

P0042
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CLEAN ROOM COURSE OUTLINE

I PURPOSE

A. PREVENT CONTAMINATION OF GYROSCOPES

1. GAP < .001" (25 Micron) IMPLIES ZERO PARTICLES 5 MICRON
2. DRAG DUE TO PARTICLES ON SURFACE
N (1 MICRON) < 100
N (0.1 MICRON) < 3000
3. TYPICAL PARTICLE SIZE CHART

II CLEAN ROOM THEORY

A. CLEAN ROOM CLASSIFICATION CHART

B. CONDUCT

1. Emphasize impact of people. The most significant impact on the cleanliness of products are the actions taken by those who handle it.
2. Sources of particulate contamination
3. Typical sources/sizes of particles chart
4. Settling rate chart
5. Increase of contamination by personnel
6. Review *GP-B General Conduct Rules (P0035)*
 - a. Emphasize prohibition on using unfamiliar equipment or specialized equipment belonging to others without specific permission.
7. Review *GP-B Approved and Restricted Actions (P0036)*

C. MATERIALS

1. Why material choice is important
 - a. Corrosion products from metals
 - b. Fibers from papers, cloth
 - c. Decomposition of plastics, rubbers
 - d. Drying of fluids, greases (fluids contain dissolved solids) which resolidify upon drying. Most greases contain particulate or fibrous thickeners which are released upon drying.
2. Review *GP-B Approved and Restricted Materials Lists (P0036)*

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III ENTERING AND EXITING

A. ORGANIZE BEFORE ENTERING

B. HOUSEKEEPING

1. Sticky Mats
2. Trash
3. Visible contaminants

C. GOWNING

1. Describe procedure
2. Demonstrate procedure
3. Explain problems with typical alternate procedures
4. Show weaknesses of gowning
 - a. Bellows action at cuffs and neck
 - b. Pore size of fabric
 - i. Herringbone 5 micron
 - ii. Chemstat 909 1 micron
 - iii. Tyvek-Micro-Clean 2-1-2

IV SUMMARY

A. Review list of *GP-B Clean Room Procedures (P0023)*

Users are responsible to read and follow them

B. Understanding the needs and technology of cleanliness as well as cooperation in implementing this technology is a key part of everyone's job on GP-B.

CLEAN ROOM CLASSIFICATION

CLASS	PARTICLE SIZE, μm				
	0.1	0.2	0.3	0.5	.5
1	35	7.5	3	1	---
10	350	75	30	10	---
100	---	750	300	100	---
1000	---	---	---	1000	7
10000	---	---	---	10000	70
100000	---	---	---	100000	700

Particles per cubic foot of sizes greater than or equal to the size shown per F. S. 209

SOURCES OF PARTICULATE CONTAMINATION

- Dust
- Street clothing
- Human hair
- Perspiration
- Smoking
- Cosmetics—flaking
- Metal chips and burs from assembly process
- Solid film lubricants
- Metal oxides—nonadherent or flaky
- Fretting corrosion
- Air circulating systems—suspended solids
- Air

TABLE II

There are many types of activities that generate particles that must be restricted or controlled in clean areas. The chart describes some of the typical particle generating activities. Refer to Table III

TYPICAL SOURCES OF PARTICLES

ACTIVITY	PARTICLE SIZE MICROMETERS
RUBBING ORDINARY PAINTED SURFACE	90
SLIDING METAL SURFACES (UNLUBRICATED)	50 TO 150
CRUMPLING OR FOLDING PAPER	60
RUBBING AND EXPOXY PAINTED SURFACE	30 TO 75
SEATING AND UNSEATING SCREWS	25 TO 120
BELT DRIVE	5 TO 35
WRITING WITH BALLPOINT PEN ON ORDINARY PAPER	15 TO 30
HANDLING PASSIVATED METALS, SUCH AS FASTENING MATERIALS	10 TO 20
VINYL FITTING ABRADED BY A WRENCH	5 TO 60
RUBBING SKIN	5 TO 300
CHIPS FROM WRENCH SEAT OF BROACHED ALLEN HEAD SCREWS	400

TABLE III

PARTICLE SETTLING VELOCITIES

PARTICLE SIZE (MICRONS)	SETTLING VELOCITY
100.00	59.2 FEET PER MINUTE
50.0	14.8 FEET PER MINUTE
10.0	7.1 INCHES PER MINUTE
1.0	5.1 INCHES PER HOUR
0.5	1.4 INCHES PER HOUR
0.1	1.13 INCHES PER DAY
<0.1	NEGLIGIBLE

TABLE IV

PARTICLE SIZE DISTRIBUTION OF ATMOSPHERIC AIR

@ a concentration of 69 micrograms per cubic meter or .03 grains per 1000 cubic feet)

PARTICLE SIZE (Microns)	AVERAGE QUANTITY PER CUBIC FOOT	PERCENT BY COUNT	PERCENT BY WEIGHT
0.01-0.02	173,929,613	7.28	----
0.02-0.05	338,577,845	14.17	0.02
0.05-0.10	395,213,491	16.54	0.18
0.10-0.22	906,959,672	37.95	4.20
0.22-0.46	501,288,728	20.98	23.22
0.46-1.00	69,890,564	2.92	32.38
1.00-2.15	3,801,973	0.18	17.60
2.15-4.64	212,705	-----	9.85
4.65-10.00	15,235	-----	7.06
10.00-21.54	645	-----	2.98
21.54 +	28	----	2.51
	2,389,890,499	100.00	100.00

TABLE V

PERFORMING NON-CONFIRMING MANUFACTURING OPERATIONS

Table VI describes the methods that should be used for performing non-conforming manufacturing operation, within clean area.

PERFORMING NON-CONFIRMING MANUFACTURING OPERATION IN CLASS III TO CLASS VI CLEAN AREAS

A. PREPARATION

1. Obtain approval of *Clean Room Manager*.
2. Cover all products and equipment in immediate area.
3. Mask-off area of product to be serviced.
4. Keep all personnel out of the work area not participating in the operation.

B. PERFORMING OPERATION

1. Two people are required for all non-conforming operations except when using a clean room approved hood.
2. Clean peripheral area whenever accumulations of soil occur or work is interrupted.

C. POST OPERATION

1. Remove all tools, cloths, solvents and so forth from clean area.
2. Clean all work surfaces and peripheral areas.
3. Uncover all nearby products and equipment.
4. Have *Clean Room Manager* check operation and area.

TABLE VI

PERSONNEL CONTAMINATION GENERATING ACTIONS

Groups of personnel or certain personnel actions can increase the ambient cleanliness level in a clean area by a factor of more than fifty to one. Some of these activities are described in Table VII

INCREASE OF CONTAMINATION LEVEL BY PERSONNEL

Times increase over ambient levels
ACTIVITY (Particles, 0.2 to 50 µm)

PERSONNEL MOVEMENT

Gathering together 4 to 5 people at one location	1.5 to 3
Normal walking	1.2 to 2
Sitting quietly	1 to 1.2
Laminar flow work station with hands inside	1.01
Laminar flow work station-no activity	None

PERSONNEL PROTECTIVE CLOTHING (SYNTHETIC FIBERS)

Brushing sleeve of uniform	1.5 to 3
Stamping on floor without shoe covering	10 to 50
Stamping on floor with shoe covering	1.5 to 3
Removing handkerchief from pocket	3 to 10

PERSONNEL per sec

Normal breath	None
Breath of smoker up to 20 minutes after smoking	2 to 5
Sneezing	5 to 20
Rubbing skin on hands and face	1 to 2

TABLE VII