



# 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!**



# CLEAN ROOM TRAINING

## SOURCES of SURFACE CONTAMINATION

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



# CLEAN ROOM TRAINING

## 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**





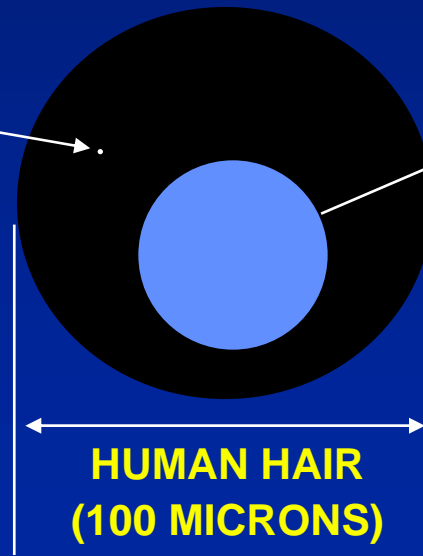
# CLEAN ROOM TRAINING

## 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)**

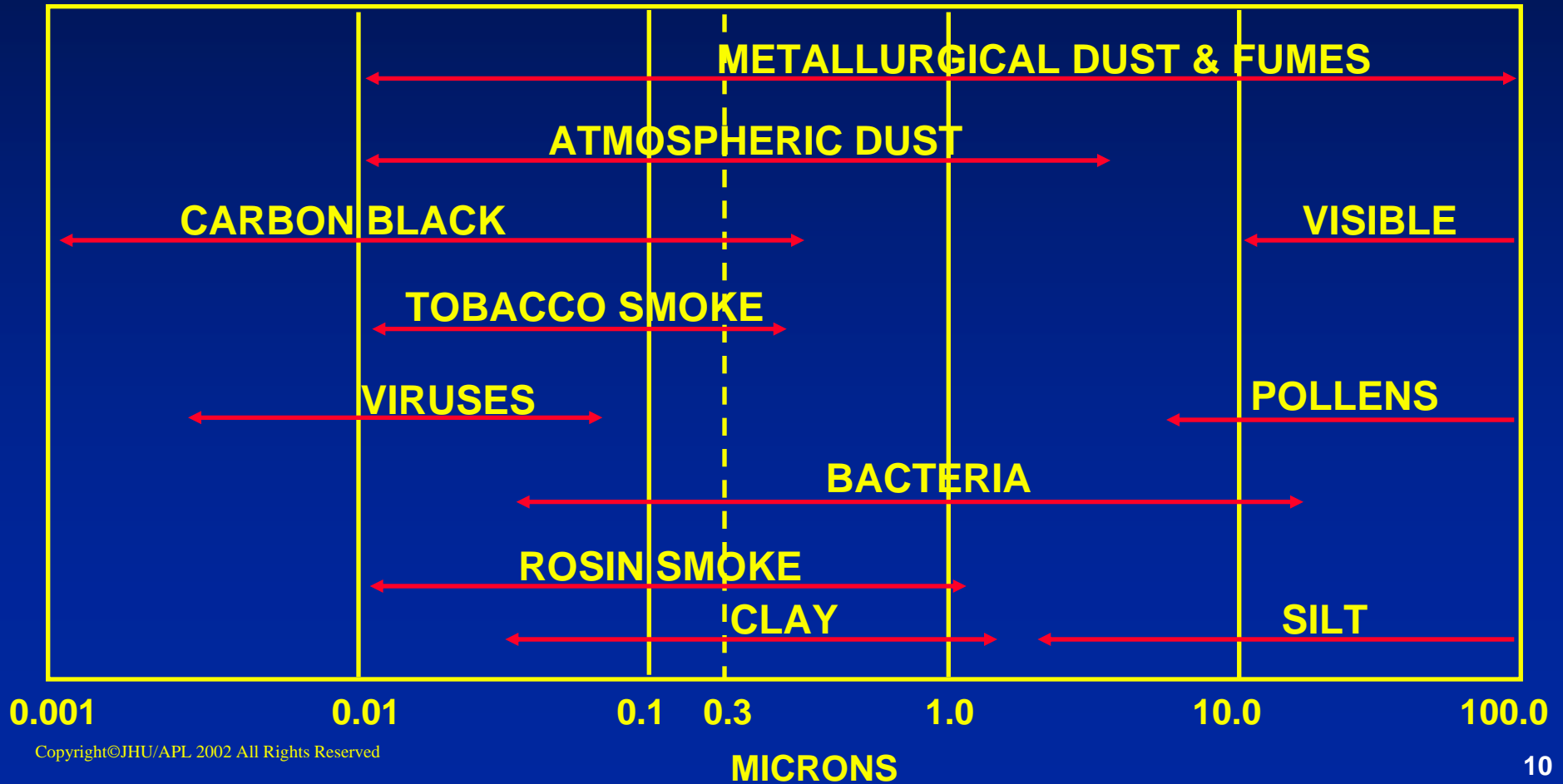


**MEASURED  
PARTICLES ARE 100  
TIMES SMALLER  
THAN SEEN BY THE  
UNAIDED EYE**



# 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 $\mu\text{M}$	800,000	66,000
• 1-2 $\mu\text{M}$	686,000	21,000
• 2-4 $\mu\text{M}$	280,000	1,600
• 4-8 $\mu\text{M}$	134,000	1,290
• 8-16 $\mu\text{M}$	36,000	490
• +22 $\mu\text{M}$	4,500	85
<b>TOTAL</b>	<b>1,940,000</b>	<b>90,765</b>



# 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.)**



# CLEAN ROOM TRAINING

## CLEAN ROOM CLASSES

**ISO-14644**

**Fed Std**

**209E**

**5**

**Class 100**

**M3.5**

**7**

**Class 10,000**

**M5.5**

**8**

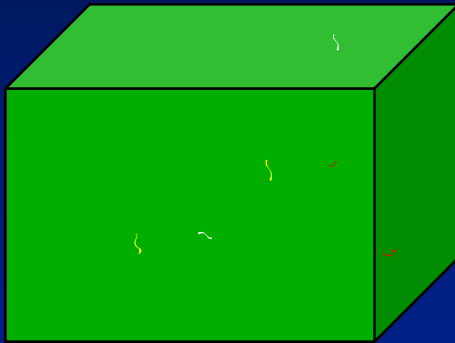
**Class 100,000**

**M6.5**

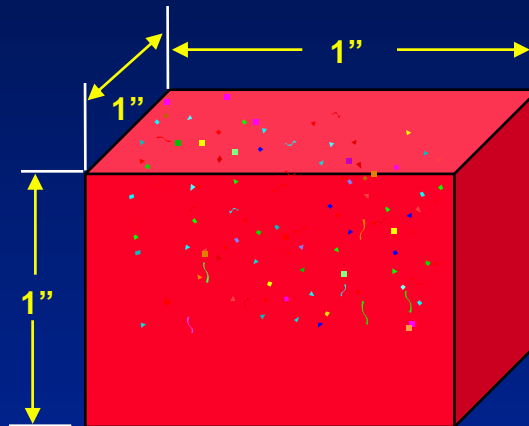


# CLEAN ROOM TRAINING

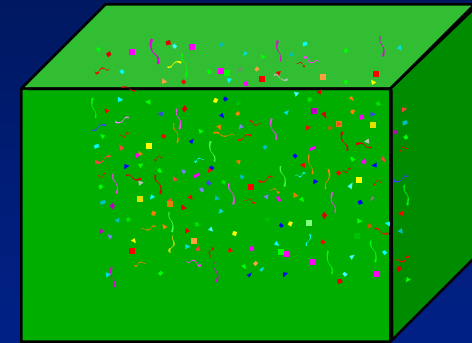
## DIRT CUBE



**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

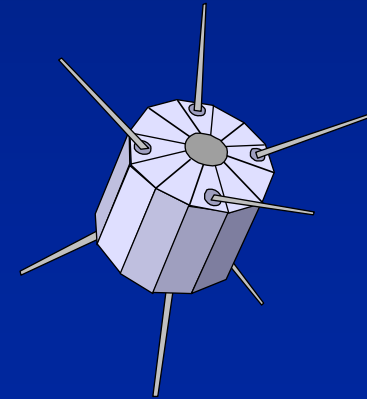
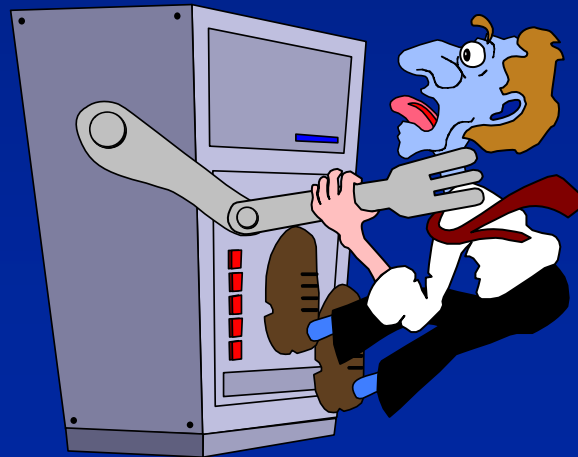
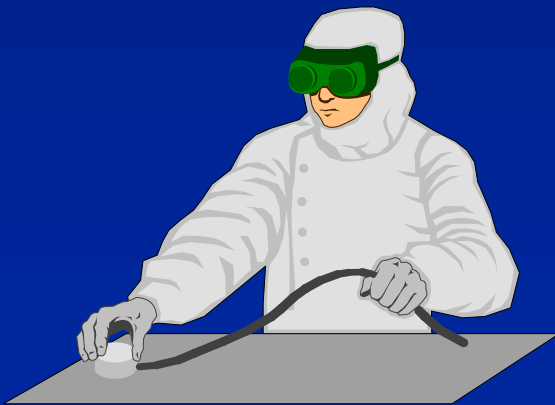


# CLEAN ROOM TRAINING

## THE BOTTOM LINE

# LIMIT

# PEOPLE - ACTIVITY - MATERIAL







# CLEAN ROOM TRAINING

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/>