



CLEAN ROOM TRAINING

PREPARED FOR USE AT APL

CLEAN ROOM AREAS

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Modified for Homewood use with permission from authors



CLEAN ROOM TRAINING

PURPOSE - EDUCATION

- **What's important**
- **What to do**
- **What not to do**
- **Rational decisions**
- **Precautions**



CLEAN ROOM TRAINING

WHAT WE WILL COVER

- **Basics of clean room (video)**
- **Practices and applications**
- **Discussion**
- **Tour and questions**



CLEAN ROOM TRAINING

CLEAN ROOM USE

- Dressing
- Entry
- Work placement
- Activity
- Discipline



CLEAN ROOM TRAINING

CONTAMINATION TYPES

- **Molecular contaminants**
- **Surface contaminants**
- **Particulate contaminants**



CLEAN ROOM TRAINING

MOLECULAR CONTAMINANT SOURCES

- **Outgassing**
- **Oil vapors**
- **Alcohols**
- **Paints, glues, & epoxies**
- **Aromatics; If you can smell it, suspect it as a contaminant**

Note: Particulate filters will NOT handle molecular contaminants!



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SOURCES of SURFACE CONTAMINATION

- Finger prints
- Skin oil
- Hand cream
- Face cream
- Polish
- Oil & grease
- Face powder
- Plasticizers
- Wax



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SOURCES of PARTICULATES

- **People (skin, scales, hair, clothing lint, etc.)**
- **Particle shedding materials (cardboard boxes, paper)**
- **Abrading actions (drilling, sawing, sanding, etc.)**
- **Bare wood products**



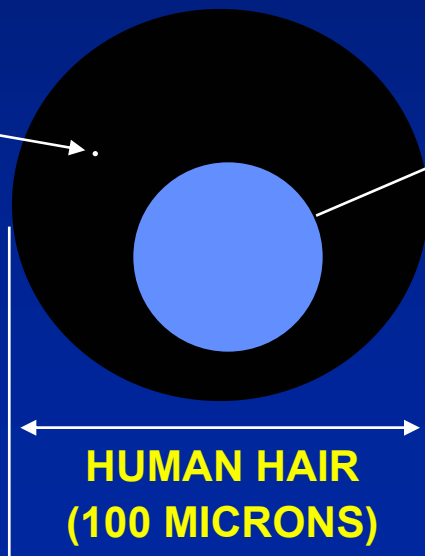
CLEAN ROOM TRAINING

RELATIVE PARTICLE SIZES

MOST PARTICLES ARE TOO SMALL TO BE SEEN WITHOUT AID. THEIR SMALL SIZE RESULTS IN ELECTROSTATIC BONDING TO SURFACES

**SIZE PARTICLE
COUNTED IN
CLEAN ROOMS.
(0.5 MICRONS)**

**SMALLEST SIZE
VISIBLE TO EYE.
(50 MICRONS)**

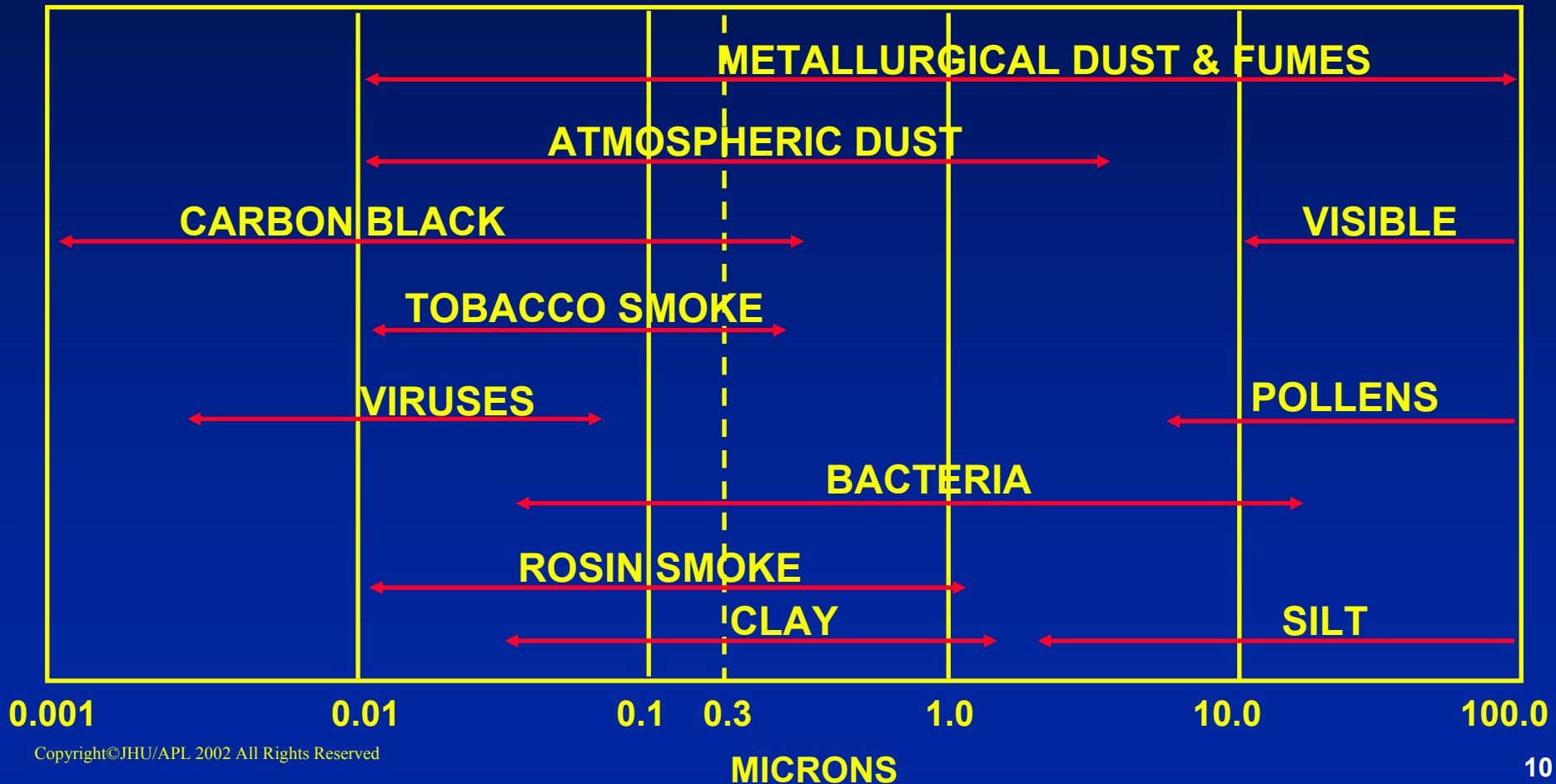


**MEASURED
PARTICLES ARE 100
TIMES SMALLER
THAN SEEN BY THE
UNAIDED EYE**



CLEAN ROOM TRAINING

PARTICULATE SIZES/MATERIALS





CLEAN ROOM TRAINING

PARTICLE GENERATION ACTIVITY

ACTIVITY	*PARTICLES	DESCRIPTION OF ACTIVITY
	100,000	MOTIONLESS IN EITHER SITTING OR STANDING POSITION
	500,000	HANDS, FOREARMS, NECK AND HEAD MOTION
	1,000,000	HANDS, ARMS, TRUNK, NECK, HEAD MOTION AND SOME LOWER BODY MOTION
	2,500,000	SITTING TO STANDING OR VICE VERSA
	5,000,000 7,500,000 10,000,000	WALKING AT 2.0 MPH WALKING AT 3.5 MPH WALKING AT 5.0 MPH



CLEAN ROOM TRAINING

SIZE DISTRIBUTION of PARTICLES from SNEEZES or COUGHS

<u>DIAMETER</u>	<u>SNEEZE</u>	<u>COUGH</u>
• <1-1 μM	800,000	66,000
• 1-2 μM	686,000	21,000
• 2-4 μM	280,000	1,600
• 4-8 μM	134,000	1,290
• 8-16 μM	36,000	490
• +22 μM	4,500	85
TOTAL	1,940,000	90,765



CLEAN ROOM TRAINING

CLEAN ROOM CLASS DEFINITION

**A CLASS (n) CLEAN ROOM IS
DEFINED AS A ROOM WITH AIR
CONTAINING NO MORE THAN (n)
PARTICLES PER CUBIC FOOT EQUAL
TO OR LARGER THAN 0.5 MICRON.**

(WHERE “n” IS 100, 1,000, 10,000, ETC.)



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CLEAN ROOM CLASSES

ISO-14644

Fed Std

209E

5

Class 100

M3.5

7

Class 10,000

M5.5

8

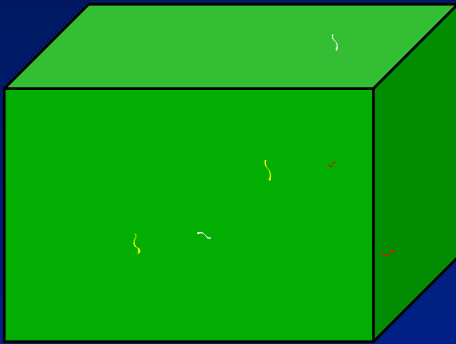
Class 100,000

M6.5

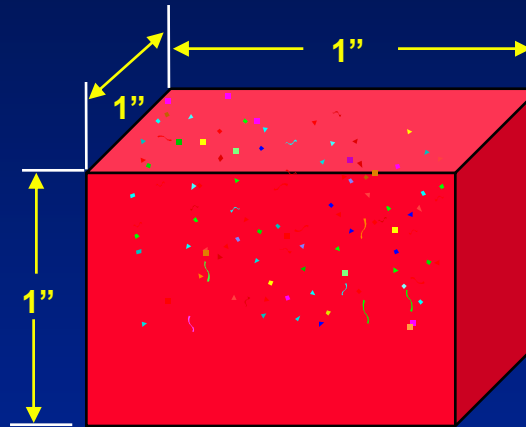


CLEAN ROOM TRAINING

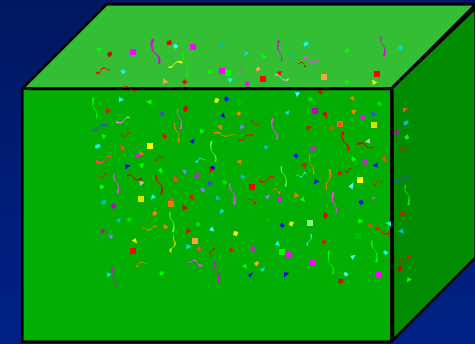
DIRT CUBE



**ABOUT 6
PARTICLES PER CU.
IN. OR 10,000 PER
CU. FT.**



**ABOUT 58
PARTICLES PER CU.
IN. OR 100,000 PER
CU. FT.**



**ABOUT 165
PARTICLES PER CU.
IN. OR 300,000 PER
CU. FT.**



CLEAN ROOM TRAINING

AIR FLOW

- Air entering the room is clean
- Air leaving the room is dirty
- Air flushes dirt out of the room
- Unidirectional flow- predictable
- Position yourself out of flow



CLEAN ROOM TRAINING

BLOCKAGE

- **Blocking air flow is undesirable**
- **Blocking air-returns reduces flushing dirt away**
- **Blocking air to flight hardware increases the chance of contamination**



CLEAN ROOM TRAINING

ACTIVITY

- **Limit vigorous actions**
- **Apply discipline to all activity**
- **Bring only clean items into the clean room**
- **Limit soldering, drilling, etc.**
- **Use only house or HEPA filtered vacuum**
- **Never sweep or dust, use C/R wet mop**



CLEAN ROOM TRAINING

GARMENTS

- **Garments control contamination**
 - They confine it inside or
 - They direct it to the floor
- **Wear proper garments**
- **Wear garments properly**



CLEAN ROOM TRAINING

CLASS 10,000 REQUIRES

- Hoods, booties, face mask, gloves & antistatic coveralls
- Garment change once per week - minimum
- Clean shoes with shoe cleaner before entering
- Entering room by walking across tacky mat
- Keep hood, if used, together with smock
- Throw away face mask & gloves on exiting
- Use approved wipes & note paper
- Pre-cleaning all tools, equipment, hardware, etc., before taking it into clean room



CLEAN ROOM TRAINING

RULES

- **No drilling, grinding, filing, sawing**
- **No thread cutting, deburring**
- **No soldering, brazing, welding**
- **No conformal coating or potting**
- **No cutting with diagonal pliers**
- **Do not vaporize plastic (wire insulation)**
- **Limit use of alcohol when cleaning**
- **Most glues not acceptable**
- **No heat stripping**
- **No masking, duct, adhesive tapes, only C/R tapes**



CLEAN ROOM TRAINING

RULES (cont)

- **No wood, cardboard, regular paper**
- **Avoid high outgassing materials (hydrocarbons)**
- **No gasoline vehicles**
- **No unpainted wood mockups**
- **Use clean room note pads & paper**
- **No felt tip or retractable pens, only ballpoint type**
- **No pencils or erasers**
- **Use proper tools that are cleaned**
- **Don't touch face with gloves**
- **No open cell foams**



CLEAN ROOM TRAINING

CLEANLINESS IS DEPENDENT

- On YOU
- On informed and trained people
- On limiting number of people in room
- On proper garment and dress
- On no smoking, drinking, eating in them
- On limited trips in/out
- On good personal hygiene
- On not blocking air return
- On cleaning all items prior to cleanroom entry
- On frequent and thorough facility cleaning
- On clean working procedures

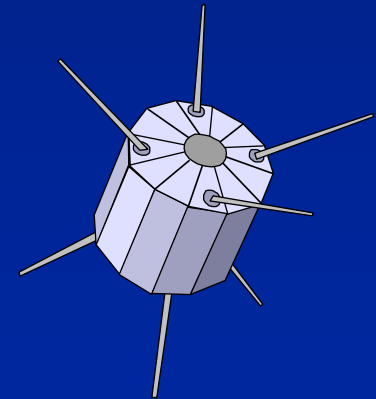
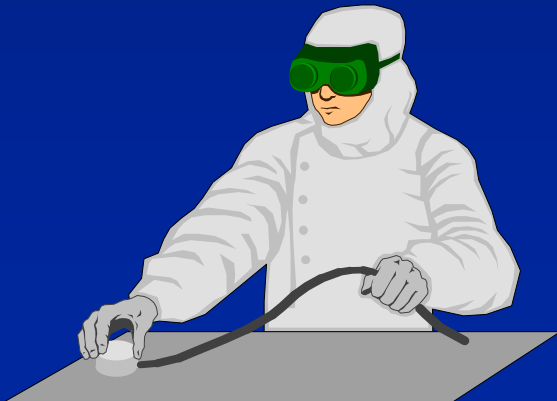


CLEAN ROOM TRAINING

THE BOTTOM LINE

LIMIT

PEOPLE - ACTIVITY - MATERIAL





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YOU

are the key

ELEMENT

in good

CLEAN ROOM OPERATION



CLEAN ROOM TRAINING

Homewood Key Contact Information

All emergencies security (24hrs)	x 67777
City Fire Department : Pull alarm and dial	911
Office of Safety and Environmental Health	x 68798

Johns Hopkins Emergency Notices Web Site

<http://webapps.jhu.edu/emergencynotices/>