CLEAN ROOM TRAINING

PREPARED FOR USE AT APL

CLEAN ROOM AREAS

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Modified for Homewood use with permission from authors
PURPOSE - EDUCATION

- What’s important
- What to do
- What not to do
- Rational decisions
- Precautions
WHAT WE WILL COVER

• Basics of clean room (video)
• Practices and applications
• Discussion
• Tour and questions
CLEAN ROOM USE

- Dressing
- Entry
- Work placement
- Activity
- Discipline
CONTAMINATION TYPES

- Molecular contaminants
- Surface contaminants
- Particulate contaminants
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
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
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)

HUMAN HAIR (100 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

0.001 0.01 0.1 0.3 1.0 10.0 100.0

MICRONS

METALLURGICAL DUST & FUMES
ATMOSPHERIC DUST
CARBON BLACK
TOBACCO SMOKE
VIRUSES
BACTERIA
ROSIN SMOKE
CLAY
VISION
POLLENS
SILT
# Particle Generation Activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Particles</th>
<th>Description of Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motionless in either sitting or standing position</td>
<td>100,000</td>
<td>hands, forearms, neck and head motion</td>
</tr>
<tr>
<td>Hands, forearms, neck and head motion</td>
<td>500,000</td>
<td>hands, arms, trunk, neck, head motion and some lower body motion</td>
</tr>
<tr>
<td>Hands, arms, trunk, neck, head motion and some lower body motion</td>
<td>1,000,000</td>
<td>sitting to standing or vice versa</td>
</tr>
<tr>
<td>Sitting to standing or vice versa</td>
<td>2,500,000</td>
<td>walking at 2.0 MPH</td>
</tr>
<tr>
<td>Walking at 2.0 MPH</td>
<td>5,000,000</td>
<td>walking at 3.5 MPH</td>
</tr>
<tr>
<td>Walking at 3.5 MPH</td>
<td>7,500,000</td>
<td>walking at 5.0 MPH</td>
</tr>
<tr>
<td>Walking at 5.0 MPH</td>
<td>10,000,000</td>
<td>minimum 0.3 micron and larger</td>
</tr>
</tbody>
</table>
## SIZE DISTRIBUTION of PARTICLES from SNEEZES or COUGHS

<table>
<thead>
<tr>
<th>DIAMETER</th>
<th>SNEEZE</th>
<th>COUGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1-1 uM</td>
<td>800,000</td>
<td>66,000</td>
</tr>
<tr>
<td>1-2 uM</td>
<td>686,000</td>
<td>21,000</td>
</tr>
<tr>
<td>2-4 uM</td>
<td>280,000</td>
<td>1,600</td>
</tr>
<tr>
<td>4-8 uM</td>
<td>134,000</td>
<td>1,290</td>
</tr>
<tr>
<td>8-16 uM</td>
<td>36,000</td>
<td>490</td>
</tr>
<tr>
<td>+22 uM</td>
<td>4,500</td>
<td>85</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1,940,000</strong></td>
<td><strong>90,765</strong></td>
</tr>
</tbody>
</table>
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 Classes

<table>
<thead>
<tr>
<th>ISO-14644</th>
<th>Fed Std</th>
<th>209E</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Class 100</td>
<td>M3.5</td>
</tr>
<tr>
<td>7</td>
<td>Class 10,000</td>
<td>M5.5</td>
</tr>
<tr>
<td>8</td>
<td>Class 100,000</td>
<td>M6.5</td>
</tr>
</tbody>
</table>
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
• 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
GARMENTS

• Garments control contamination
  – They confine it inside or
  – They direct it to the floor

• Wear proper garments
• Wear garments properly
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
• 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
YOU are the key element in good clean room operation.
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/