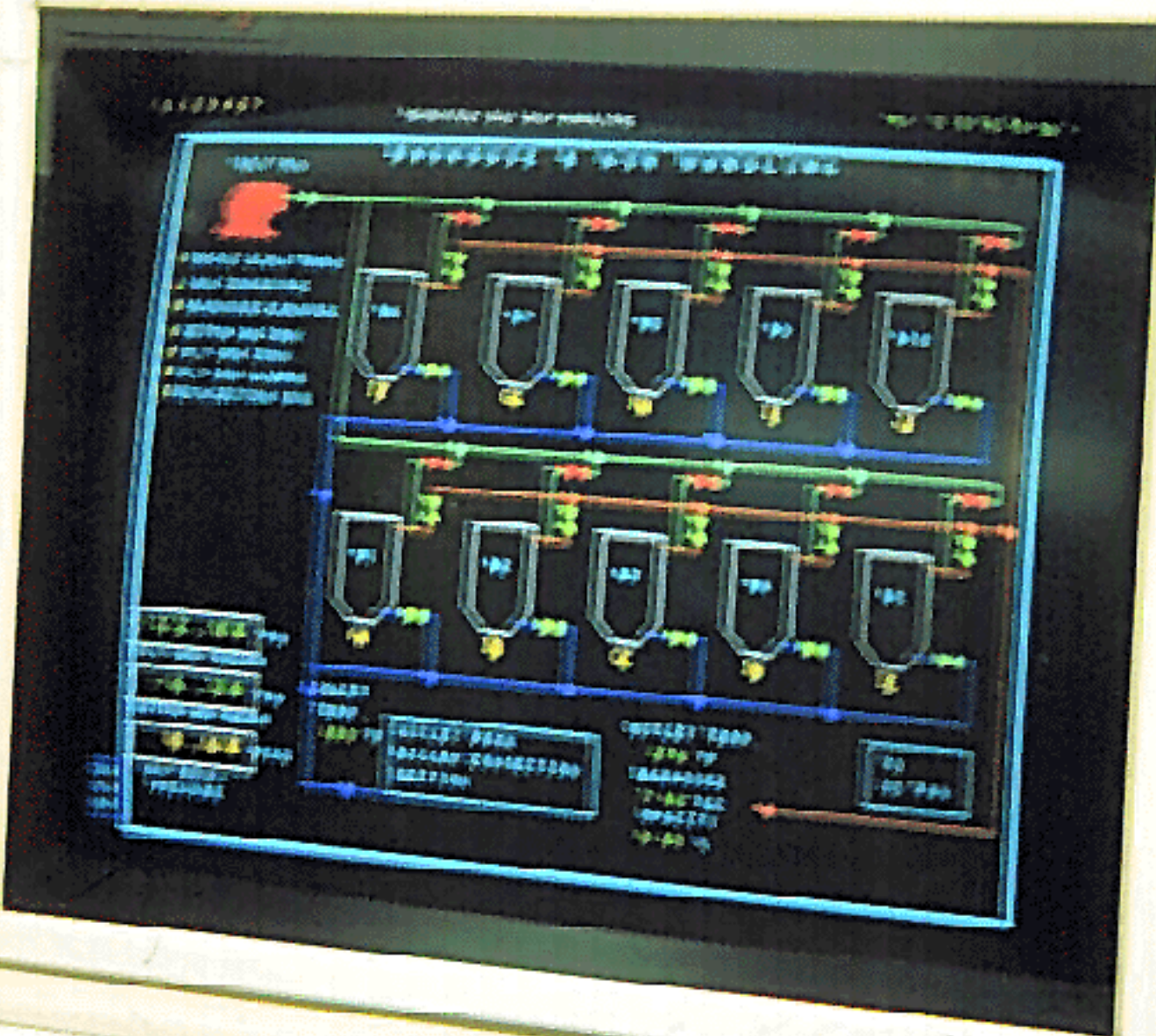
F.D. EXHAUST VACUUM

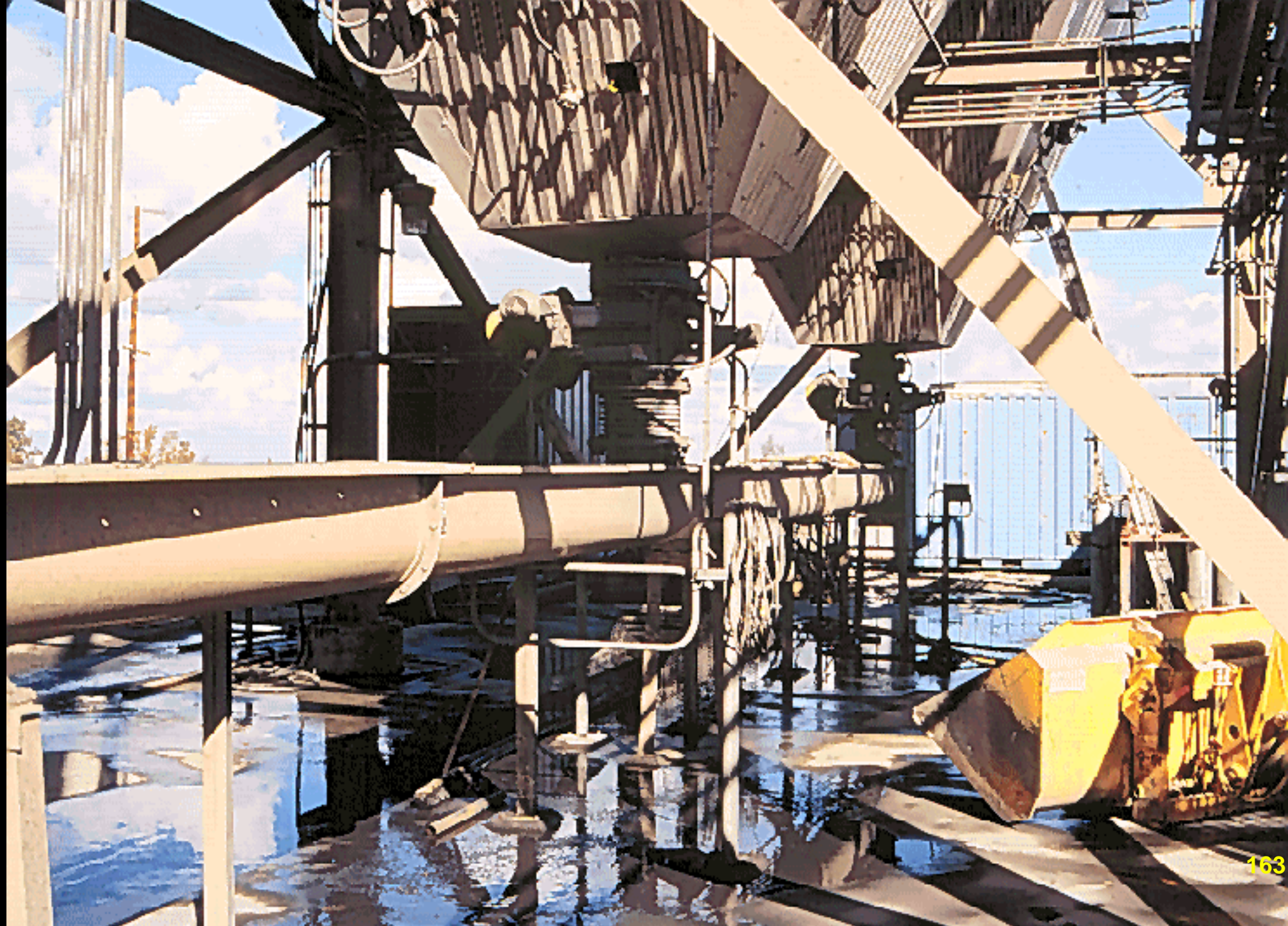
MODE PV 320
ALM
INSTA-SET SV 479
MODE RESET

F.D. INTAKE HIGH TEMP
F.D. EXHAUST HIGH TEMP

MODE PV 361
ALM
INSTA-SET SV 479
MODE RESET

FUGITIVE DUST EXHAUST









General Safety Policies

- **Anticipate hazards before leaving for inspection site**
- **Have all necessary personal protective equipment**
- **Be aware of and conform to all applicable plant and agency safety policies**
- **Do one thing at a time**
- **Don't work alone**

⚠ WARNING
OPERATION OF THIS EQUIPMENT
WITHOUT ACCESS DOORS,
COVERS, AND GUARDS CAN RE-
SULT IN PERSONAL INJURY OR
DEATH. SECURELY FASTEN ALL
COVERS, DOORS, AND GUARDS
BEFORE OPERATING THIS
EQUIPMENT.



⚠ WARNING
CONTACT WITH TURNING SCREW
CAN RESULT IN PERSONAL
INJURY OR DEATH. STAY
CLEAR OF SCREW WHILE
CONVEYOR IS IN OPERATION.

24

A. P. C. D.
C. A. G. E. NO. 63

PO 2189

DANGER
ACOUSTIC HORNS
INTENSE SOUND WAVES

WARNING
AUTO-START
BEFORE WORKING ON THIS EQUIPMENT
LOCK OFF ALL AIR SUPPLIES AND
TURN OFF AIR VALVE TO LOW

EMERGENCY RESPONSE FOR BAGHOUSE FIRES

IN THE EVENT OF A BAGHOUSE FIRE:

1. Kill fan.
2. Close isolation damper.
3. Kill burner.
4. Shut down fuel flow
(double check if automatic with burner).
5. Shut down asphalt cement flow.
6. Continue feeding cold material through the drum
(pre-designate one aggregate bin for this purpose).

SMALL FIRE

Attempt to smother fire:

1. Eliminate all air flow into baghouse.
2. Spray exterior with water to cool it down.

If these steps do not control fire, call Fire Department.

RAGING FIRE

Attempt to extinguish fire:

CALL FIRE DEPARTMENT _____

Telephone Number

USE:

1. Water or
2. Chemical (such as carbon dioxide, CO₂).

CAUTION:

Do not open up baghouse until **ABSOLUTELY** certain the fire is out.
Smoke from burning/smoking bags may cause temporary discomfort.

AFTER FIRE INSPECTION

CHECK: Bags for damage.
Cages for breakage or distortion.
Tube sheet for warping or hole distortion.
Venturis in tube sheet for distortion.
Solenoid mechanism.
Blow pipe (if jet-pulse system).

napa



A Safety Information Service of the

NATIONAL ASPHALT PAVEMENT ASSOCIATION

6811 Kenilworth Avenue, Riverdale, Maryland 20737 (301) 779-4900

