SRS/STG-TR92-01

Volume V - Appendix H
Task 8 Report
Clean Room Survey and Assessment

Technical Report

September 3, 1991

ADVANCED LIFE SUPPORT ANALYSES (Contract No.: NAS8-38781)

APPROVED BY: Jay M. Laue
Jay M. Laue
STG Vice President
Aerospace Systems

APPROVED BY: Dennis E. Homesley
Dennis E. Homesley
STG Vice President
Tactical Systems

SRS TECHNOLOGIES

SYSTEMS TECHNOLOGY GROUP

990 EXPLORER BLVD. N.W.
CUMMINGS RESEARCH PARK WEST
HUNTSVILLE, ALABAMA 35806
(205) 895-7000

SRS/STG-TR91-22
5738-01

MSFC CLEAN ROOM
SURVEY AND ASSESSMENT

FINAL TASK REPORT
JANUARY 7, 1991

SUBMITTED BY: SRS Technologies
Systems Technology Group
990 Explorer Blvd., NW
Cummings Research Park West
Huntsville, AL 35806

PREPARED FOR: George C. Marshall Space Flight Center
Materials and Processes
Marshall Space Flight Center, AL 35812

Approved by: Jay H. Laue
Jay H. Laue
Vice President
Aerospace Systems Directorate

Approved by: Dennis E. Homesley
Dennis Homesley
Vice President
Tactical Systems Directorate

SRS TECHNOLOGIES

SYSTEMS TECHNOLOGY GROUP

990 EXPLORER BLVD. N.W.
CUMMINGS RESEARCH PARK WEST
HUNTSVILLE, ALABAMA 35806
(205) 895-7000

SRS TECHNOLOGIES

990 EXPLORER BLVD. N.W.
CUMMINGS RESEARCH PARK WEST
HUNTSVILLE, ALABAMA 35806
(205) 895-7000

SYSTEMS TECHNOLOGY GROUP

January 7, 1991
OL91-3028

TO: Distribution

SUBJECT: Final Report - Advanced Life Support Analyses, Task D, ECLSS Evolution, Modification No. 1

PREPARED FOR: Mr. Paul Wieland
Mail Code ED62
George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812

CONTRACT NO.: NAS8-38781

DATE OF PUBLICATION: January 7, 1991

The enclosed final report is submitted in conclusion of the work required under the subject contract modification for the period October 1, 1990 - December 31, 1990. Also enclosed is an outline for Phase II Cleanroom Support.

Sincerely,

SRS TECHNOLOGIES
Systems Technology Group

Jay H. Laue
Vice President
Aerospace Systems Directorate

JHL/kct

Distribution: ED62/Wieland
EH41/Sharpe

Enclosure: as stated

FOREWORD

This three month effort was performed by a prime/subcontract team consisting of SRS Technologies and NTS Technical Services, respectively. Mr. Jim Moore served as the SRS Project Manager. Mr. Gary Willey served as NTS Project Manager. The COTR for NASA/Marshall Space Flight Center was Mr. Max Sharpe. He was assisted by Ms. Gigi Smith. The following SRS/NTS personnel contributed to this effort.

Mr. Jim Moore (SRS)
Mr. Jim Pearson (SRS)
Mr. Mike Maness (SRS)
Mr. Gary Willey (NTS)
Mr. Tim Marrs (NTS/CLESTRA).

CONTENTS

LIST OF EXHIBITS

1.0 INTRODUCTION

This effort was conducted to support the Advanced Life Support Analysis Study, Task D, ECLSS Evolution, under NASA Contract No. NAS8-38781. The scope of this task is to perform a comparative analysis of the various ECLSS evaluation options for different growth scenarios. The Space Station Freedom ECLSS design and existing ground-based clean room facilities are used as a baseline for comparison. This report specifically addresses ground-based clean room facilities at MSFC. This report consists of an evaluation of the facilities, equipment, technologies, and procedures used to maintain specified environments in typical aerospace industrial areas. The 25 specific clean rooms evaluated in this report are listed in Exhibit 1.1.

The objectives of this study were as follows:

- Collect, Compare, and Catalog Data for Each Specified Facility, Including:
  - Engineering/Design
  - Construction Materials
  - Work Stations
  - Contamination Control
  - Particulate Elimination
  - Entry Systems
  - Instrumentation
- Formulate Recommendations Concerning Enhancements Required to Assure an Efficient and Orderly Evolution of MSFC Clean Room Environmental Control Facilities

The results of the clean room survey and resulting recommendations are presented in this report.

The SRS/NTS team conducted the on-site survey of the NASA MSFC cleanroom facilities on October 29, 1990 through November 4, 1990. The survey was conducted in accordance with FED-STD-209D, which calls out the various requirements for different classes of cleanrooms.

The survey was conducted in cleanrooms that fall under the following definitions:

1) As-built cleanrooms: Cleanrooms (facilities) that are complete and ready for operation, with all services connected and functional, but without production equipment or personnel within the facility.

2) At-rest cleanrooms: Cleanrooms (facilities) that are complete and have the production equipment installed and operating, but without personnel within the facility.

3) Operational cleanrooms: Cleanrooms (facilities) in normal operation with all services functioning and with production equipment and personnel present and performing their normal functions in the facility.

LOCATION	DESCRIPTION (Name)	MONITORING LEVEL	ROOM DIMENSIONS LxWxH (ft)	ENGINEER RESPONSIBLE	SUPPORT GROUP(S) Projects
1. Bldg 4707 Rm120B	Tape Wrap Cell	100K	55x38x30	John Vickers/EH43	SRM
2. Bldg 4707 Rm121	Tape Laying/Pultrusion	100K	80x70x30	Gail Gordon/EH43	ET, SRB, SS, ALS
3. Bldg 4707 Rm124	Filament Winding Lab	100K	80x66x30	Gerald Franks/EH43	ET, SRB, SS, ALS
4. Bldg 4707 Rm129	Composite Lay-up Lab	100K	40.8x21.4x15	Gail Gordon/EH43	ET, SRB
5. Bldg 4707	Bonding and Conscan P.B.	100K	12x12x10	Paul Gill/EH44	SRB
6. Bldg 4707	Prepreg P.B.	100K	12x12x10	Gail Gordon/EH43	SRB, CDDF
7. Bldg 4707	Modular Clean Room SRB Composites	30K	18x24x12	Carl Lester/Gail Gordon/EH43	SRB
8. Bldg 4707	Modular Clean Room SS Composites	100K	30x20x10	Gail Gordon/EH43 & Bruce Baker(BAC)	SS
9. Bldg 4707	Subscale Solid Rocket Motor Processing Facility	100K	33x50x10	Nance Jo Ogozalek/Gerald Franks/EH43	SRM
10 Bldg 4711, Rm W12	Dry Film/ Lubricant Application	100K	25x21x15	Lewis Moore/EH14	SSME/SR&T, OAET
11 Bldg 4711, Rm W13	Metrology Lab	100K	26x25x15	Lewis Moore/EH14	SSME/SR&T, OAET

Exhibit 1.1a Clean Room Facilities Included in Survey

LOCATION	DESCRIPTION (Name)	MONITORING LEVEL	ROOM DIMENSIONS LxWxH (ft)	ENGINEER RESPONSIBLE	SUPPORT GROUP(S) Projects
1. Bldg 4705, Rm A10	A104A, (Packaging and unpackaging)	30K	16x11x10	J.R. Williams/EH51 & George Rittenhouse(VVE)	Multi-Program
2. Bldg 4705, Rm A10	MLI Blanket Room	30K	24x99x10	J.R. Williams/EH51 & Bobby Tidmore (VVE)	SSME/ Multi-Program
3. Bldg 4705	A106A, Test Article Check	30K	19x15x10	J.R. Williams/EH51 & Bobby Tidmore (VVE)	SSME/ Multi-Program
4. Bldg 4705 Rm A106	Flight Experiments	30K	46x38x10	J.R. Williams/EH51 & Bobby Tidmore (VVE)	SSME/ Multi-Program
5. Bldg 4705, Rm A10	Adhesive Bonding Rm	100K	19x15x10	J.R. Williams/EH51 & Bobby Tidmore (VVE)	Multi-Program
6. Bldg 4705, High Ba	High Bay Small Tent	100K	18x12x10	J.R. Williams/EH51 & Bobby Tidmore (VVE)	Multi-Program
7. Bldg 4705, High Ba	High Bay Large Tent	100K	46x28x15	J.R. Williams/EH51 & Bobby Tidmore (VVE)	Multi-Program/ Experiment Assembly
8. Bldg 4705, Rm B11	Precision Cleaning	30K	75x38x14	J.R. Williams/EH51 & George Rittenhouse(VVE)	Multi-Program Precision Cleaning
9. Bldg 4705	B120	100K	75x52x9	J.R. Williams/EH51 & George Rittenhouse(VVE)	Multi-Program
10 Bldg 4705	B120B, Potting Shop	100K	22x14x10	J.R. Williams/EH51 & George Rittenhouse(VVE)	Multi-Program

Exhibit 1.1b Clean Room Facilities Included in Survey

LOCATION	DESCRIPTION (Name)	MONITORING LEVEL	ROOM DIMENSIONS LxWxH (ft)	ENGINEER RESPONSIBLE	SUPPORT GROUP(S) Projects
11 Bldg 4705 Rm B122	Cleaned Parts Packaging	30K	14x13x10	J.R. Williams/EH51 & George Rittenhouse(VVE)	Multi-Program Packaging ULTRA-Cleaned Parts
12 Bldg 4705 Rm B124	Ultra-Cleaned Hydraulic Components	4K	22x12x10	J.R. Williams/EH51 & George Rittenhouse(VVE)	Multi-Program/ Hydraulic Components
13 Bldg 4760, Rm 118	Dry Film Lubrication	100K	21x12x10	J.R. Williams/EH51 & George Rittenhouse(VVE)	SSME/ Multi-Program
14 Bldg 4760, Rm 201	MLI Blanket Fabrication Shop	100K	28x19x10	J.R. Williams/EH51 & George Rittenhouse(VVE)	Multi-Program

Exhibit 1.1c Clean Room Facilities Included in Survey

2.0 GENERAL OVERVIEW

In a cleanroom environment, it is important that air flow rates and direction, pressurization, temperature, humidity, and specialized filtration are tightly controlled wherever possible. The survey showed that, in general, the temperature was adequately controlled in most of the rooms, but the humidity varied greatly. Most of the rooms should have additional High Efficiency Particulate Air (HEPA) filters installed and the return vents should be relocated close to the floor. This arrangement is the correct way to circulate the air and remove the contamination from the room (see Exhibit 2.1). Most of the cleanrooms were constructed in the 1960's and the Heating Ventilation and Air Conditioning (HVAC) systems have been upgraded, but better systems are available today and they are much easier to maintain (see Exhibit 2.2). The new integrated units provide cooling, heating, and reheating to control temperature and humidity to the acceptable tolerance.

The cleanrooms are stick-built. This was the construction method of choice for cleanrooms in the 60's. Each room was a custom design and all construction is on site. Historically, this type of construction will tie up space and cash. The upkeep is expensive and requires a lot of maintenance. The new prefabricated construction has added benefits, such as moving, modifying or relocating them at any time with less disruption. The walls don't have to be painted on a yearly basis. The HVAC systems are all compact and very easy to maintain and are located on the floor. The rooms have the correct number of HEPA filters, the return vents are in the right locations, control monitor systems are built in the HVAC unit and control the temperatures in the range of 65 to 75 degree to a tolerance of ± 2 degrees. The humidity maintained at 45 percent to a tolerance of +5 percent RH and, for critical applications, to a tolerance of +0.5 percent RH (see Exhibit 2.3).

The entry areas in most cleanrooms today are controlled by positive pressure and very few use air showers. Most of the cleanroom people feel that air showers blow the particles around and they cling to the walls, ceilings and on the garments. People working in the cleanrooms are usually clothed in special, non-shedding garments, from head to toe. The garments are usually packaged particle-free. We found that there was no consistency or standard procedure being used for wearing cleanroom garments in the cleanrooms. It is obvious that the training of personnel is essential and a manual should be written for the proper procedure to be followed. In all cleanrooms, the ceilings, walls and floors must be finished with materials that will not shed particles into the environment. In some cases, where static control is a concern, the surfaces should be metallic. We found that many of the ceilings were made of material that is not compatible in a cleanroom environment. Also, cinder block walls that are painted should be covered up with wall material that is cleanroom compatible.

CLEANROOM

AIR SUPPLY (HEPA FILTERS)

AND RETURN

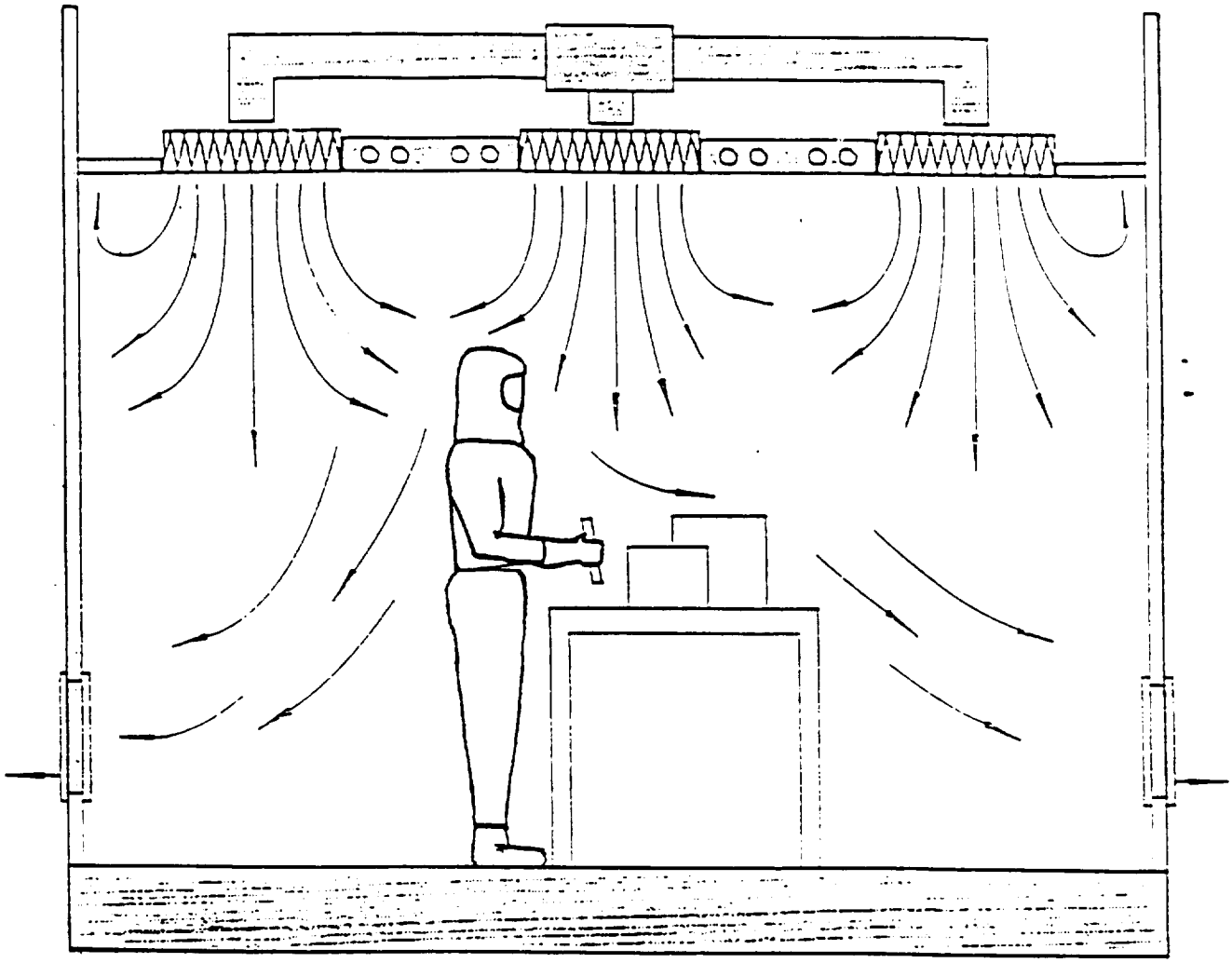
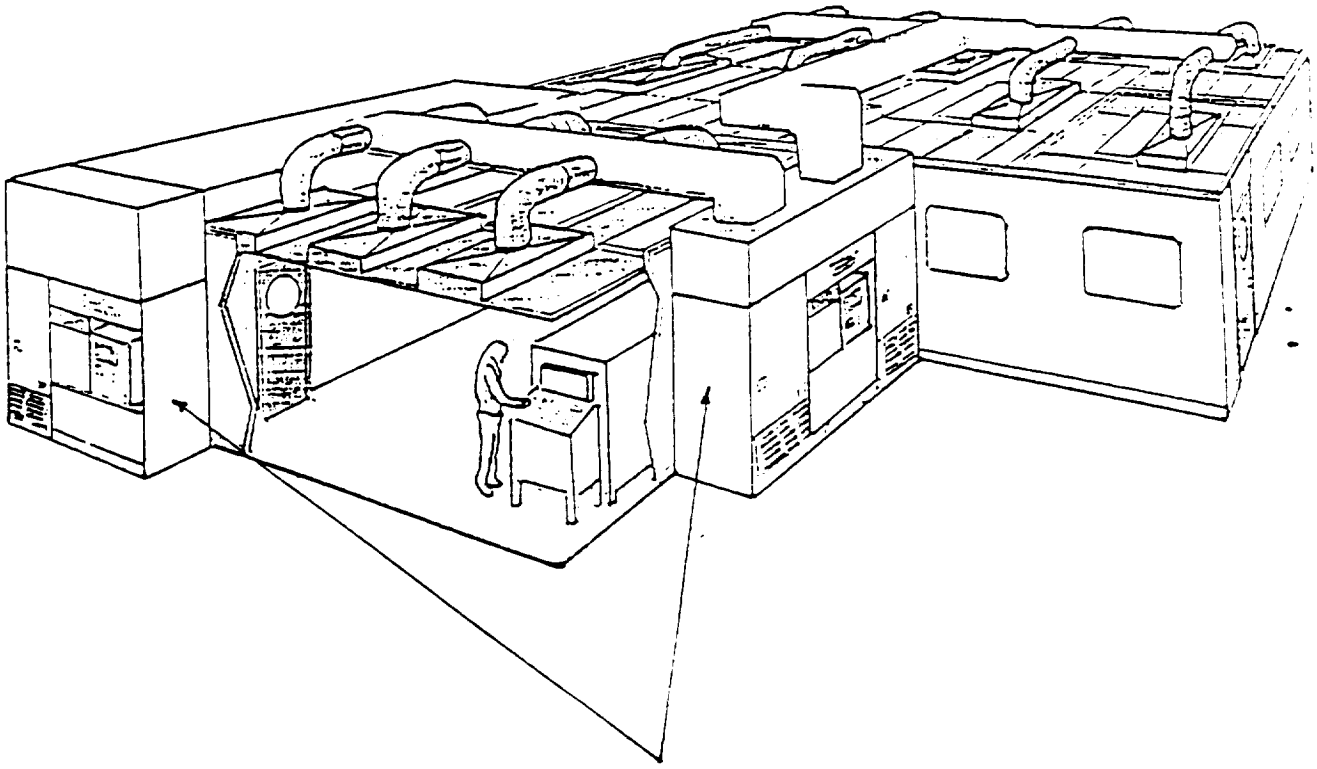


Exhibit 2.1

CLEANROOM

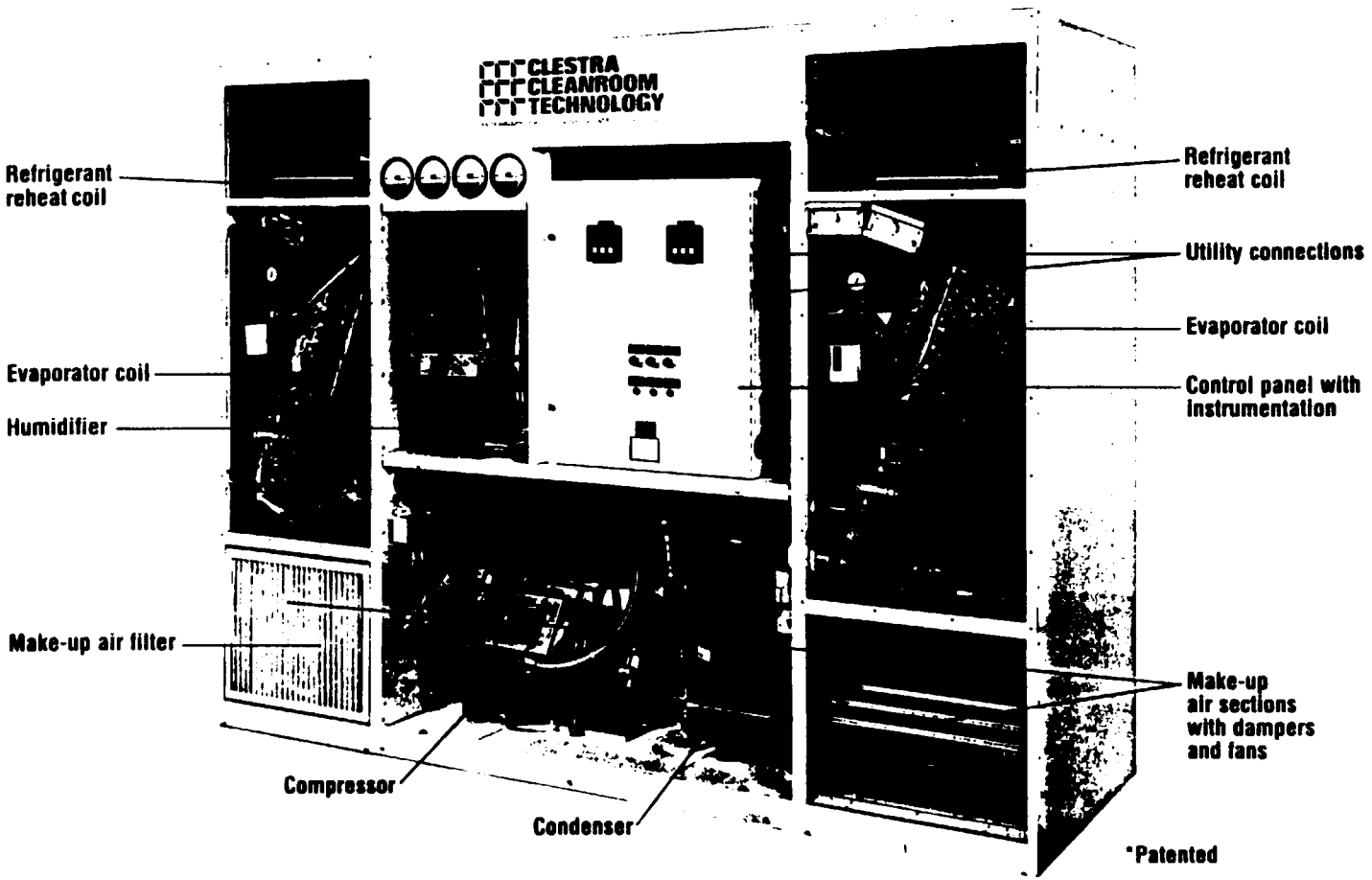
HVAC SYSTEM



The AC Unit Located on the Outside of the Cleanroom Controls Temperature, Pressurization, Humidity and Cleanliness to All Specifications and Has Gauges Mounted on Each Unit For Observing the Various Conditions.

Exhibit 2.2

SRS/NTS



Easily installed and maintained.
Ideal for multiple rooms or multiple locations

Exhibit 2.3 Advanced Air Clean Room System

SRS/INTS

While surveying the cleanrooms, we found that maintenance is a major problem throughout. In many of the cleanrooms, a hand wiped across the tables, benches, equipment, etc. would become visibly soiled. The rooms should be cleaned on a daily basis and a chart posted on the outside of the room stamped or initialed that the room has been mopped, vacuumed, and that tables, benches, and equipment have been wiped down. The people need to be trained on the proper maintenance of cleanrooms and a procedure manual should be written.

3.0 EXISTING CONDITIONS

Ceilings

The ceilings in some of the rooms need to be replaced with new drop ceilings with tiles that are compatible with cleanroom requirements. The rooms that have been recently upgraded had porous office tiles installed for the ceiling. This type of tile generates particles and is not cleanroom compatible. Cleanroom ceiling tiles should be made of Armstrong Mylar or equivalent. Each cleanroom needs new light fixtures that are accessible from the inside of the cleanroom. The large diffusers that are being used inside the cleanroom are obsolete. Flush mounted supply vents with HEPA filters are now used.

Walls

In some of the cleanrooms, cinder block walls have been painted with epoxy paint. For cleanroom conditions, the walls should be skinned using hard board with baked melaine or equivalent material.

Exposed cables and metal structures on the walls need to be blocked in. Ducts above hoods located in the rooms need to be boxed in. Steel I beams and steel support poles in the rooms need to be boxed in. Return chases that are exposed need to be boxed in.

Floors

The floors in many of the rooms are very dirty and need to be cleaned daily. Some of the floors need to be replaced and others need to be repaired in various areas. Coving along the floors needs to be replaced in many of the rooms.

Air Showers

Some of the air showers were working and others were not. The ends on some were broken and had not been replaced.

Most cleanrooms today are controlled in the entry area by positive pressure. If NASA wants to continue to use air showers in their entry areas, the industry has new showers that should be used to replace the existing showers.

Shoe Cleaners

The industry has much better shoe cleaning machines today that should be used to replace the old ones at the MSFC facilities. Very few cleanrooms use the shoe cleaning machines.

Garments

While conducting the survey it was obvious that NASA personnel were not trained in the proper garment procedures that should be utilized in a cleanroom environment. During the personnel breaks the garments should be placed upon garment hooks located below a HEPA filter for garment air wash. During breaks the garments were placed back inside individual lockers which had previously stored personal articles and street clothes. Lockers should be used for personal items only and not cleanroom garments. When SRS and NTS personnel entered the first cleanroom where garments were required, garments were found that had been worn before, and were very dirty. The garments should have been replaced. Cleanroom garments were observed being worn outside the clean room facility and the garments were allowed to be carried from one cleanroom to another under the arms of individuals. We found that the cleanroom methods and procedures used for cleanroom garments were not consistent.

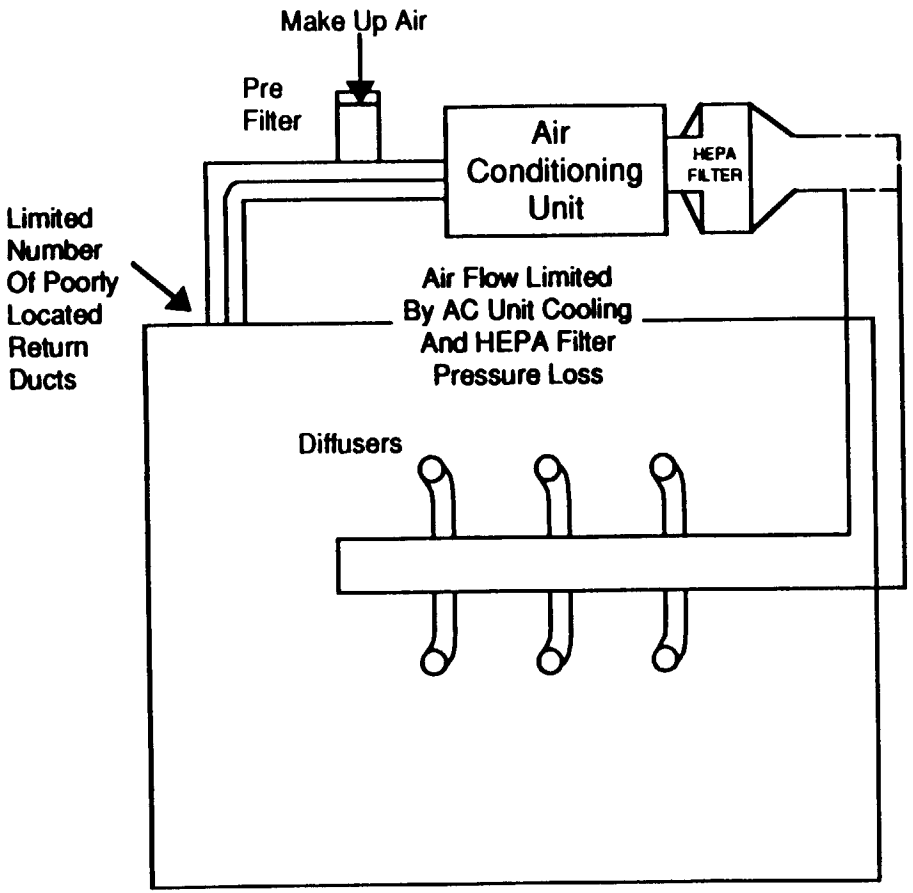
Equipment

Some of the equipment being used inside the cleanroom had paint chipping off, was dirty, had oil leaks, and needs to be replaced. Specific items are listed under the recommendations for the cleanrooms.

Most of the HVAC systems have been upgraded, but some of them had HEPA filters located by the main unit and not in the supply vents going into the room. One unit located in Building 4707 had a large desiccant dehumidifier that was not operating. There are better HVAC systems available today that are installed on the outside of the cleanroom wall located on the floor, which makes maintenance much more cost effective. The gauges are located on the face of the units and they monitor all conditions inside the cleanroom.

Most of the cleanrooms surveyed in this review used a standard industrial air handling unit for air conditioning in the facility. Typically a single large HEPA filter bank was installed in the primary supply duct to filter the air. A typical cleanroom HVAC system of this type is shown in Exhibit 2.4. This configuration has some significant drawbacks in terms of providing a cleanroom environment.

The most significant limitation of the system is air handling volume. Exhibit 2.4 shows the air change velocity schedule specified for various clean room environments in MSFC-STD-246-B. The large air change rates are required in the cleanroom to perform two functions. First, clean HEPA filtered air is supplied to the room to assure that the air entering the room meets particle size and concentration limits as specified by the Federal Standard 209-D and MSFC-STD-246-B. The second function of the high air change velocity requirement is to assure that air contaminated by particles generated within the room is quickly displaced by clean air from HEPA filters. This second function is particularly important in cleanroom



Typical HVAC Configuration For Current Clean Room Facilities(6 Changes/Hour Typical)

- Air handling volume is limited by A/C air exit temp requirements and by pressure drop across filter. A/C units capacity was verified by top-level clean room HVAC design program.
- Typically there are very few return ducts, and they are poorly located with respect to maintaining uniform flow.
- MSFC-STD-246B specifies the following air change velocity schedule:

Room Cleanliness Level	Air Change Schedule
300K Controlled Area	10 Changes/Hour
100K Conventional Clean Room	15-20 Changes/Hour ~5-6.5 FPM for 20 ft. ceiling
10K Laminar Cross Flow	Vel > 75 FPM
1K Laminar Down Flow	Vel > 50 FPM

901213JM1005

Exhibit 2.4 Typical HVAC Configuration In Existing Clean Rooms

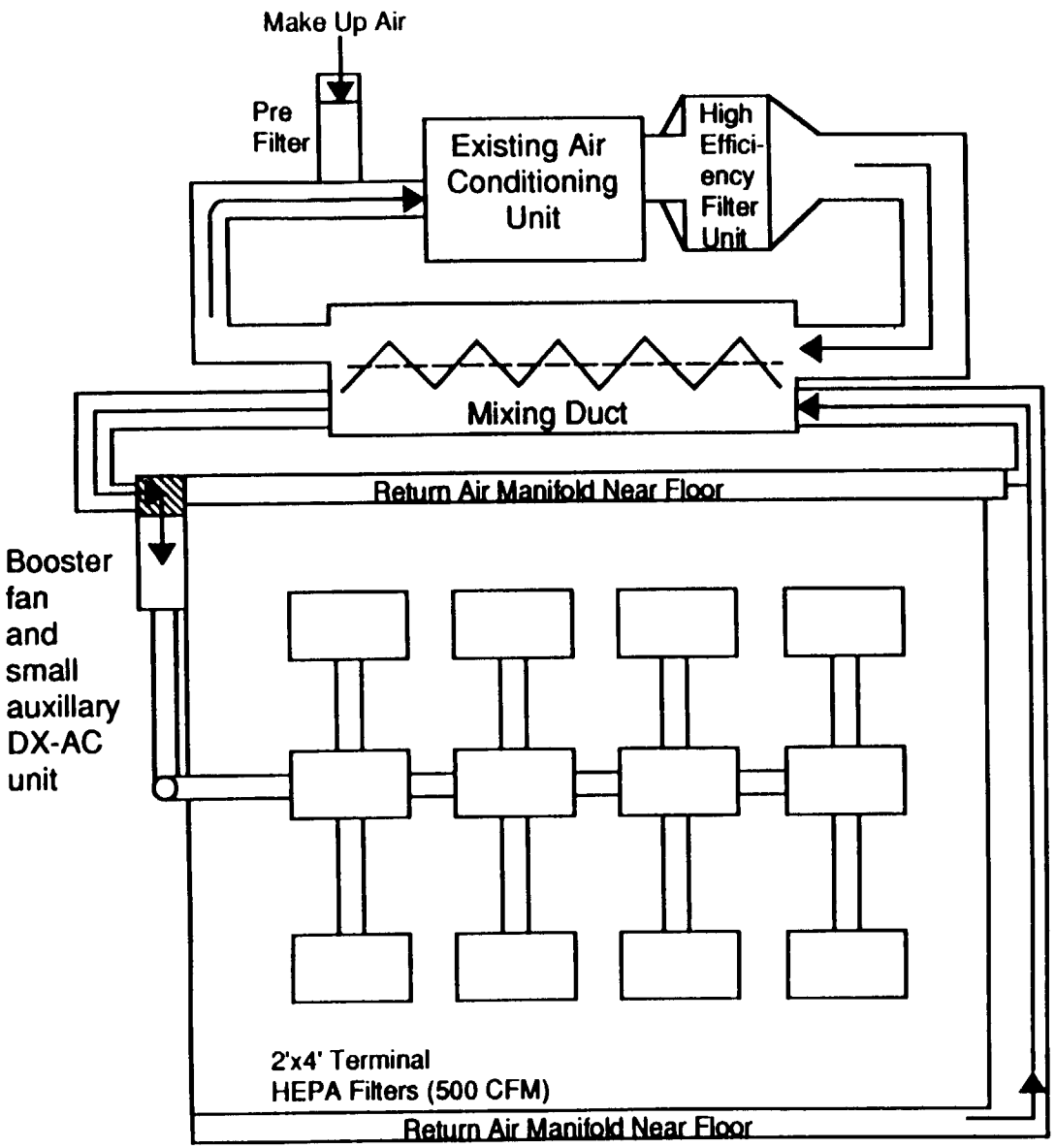
facilities which perform industrial processing tasks that result in the generation of a large number of particles.

In the HVAC system illustrated in Exhibit 2.4 all of the air which is circulated through the room must flow through the air handling unit. This restriction severely limits the volumetric flow rate capabilities of the system. The unit must operate at a specific flow rate in order to provide the design exit air temperature. If the blower fans in the system are modified to increase the flow rate, this system will not be able to properly control temperature and humidity in the cleanroom.

HVAC systems specifically designed for cleanrooms are available and ideally could be used to replace the standard air handling units currently being used. These units are designed for high flow rates. The units provide high flow rates by providing for by-pass flow around the A/C unit. Typically only 10 to 50 percent of the air being passed through the system actually goes through the cooling coils. The bypass flow is recirculated in the room and used to increase the air change velocity.

The idealistic approach to upgrading the MSFC cleanroom facilities HVAC systems is to replace the existing HVAC systems with new high by-pass cleanroom HVAC systems. However, this is not the most cost effective preferred approach. Exhibit 2.5 shows how the existing systems could be modified to provide increased room air change velocities while still utilizing the existing air handling unit to provide the majority of the air conditioning for the room. The modification involves installing a mixing duct and a recirculation fan system in the room. The existing air handling unit is disconnected from the supply diffusers in the room and reducted to supply air to the mixing duct instead. The mixing duct is dampered to maintain the design flow rate through the air handler. The mixing duct mixes the air-conditioned air from the air handler with recirculated air from the room. The recirculation fans increase the air change velocity in the room to an acceptable level. A small A/C unit can be installed in the recirculation air circuit if additional cooling capacity is required for tighter control of temperature and humidity. In most cases, the cooling capacity of the existing system is adequate for room temperature control. The additional work done on the air by the recirculation fans typically introduces an additional heat load of about 1.1 BTU/H per additional CFM. This additional heat load can usually be handled by the existing air handlers. If not, a small auxially unit, as previously described, is required.

Exhibits 2.4 and 2.5 also show upgrading of the room supply and return ducting. To accommodate the increased air flow volume, the surface area of HEPA filters has to be increased to reduce system pressure drops. The most efficient way to increase the filter surface area is to replace the single HEPA filter bank used in the current systems with terminal HEPA filters which can be easily integrated into a 2 x 4 drop in ceiling arrangement. These type of filters



Upgraded Clean Room For Improved Air Velocity And Filtering (Velocity > 7.5 FPM)

- Existing air handling unit is used to perform the majority of air conditioning
- Mixing duct is installed and dampered to maintain design flow rate through the A/C unit.
- A booster fan is installed to circulate room air. Recirculated room air is mixed with cooled air in mixing duct.
- A small auxillary DX A/C unit can be installed in room air circuit to add additional A/C capacity if required.(Typically 1.1 BTU/H per additional CFM)
- Return air manifolds installed near floor.
- Terminal HEPA filters installed to provide cleaner more uniform flow with an acceptable pressure drop. (Filters sized for 500 CFM)

901213JM1010

Exhibit 2.5 Potential Method for Cost Effective Upgrade of Existing Clean Rooms

SRS/NTS

and ceilings are commercially available from numerous sources. This type of filter arrangement also provides for uniform flow throughout the room. The through-flow in the room can also be improved by increasing the number of return ducts and locating them near the floor. Ideally, a return manifold is installed along the base of one wall or two parallel walls to help maintain a laminar like uniform-flow in the room. However, this type of return duct arrangement is not usually required for class 100,000 facility.

4.0 CLEANROOMS AND RECOMMENDATIONS

(INDIVIDUAL ROOMS LISTED SEPARATELY)

B-MLI BLANKET ROOM
ROOM A104B
LOCATION: BUILDING 4705
ROOM SIZE: 24'L X 20'W X 8'8"H

THIS ROOM WAS UNDER CONSTRUCTION AND HAD NO CEILING AT THIS TIME. WE DID NOT RUN THE AIR SAMPLE, TEMPERATURE OR HUMIDITY TEST BECAUSE OF THE CONSTRUCTION.

RECOMMENDATIONS:

1.) THE RETURN AIR VENT NEEDS TO BE BOXED IN AND THE ELECTRICAL OUTLETS INSTALLED ON THE NEW BOXED IN WALL.

2.) INSTALL NEW VENT.

3.) REPLACE THE PASS THRU WINDOW WITH A NEW UNIT.

4.) SKIN THE CINDER BLOCK WALL WITH FIBERGLASS REINFORCED POLYESTER OR HARD BOARD WITH BAKED MELAINE.

5.) DROP CEILING SHOULD BE ARMSTRONG MYLAR OR EQUAL.

6.) INSTALL MAGNA HELI GAGE TO MONITOR PRESSURE.

ROOM 104AB
LOCATION: BUILDING 4705
ROOM SIZE: ONE SECTION WAS 8'8"L X 11'W X 8'8"H
ONE SECTION WAS 7'W X 16'L X 8'8"H
TEMPERATURE RECORDED: 65.5 F
HUMIDITY RECORDED: 30% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
.3	41410	.5	36082
1.0	15810	2.0	10313
5.0	1586	10.0	310

THIS AREA IS BETWEEN ROOM A104A AND ROOM A106 AND WAS NOT LISTED WITH A ROOM NUMBER SO WE LISTED IT AS ROOM 104AB.

RECOMMENDATIONS:

1.) INSTALL NEW DROP CEILING USING ARMSTRONG TILE OR EQUAL.

2.) INSTALL ONE HEPA FILTER AND TWO LIGHTS IN THE 8'8"L X 11'W X 8'8"H AREA AND INSTALL ONE HEPA FILTER AND 2 LIGHTS IN THE 7'W X 16'L X 8'8"H AREA.

3.) INCREASE FILTERED AIR CHANGE RATE TO 500 CFM IN EACH OF THE AREAS.

4.) CLEAN AND REPLATE OR REPLACE RUSTY HINGES AND HANDLE ON THE OVEN DOOR.

5.) STRIP AND PAINT THE TABLE WITH THE HYDRAULIC JACK.

6.) HYDRAULIC JACK IS LEAKING OIL. REPLACE SEAL ON THE UNIT.

7.) REPLACE SEALS ON THE PASS THRU DOORS.

8.) BOX IN PIPE ON THE WALL.

9.) INSTALL A MET ONE OR EQUAL PARTICLE MONITORING STATION IN ROOM 104AB AND INTERFACE WITH A DATA MANAGEMENT SYSTEM. FROM THIS SINGLE MONITORING STATION PROBES CAN BE INSTALLED TO MONITOR ROOMS A104A, A104B, A106, A106A, AND THE ENTRY AREA.

PACKAGING & UNPACKAGING
ROOM A104A
LOCATION: BUILDING 4705
ROOM SIZE: 14'L X 11'W X 8'8"H
CLASS: 30K

TEMPERATURE RECORDED: 70.7 F
HUMIDITY RECORDED: 26.9% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	13161	.5	11482
1.0	5182	2.0	3386
5.0	657	10.0	254
2nd .3	12729	.5	10962
1.0	4919	2.0	3193
5.0	642	10.0	239
3rd .3	11500	.5	9931
1.0	4591	2.0	2993
5.0	638	10.0	221

RECOMMENDATIONS:

1.) INSTALL NEW INTERCOM.

2.) INSTALL NEW DROP CEILING USING ARMSTRONG TILE OR EQUAL.

3.) INSTALL THREE NEW CLEANROOM LIGHTS.

4.) INSTALL THREE HEPA FILTERS. INCREASE FILTERED AIR CHANGE RATE TO 1500 CFM.

5.) STRIP DOORS AND PAINT.

6.) RETURN AIR VENT NEEDS TO BE MODIFIED.

7.) COMPRESSION TESTER NEEDS TO BE STRIPPED AND PAINTED.

8.) RE-CAULK COVING.

9.) REPLACE EPOXY PAINTED CARTS WITH STAINLESS STEEL CARTS.

TEST ARTICLE CHECKS AND ASSEMBLY/DISASSEMBLY
ROOM A106
LOCATION: BUILDING 4705
SIZE: 47'L X 38'W X 8'8"H
CLASS: 30K

TEMPERATURE RECORDED: 74.6 F
HUMIDITY RECORDED: 21% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	1930	.5	1633
1.0	689	2.0	446
5.0	92	10.0	34
2nd .3	2498	.5	2123
1.0	1036	2.0	701
5.0	187	10.0	83
3rd .3	2390	.5	2053
1.0	997	2.0	679
5.0	160	10.0	79
4th .3	2856	.5	2396
1.0	1003	2.0	657
5.0	130	10.0	49

RECOMMENDATIONS:

1.) REPLACE EMERGENCY DOORS.

2.) REPLACE THE TABLE THAT THE VERTROID HEAT SEALER IS MOUNTED ON WITH A NEW STAINLESS STEEL TABLE.

3.) CRANE HAS SOME RUST LOCATED IN VARIOUS AREAS. THE RUST SHOULD BE REMOVED AND THE AFFECTED AREAS PLATED.

4.) VICES NEED TO BE REPLATED. THEY ARE CHIPPING IN VARIOUS AREAS.

5.) HOLDING FIXTURE (BLUE) BEING USED IN THE ROOM NEED TO BE STRIPPED AND PAINTED. THE PAINT HAS STARTED TO CHIP IN VARIOUS AREAS.

6.) REPLACE OR REPAIR EXIT DOOR.

7.) RE-CAULK FLOOR COVING AROUND THE WALLS.

8.) REPLACE AND MODIFY AIR RETURN VENT.

9.) REPAIR CORNER IN BURST TEST AREA AND REPAINT THAT AREA.

10.) UP GRADE TEST CONSOLE NUMBER ONE.

11.) REMOVE PHONE FROM INSIDE THE ROOM TO THE DRESSING ROOM AND INSTALL A LIGHT THAT WILL FLASH INSIDE THE CLEANROOM WHEN THE PHONE RINGS.

12.) REMOVE THE WATER FOUNTAIN FROM THE CLEANROOM AND INSTALL IT OUTSIDE IN THE HALL WAY.

13.) INSTALL A NEW DROP CEILING USING ARMSTRONG MYLAR OR EQUAL.

14.) INSTALL THIRTY TWO CLEANROOM LIGHTS.

15.) INSTALL TWENTY SIX HEPA FILTERS. INCREASE FILTERED AIR CHANGE RATE TO 13,000 CFM.

16.) REPLACE THE ELECTRICAL OUTLET NEAR THE BURST TEST AREA.

17.) REMOVE AIR SHOWERS AND CONTROL THE AREA WITH POSITIVE PRESSURE ONLY.

18.) INSTALL MAGNA HELI GAGE FOR MONITORING PRESSURE.

ENTRY AND DRESSING ROOM
TO ROOM A104A, A104B, A106 AND A106A

TEMPERATURE RECORDED: 74.9 F
HUMIDITY RECORDED: 21% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	23645	.5	20982
1.0	9915	2.0	6752
5.0	1587	10.0	668
2nd .3	19629	.5	17248
1.0	7916	2.0	5184
5.0	1130	10.0	418

RECOMMENDATIONS:

1.) IN THE FIRST ENTRY ROOM, THE METAL GRILL NEEDS TO BE REMOVED. THE HOLE SHOULD BE FILLED WITH CONCRETE. THE PATCHED FLOOR SHOULD BE COVERED WITH ARMSTRONG FLOORING OR EQUIVALENT.

2.) INSTALL DROP CLEANROOM CEILING IN THE DRESSING ROOM WITH ONE HEPA FILTER AND TWO LIGHTS. INCREASE FILTERED AIR CHANGE RATE TO 500 CFM.

3.) CHANGE GARMENTS FOR VISITORS DAILY.

4.) LEAVE SIX OR SEVEN LOCKERS IN THE ROOM FOR THE PEOPLE THAT WORK IN THE ROOMS AND REPLACE THE OTHER LOCKERS WITH STORAGE CABINETS.

5.) IT WOULD BE MUCH BETTER TO USE GARMENTS SEALED IN POLY BAGS AND HAVE A SERVICE TO REPLACE THEM WEEKLY. HAVE NAME LABELS ON THE GARMENTS FOR THE PEOPLE THAT WORK IN THE ROOM.

6.) HAVE VISITORS GARMENTS IN THE STORAGE CABINET.

7.) DRESSING ROOM NEEDS TO BE REPAINTED. ALTERNATIVELY, HARDBOARD CLEANROOM WALLS COULD BE INSTALLED. THESE WALLS REQUIRE NO PAINTING AND LAST LONGER.

9.) ALL FIXTURES, INCLUDING TOILET SEAT, NEED TO BE REPLACED.

ROOM A106A
LOCATION: BUILDING 4705
ROOM SIZE: 16'L X 20'W X 8'H
CLASS: 30K

TEMPERATURE RECORDED: 68.2 F
HUMIDITY RECORDED: 28% RH

AIR SAMPLE: THIS ROOM HAD SO MUCH EQUIPMENT STORED INSIDE THAT WE COULD NOT GET AROUND IN THE ROOM TO TAKE AN AIR SAMPLE.

RECOMMENDATIONS:

1.) INSTALL A NEW DROP CEILING WITH ARMSTRONG MYLAR TILES OR EQUAL.

2.) INSTALL FOUR NEW CLEANROOM LIGHTS IN THE CEILING.

3.) INSTALL FIVE HEPA FILTERS IN THE CEILING. INCREASE FILTERED AIR CHANGE RATE TO 2,500 CFM.

4.) CAULK COVING.

5.) MODIFY RETURN VENT AND BOX IN THE VENT.

6.) REPAIR THE PASS THRU WINDOW.

7.) INSTALL MAGNA HELI GAGE TO MONITOR PRESSURE.

ADHESIVE BONDING ROOM
ROOM A107
LOCATION: BUILDING 4705
SIZE: 29'L X 18'8"W X 8'8"H
CLASS: 100K

TEMPERATURE RECORDED: 76.4 F
HUMIDITY RECORDED: 19.1% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	4726	.5	2079
1.0	586	2.0	393
5.0	129	10.0	52
2nd .3	3663	.5	1487
1.0	423	2.0	289
5.0	89	10.0	30
3rd .3	3242	.5	1164
1.0	333	2.0	250
5.0	79	10.0	33
4th .3	4852	.5	2552
1.0	978	2.0	725
5.0	277	10.0	82

RECOMMENDATIONS:

1.) CLEAN AND POLISH STAINLESS STEEL BENCHES OR REPLACE.

2.) THE CLEANROOM CHAIRS ARE EXTREMELY DIRTY AND NEED TO BE CLEANED.

3.) REPLACE COVING.

4.) FLOOR NEEDS TO BE REPAIRED OR REPLACED.

5.) INSTALL A DROP CEILING USING ARMSTRONG MYLAR OR EQUAL.

6.) INSTALL TEN NEW CLEANROOM LIGHTS.

7.) INSTALL FIVE HEPA FILTERS. INCREASE FILTERED AIR CHANGE RATE TO 2,500 CFM.

8.) BOX IN NITROGEN SUPPLY SYSTEM.

9.) CLEAN UP THE FRONT OF THE CABINETS.

10.) REPLACE AUTOGRAM 1000 BALANCE (OHAUS) WITH A NEW DIGITAL UNIT.

11.) REPLACE DIAL-O-GRAM SCALE, CAPACITY 1600 GRAMS, WITH A NEW DIGITAL SCALE.

12.) ROOM NEEDS A CHEMICAL STORAGE SAFETY CABINET.
(CHEMICALS ARE STORED ON TOP OF THE STAINLESS STEEL BENCHES)

13.) STRIP AND PAINT ENTRY DOORS.

14.) MAINTENANCE NEEDS TO BE PERFORMED DAILY ON THE ROOM.

PRECISION CLEANING
ROOM B119
LOCATION: BUILDING 4705
SIZE: 75'L X 38'W X 14'HIGH
CLASS: 30K

TEMPERATURE RECORDED: 75.2 F
HUMIDITY RECORDED: 27.3% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	7777	.5	3525
1.0	735	2.0	469
5.0	134	10.0	50
2nd .3	6136	.5	2288
1.0	330	2.0	199
5.0	76	10.0	28
3rd .3	5367	.5	1798
1.0	152	2.0	66
5.0	20	10.0	7

THIS ROOM IS A VERY GOOD PRECLEAN FACILITY AND IS NOT BEING USED TO ITS FULL CAPACITY.

RECOMMENDATIONS:

1.) THE BENDIX RECIRCULATOR FILTER UNIT HAS A LOT OF CORROSION BETWEEN THE FILTER UNIT AND THE ULTRASONIC TANK. IT NEEDS TO BE REPAIRED BEFORE IT CORRODES COMPLETELY THROUGH THE MATERIAL.

2.) REPLACE THE CORRODED VALVES THAT ARE ON THE BOTTOM OF SOME OF THE TANKS.

3.) REPLACE TOPS OF TABLES IN CENTER OF THE ROOM.

4.) REPLACE MOLDING ON DOORS.

5.) REPLACE CHAIRS WITH NEW CHAIRS.

6.) REPLACE FLASKS, TOOLS, AND MILLIPORE BOMBS WITH NEW ONES.

7.) THE AIR CHANGE RATE IN THE ROOM SHOULD BE INCREASED. INSTALL 43 HEPA FILTERS WITH BOOSTER BLOWERS.

8.) SOME OF THE AIR SHOWERS NOZZLES ARE BROKEN AND NEED TO BE REPLACED. ALTERNATIVELY, THE AIR SHOWERS COULD BE REMOVED AND POSITIVE PRESSURE IN THE ROOM SHOULD BE SUFFICIENT TO CONTROL CONTAMINATION THROUGH THE ENTRY ROOM.

9.) REPLACE OLD CABINET IN CORNER WITH NEW STORAGE CABINET.

10.) OVEN NEEDS TO BE UPGRADED.

11.) WALLS IN THE HIGH BAY AREA HAVE SOME AREAS THAT NEED TO BE REPAIRED.

PACKAGING CLEANED PARTS
ROOM B122
LOCATION: BUILDING 4705
SIZE: 14'L X 13'W X 10'H
CLASS: 30K

TEMPERATURE RECORDED: 75.5 F
HUMIDITY RECORDED: 26.7% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	9066	.5	3972
1.0	757	2.0	428
5.0	106	10.0	42
2nd .3	6967	.5	2499
1.0	214	2.0	100
5.0	24	10.0	6
3rd .3	8004	.5	3278
1.0	586	2.0	324
5.0	75	10.0	26

RECOMMENDATIONS:

1.) FLOOR NEEDS TO BE REPLACED WITH ARMSTRONG OR EQUAL.

2.) WALLS NEED TO BE SANDED DOWN AND PAINTED. ALTERNATIVELY, THE WALLS COULD BE COVERED WITH HARD BOARD MATERIAL WITH BAKED MELAINE OR EQUALIVANT.

3.) ENTRY DOOR NEEDS TO BE STRIPPED AND PAINTED.

4.) VERTROID HEAT SEALER CABINET NEEDS TO BE REPLACED WITH A STAINLESS STEEL OR BAKED ENAMEL CABINET.

5.) A STORAGE CABINET FOR THE VARIOUS PACKAGING MATERIALS SHOULD BE IN THE ROOM. MATERIAL IS LAYING ALL AROUND THE ROOM GETTING DIRTY.

6.) INSTALL A NEW CLEANROOM CEILING.

7.) LARGE HEAT SEALER NEEDS TO BE REPLACED WITH A NEW ONE.

8.) NO CALIBRATION STICKER ON GN2 SYSTEM GAUGE.

9.) REPLACE CLEANROOM STOOLS.

10.) NEED NEW UV LIGHT.

11.) SCISSORS ARE CORRODED AND NEED TO BE REPLACED.

12.) ADD THREE HEPA FILTERS. INCREASE FILTERED AIR CHANGE RATE TO 1,500 CFM.

13.) INSTALL MAGNA HELI GAUGE TO MONITOR PRESSURE.

PART OF PRECISION CLEANING
ROOM B124
LOCATION: BUILDING 4705
SIZE: 13'L X 14'W X 10'H
CLASS: 4K

TEMPERATURE RECORDED: 68 F
HUMIDITY RECORDED: 35% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
.3	1818	.5	1320
1.0	445	2.0	280
5.0	61	10.0	19

RECOMMENDATIONS:

1.) REPLACE SINK. (CORRODED)

2.) REPLACE MOLDING.

3.) REPLACE FLOOR WITH ARMSTRONG OR EQUAL.

4.) INSTALL NEW DROP CEILING USING ARMSTRONG MYLAR OR EQUAL.

5.) NEW CLEANROOM LIGHTS.

6.) REPLACE DIFFUSERS AND INSTALL FLUSH MOUNTED HEPA FILTER UNITS.

7.) ELECTRICAL OUTLETS ARE CORRODED AND NEED TO BE REPLACED.

8.) BOX IN ELECTRICAL LINES.

9.) REPLACE CLEANROOM CHAIR WITH NEW ONE.

10.) INSTALL A CLEANROOM STORAGE CABINET.

11.) INSTALL A FLUSHING BENCH SO THAT SAMPLES CAN BE TAKEN FROM CLEANED PARTS.

12.) CLEANROOM NEEDS A ENTRY ROOM CONSTRUCTED FOR THAT ROOM.

13.) PURCHASE A MICROSCOPE, DIGITAL GRAM SCALE, MILLIPORE FLASK, VACUUM PUMP, AND MILLIPORE BOMB SO THAT SAMPLES COULD BE PERFORMED IN THIS ROOM.

14.) INSTALL MAGNA HELI GAUGE TO MONITOR PRESSURE.

15.) INSTALL RETURN VENTS

ELECTRICAL ASSEMBLY
ROOM B120
LOCATION: BUILDING 4705
ROOM SIZE: 75'L X 49'W X 9'H
CLASS: 100K

TEMPERATURE RECORDED: 72.6 F
HUMIDITY RECORDED: 33.8% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	1797	.5	1308
1.0	540	2.0	366
5.0	123	10.0	44
2nd .3	1765	.5	1232
1.0	582	2.0	444
5.0	168	10.0	68

THE ROOM IS UNDER CONSTRUCTION AND THE CORRECT AMOUNT OF HEPA FILTERS HAVE BEEN INSTALLED ALONG WITH THE CORRECT LIGHTING.

RECOMMENDATIONS:

1.) THE NEW DROP CEILING TILES THAT ARE INSTALLED ARE NOT CLEANROOM COMPATIBLE. REPLACE THE TILES WITH ARMSTRONG MYLAR OR EQUAL.

2.) THE BLOCK WALLS SHOULD BE SKINNED WITH FIBERGLASS REINFORCED POLYESTER OR HARD BOARD WITH BAKED MELAINE.

3.) THE WINDOWS IN THE ROOM ARE NOT FLUSH MOUNTED LIKE CLEANROOM WINDOWS SHOULD BE. THE SILLS WILL COLLECT DIRT DAILY.

4.) THE ROUND STEEL POLES IN THE ROOM SHOULD BE BLOCKED IN.

5.) THE ELECTRICAL BOXES, WATER LINES SHOULD ALSO BE BLOCKED IN.

6.) INSTALL MAGNA HELI GAUGE TO MONITOR PRESSURE.

7.) VECTOR FLOW WORK STATIONS SHOULD BE INSTALLED ALONG THE INNER WALL WITH PULSE NEUTRALIZER FOR WORKING WITH ELECTRICAL PARTS.

ELECTRICAL POTTING SHOP
ROOM B120B
LOCATION: BUILDING 4705
SIZE: 22'L X 14'W X 10'H
CLASS: 100K

TEMPERATURE RECORDED: 73 F
HUMIDITY RECORDED: 34% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	3479	.5	2915
1.0	1485	2.0	1052
5.0	362	10.0	113
2nd .3	7788	.5	6602
1.0	3188	2.0	2281
5.0	848	10.0	274

RECOMMENDATIONS:

1.) SKIN CINDER BLOCK WALL WITH FIBERGLASS REINFORCED POLYESTER OR HARD-BOARD WITH BAKED MELAINE.

2.) REFINISH HOODS OR REPLACE WITH NEW ONES.

3.) REPLACE FILTERS IN STATIC CONTROL WORK STATION AND CERTIFY.

4.) BOX IN PRESSURE SYSTEMS AND ELECTRICAL PANNEL.

5.) REMOVE WATER FOUNTAIN TO OUTSIDE OF ROOM.

6.) THE NEW DROP CEILING IS NOT COMPATIBLE WITH CLEANROOMS. IT SHOULD BE ARMSTRONG MYLAR OR EQUAL.

7.) INSTALL MAGNA HELI GAUGE FOR MONITORING PRESSURE.

PORTABLE HIGH BAY LARGE TENT
LOCATION: BUILDING 4705
SIZE: 46'L X 28'W X 15'H
CLASS: 100K

TEMPERATURE RECORDED: 76.5 F
HUMIDITY RECORDED: 20.5% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	40203	.5	17396
1.0	2464	2.0	1248
5.0	219	10.0	54
2nd .3	39013	.5	17045
1.0	2553	2.0	1288
5.0	203	10.0	42
3rd .3	41594	.5	19089
1.0	3238	2.0	1823
5.0	388	10.0	128

RECOMMENDATIONS:

1.) STRIP AND PAINT THE CRANE.

2.) EPOXY PAINT SUPPLY VENTS OR REPLACE WITH CLEANROOM COMPATIBLE VENTS.

3.) REPLACE CLEANROOM STOOLS WITH NEW ONES.

4.) CLEAN WALLS AND CEILINGS. (VERY DIRTY)

5.) REPLACE HEAT SEALER TABLE WITH A NEW STAINLESS STEEL OR EQUAL.

6.) REPLACE GRILL IN CLASS 100 WORK STATION.

7.) REPLACE PRE-FILTERS IN CLASS 100 WORK STATION.

8.) CLEAN CLASS 100 WORK STATION.

THE FOLLOWING IS THE AIR SAMPLE FOR THE CLASS 100 WORK STATION LOCATED IN THE HIGH BAY LARGE TENT:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	58	.5	41
1.0	19	2.0	19
5.0	12	10.0	8
2nd .3	71	.5	44
1.0	20	2.0	17
5.0	6	10.0	2

PORTABLE HIGH BAY SMALL TENT
LOCATION: BUILDING 4705
SIZE: 16'L X 12'W X 10'H
CLASS: 100K

THIS ROOM WAS NOT OPERATING. POWER HAD BEEN TEMPORARILY DISCONNECTED.

THE ROOM HAS 24 2' X 4' HEPA FILTERS. IT WAS ESTIMATED THAT THIS WOULD PRODUCE A FLOW OF APPROXIMATELY 19,200 CFM.

THIS ROOM SHOULD BE PRODUCING TEN CHANGES PER MINUTE, 600 CHANGES PER HOUR AND SHOULD BE CLASSIFIED AS A CLASS 100.
HALF OF THE LOCKERS IN THE ENTRY SHOULD BE REPLACED WITH STORAGE CABINETS.
GARMENTS SHOULD BE SEALED IN POLY BAGS.
BOTH OF THE HIGH BAY TENTS SHOULD HAVE MAINTENANCE PERFORMED ON A DAILY BASIS.

FILAMENT WINDING LAB
ROOM 124
LOCATION: BUILDING 4707
SIZE: 80'L X 66'W X 25'H
CLASS: 100K - TO BE UPGRADED TO 30K

TEMPERATURE RECORDED: 73.9 F
HUMIDITY RECORDED: 31.4% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	73305	.5	18560
1.0	1065	2.0	502
5.0	18560	10.0	38
2nd .3	75753	.5	19667
1.0	1293	2.0	648
5.0	122	10.0	41
3rd .3	75690	.5	20058
1.0	1571	2.0	860
5.0	206	10.0	73
4th .3	61074	.5	14517
1.0	648	2.0	301
5.0	55	10.0	30

RECOMMENDATIONS:

1.) REMOVE ALL WOOD MATERIAL FROM THE ROOM.

2.) REMOVE ALL TABLES THAT ARE NOT CLEANROOM COMPATIBLE AND REPLACE WITH STAINLESS STEEL TABLE TOPS.

3.) REMOVE ALL PAPER FROM THE TOPS OF TABLES.

4.) THE FLOOR NEEDS TO BE CLEANED. (DIRTY)

5.) CLEAN THE TOPS OF THE STAINLESS STEEL BENCHES.

6.) REPLACE COVING AROUND THE ROOM.

7.) REMOVE CARDBOARD BOXES FROM THE ROOM.

8.) BUY A FEW CLEANROOM STORAGE CABINETS TO STORE EQUIPMENT IN.

9.) REPLACE CEILING WITH A CLEANROOM ARMSTRONG MYLAR TILE OR EQUAL.

10.) INSTALL THE RETURN VENTS DOWN LOW TO THE FLOOR FOR CORRECT RETURN OF AIR FROM THE ROOM. VENTS ARE NOT POSITIONED CORRECTLY FOR A CLEANROOM.

11.) INSTALL SEVENTY NINE HEPA FILTERS IN THE CEILING. INCREASE FILTERED AIR CHANGE RATE TO 39,500 CFM.

12.) PERSONNEL INTERVIEWED INDICATED THAT HUMIDITY CONTROL WAS INADEQUATE. A NEW HIGH BY PASS CLEANROOM HVAC SYSTEM COULD BE INSTALLED TO MAINTAIN HUMIDITY WITHIN ±5% RH AT ALL TIMES.

13.) INSTALL MAGNA HELI GAUGE TO MONITOR PRESSURE.

14.) PROPER MAINTENANCE ON THE ROOM DAILY.

TAPE WRAP CELL
ROOM 120B
LOCATION: BUILDING 4707
SIZE: 55'L X 38'W X 30'H
CLASS: 100K - TO BE UPGRADED TO 30K

TEMPERATURE RECORDED: 70.2 F
HUMIDITY RECORDED: 35% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	1797	.5	1308
1.0	540	2.0	366
5.0	123	10.0	44
2nd .3	4909	.5	3924
1.0	1930	2.0	1537
5.0	762	10.0	392
3rd .3	1765	.5	1232
1.0	582	2.0	444
5.0	168	10.0	68
4th .3	3479	.5	2915
1.0	1485	2.0	1052
5.0	362	10.0	113

RECOMMENDATIONS:

1.) ENTRY DOOR NEEDS TO BE STRIPPED AND PAINTED.

2.) EXPOSED CABLES ON WALL NEED TO BE BOXED IN.

3.) I BEAMS LAYING ON FLOOR BEHIND EQUIPMENT NEED TO BE STORED IN A CABINET OR STORAGE AREA.

4.) RUBBER MATS ON TOP OF CARTS ARE VERY DIRTY AND NEED TO BE CLEANED DAILY.

5.) ALL WOODEN ARTICLES NEED TO BE REMOVED FROM THE ROOM.

6.) REPLACE WOOD STEPS WITH METAL OR EQUAL.

7.) UP DATE CHAMBERS WITH DIGITAL CONTROLS.

8.) INSTALL CLEANROOM CEILING WITH ARMSTRONG MYLAR OR EQUAL TILES. THE EXISTING CEILING IS NOT CLEANROOM COMPATIBLE.

9.) INSTALL THIRTY ONE HEPA FILTERS. INCREASE FILTERED AIR CHANGE RATE TO 15,500 CFM.

10.) INSTALL RETURN VENTS WITH CHARCOAL FILTERS AT THE FLOOR LEVEL. CHARCOAL FILTERS WILL REMOVE PROCESS FUMES GENERATED IN THE ROOM. RELOCATING THE RETURN VENTS CLOSER TO THE FLOOR WILL IMPROVE ROOM AIR CIRCULATION AND HELP CONTROL ODOR BY PASSING THE AIR THROUGH THE CHARCOAL FILTERS MORE FREQUENTLY.

11.) INSTALL MAGNA HELI GAUGE TO MONITOR PRESSURE.

12.) INSTALL A PARTICLE MONITORING STATION IN BUILDING 4707 THAT WILL INTERFACE TO A DATA MANAGEMENT SYSTEM.

13.) PERFORM MAINTENANCE ON THE ROOM DAILY. THE EQUIPMENT IN THIS ROOM (TABLES, MACHINES, CARTS, ETC.) ARE VERY DIRTY AND NEED TO BE CLEANED.

14.) IN THE FUTURE YOU MIGHT CONSIDER THE OPTION OF INSTALLING AN ADVANCE AIR SYSTEM OR EQUAL. THIS TYPE ON SYSTEM WOULD BE MORE COST EFFECTIVE AND WOULD REQUIRE LESS MAINTENANCE AND WOULD BE MUCH MORE ACCESSIBLE TO WORK ON. ALL THE MONITORING GAUGES WOULD BE ON THE FRONT OF THE PANEL.

TAPE LAYING & PULTRUSION
ROOM 121
LOCATION: BUILDING 4707
SIZE: 80'L X 70'W X 30'H
CLASS: 100K - TO BE UPGRADED TO 30K

TEMPERATURE RECORDED: 70.1 F
HUMIDITY RECORDED: 35.5 % RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	56307	.5	10408
1.0	515	2.0	244
5.0	14	10.0	16
2nd .3	56239	.5	10546
1.0	610	2.0	277
5.0	11	10.0	14
3rd .3	56528	.5	10440
1.0	620	2.0	290
5.0	18	10.0	21
4th .3	56721	.5	10926
1.0	754	2.0	309
5.0	20	10.0	25

RECOMMENDATIONS:

1.) CONSTRUCT THE ENTRY ROOM USING HARD BOARD WITH BAKED MELAINE AND CONTROL IT WITH A POSITIVE PRESSURE. INSTALL A CLEANROOM ENTRY DOOR GOING INTO THE LAB.

2.) REPLACE THE BENCHES WITH CLEANROOM STORAGE CABINETS AND GARMENT HOOKS LOCATED UNDER A HEPA FILTER THAT WILL AIR WASH THE GARMENTS DURING STORAGE.

2.) CLEANROOM GARMENTS SHOULD BE SUPPLIED BY A SERVICE THAT PROVIDES GARMENTS IN A HEAT SEALED POLY BAG.

3.) REMOVE CARDBOARD BOXES.

4.) STORE MATERIALS IN A STORAGE CABINET INSTEAD OF SITTING IT IN THE MIDDLE OF THE ROOM IN BOXES.

5.) REMOVE WOOD FROM CLEAN ROOM.

6.) REMOVE PAPER FROM THE CLEANROOM.

7.) CRANE DRIPS OIL AND NEEDS TO BE REPAIRED.

8.) NEED TO REPLACE EXISTING CEILING WITH ARMSTRONG MYLAR OR EQUAL TILES.

9.) INSTALL EIGHTY FOUR HEPA FILTERS. INCREASE FILTERED AIR CHANGE RATE TO 42,000 CFM.

10.) INSTALL RETURN VENTS AT FLOOR LEVEL.

11.) INSTALL MAGNA HELI GAUGE TO MONITOR PRESSURE.

12.) HUMIDITY APPEARS TO BE A PROBLEM IN THIS ROOM.
WE SUGGEST THAT AN ADVANCE AIR SYSTEM OR EQUAL BE INSTALLED THAT WILL CONTROL THE HUMIDITY AT ±5% RH. THIS TYPE OF SYSTEMS IS VERY EASY TO MAINTAIN AND MUCH MORE COST EFFECTIVE THEN THE HVAC SYSTEM THAT IS CURRENTLY BEING USED.

BONDING & CONSCAN
PORTABLE BOOTH
LOCATION: BUILDING 4707
SIZE: 12'L X 12'W X 10'H
CLASS: 100K - TO BE UPGRADED TO 30K

TEMPERATURE RECORDED: 77 F
HUMIDITY RECORDED: 28% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	5147	.5	2216
1.0	644	2.0	403
5.0	109	10.0	34
2nd .3	2777	.5	838
1.0	130	2.0	74
5.0	12	10.0	1
3rd .3	2604	.5	793
1.0	109	2.0	77
5.0	24	10.0	6

RECOMMENDATIONS:

1.) REPLACE ENTRANCE CURTAIN.

2.) CLEAN CURTAINS.

3.) REMOVE SELF THAT HAS THE WOODEN BACK AND REPLACE WITH A CLEANROOM STORAGE CABINET.

4.) REPLACE LARGE HVAC SYSTEM WHICH IS TAKING UP EXCESS FLOOR SPACE WITH A FIELD AIR UNIT ON CASTORS. THIS UNIT CAN OPERATE BOTH PORTABLE BOOTHS AND IS 26"L X 26"W X 8'H AND CAN BE MOVED AROUND VERY EASILY.

5.) IF THIS UNIT IS GOING TO BE MOVED TO A PERMANENT LOCATION, THEN IT SHOULD BE REPLACED WITH A SELF CONTAINED PREFAB CLEANROOM.

6.) MAINTENANCE ON THE BOOTH SHOULD BE DAILY.

PREPEG PORTABLE BOOTH
LOCATION: BUILDING 4707
SIZE: 12'L X 12'W X 10'H
CLASS: 100K

TEMPERATURE RECORDED: 75.5 F
HUMIDITY RECORDED: 29% RH
AIR SAMPLE RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	1030	.5	470
1.0	163	2.0	118
5.0	46	10.0	2
2nd .3	887	.5	418
1.0	89	2.0	52
5.0	4	10.0	0
3rd .3	1292	.5	450
1.0	93	2.0	58
5.0	23	10.0	2

RECOMMENDATIONS:

1.) REPLACE LARGE HVAC SYSTEM WHICH IS TAKING UP EXCESS FLOOR SPACE WITH A FIELD AIR UNIT ON CASTORS. THIS UNIT IS 26"L X 26"W X 8'H.

2.) IF THIS UNIT IS GOING TO BE MOVED TO A PERMANENT LOCATION, THEN IT SHOULD BE REPLACED WITH A PREFAB CLEANROOM THAT IS SELF CONTAINED.

3.) MAINTENANCE ON THE BOOTH SHOULD BE DAILY.

NOTE: THIS ROOM WAS ALMOST COMPLETELY EMPTY EXCEPT FOR ONE TABLE.

COMPOSITE LAY-UP LAB
ROOM 129
LOCATION: BUILDING 4707
SIZE: 41'L X 22'W X 15'H
CLASS: 100K - TO BE UPGRADED TO 30K

TEMPERATURE RECORDED: 70.6 F
HUMIDITY RECORDED: 39.4% RH
AIR SAMPLE RECORDED:

CUM. COUNT MICRON SIZE	COUNT- ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	10841	.5	4222
1.0	950	2.0	471
5.0	36	10.0	15
2nd .3	9887	.5	3802
1.0	856	2.0	462
5.0	80	10.0	12
3rd .3	10829	.5	4159
1.0	748	2.0	388
5.0	40	10.0	14

RECOMMENDATIONS:

1.) REPLACE CEILING WITH CLEANROOM ARMSTRONG MYLAR OR EQUAL.

2.) INSTALL 14 HEPA FILTERS. INCREASE FILTERED AIR CHANGE RATE TO 7,000 CFM.

3.) REPOSITION RETURN VENTS.

4.) INSTALL NEW FLOOR - ARMSTRONG OR EQUAL.

5.) SAND WALL AND PAINT OR SKIN WILLS WITH HARD BOARD WITH BAKED MELAINE OR EQUAL.

6.) REPLACE OR REFINISH CABINETS AND FUME HOOD.

7.) BOX IN ELECTRICAL CABLES ON WALL AND BOX IN DUCTS RUNNING FROM THE HOOD AND OVEN.

8.) REPLACE CORRODED SINKS AND FAUCETS.

9.) BUILD ENTRY ROOM WITH CABINETS AND GOWN RACKS.

10.) INSTALL MAGNA HELI GAUGE TO MONITOR PRESSURE.

11.) INSTALL NEW CLEANROOM LIGHTS.

12.) BUILD STORAGE CABINET TO HOLD WOVEN MATERIAL. CABINET SHOULD CONTAIN A HEPA FILTERED AIR WASH.

DRY FILM LAB
ROOM W129
LOCATION: BUILDING 4711
SIZE: 25'L X 21'W X 15'H
CLASS: 100K

TEMPERATURE RECORDED: 71.7 F
HUMIDITY RECORDED: 34.3% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	11009	.5	3091
1.0	369	2.0	234
5.0	62	10.0	29
2nd .3	7392	.5	2199
1.0	319	2.0	227
5.0	69	10.0	19
3rd .3	3755	.5	1234
1.0	242	2.0	154
5.0	47	10.0	16

RECOMMENDATIONS:

1.) CRANE HAS PAINT PEELING OFF AND SHOULD BE STRIPPED AND PAINTED. (VERY DIRTY)

2.) EQUIPMENT AND TOOLS JUST LAYING AROUND ON THE TOP OF BENCHES. THEY NEED TO BE STORED IN CABINETS.

3.) THE FLOOR NEEDS TO BE REPLACED WITH ARMSTRONG OR EQUIVALENT.

4.) PAINT IS CHIPPING AROUND THE BASE OF THE SCHENEK MACHINE IS MOUNTED ON. IT NEEDS TO BE STRIPPED AND PAINTED.

5.) FLOOR AROUND DRY FILM BOOTH IN THE CORNER SHOULD BE CLEANED. (VERY DIRTY)

6.) THE OLD CHAIRS NEED TO BE REPLACED.

7.) DRY FILM BOOTH NEEDS TO BE UP DATED.

8.) MAINTENANCE NEEDS TO BE DONE DAILY.

9.) INSTALL 10 HEPA FILTERS AND NINE LIGHTS IN THE CEILING. INCREASE FILTERED AIR CHANGE RATE TO 5,000 CFM.

10.) REPLACE LIGHT BULBS IN THE PORTABLE LAMINAR FLOW ROOM AND LEAK TEST THE FILTERS.

11.) INSTALL CLEANROOM DROP CEILING WITH A ARMSTRONGMYLAR OR EQUAL

THE FOLLOWING AIR SAMPLES WERE TAKEN FROM THE LAMINAR FLOW ROOM:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	1	.5	0
1.0	0	2.0	0
5.0	0	10.0	0
2nd .3	16	.5	13
1.0	5	2.0	5
5.0	1	10.0	0

THIS ROOM SHOULD BE CERTIFIED EVERY SIX MONTHS.

LOX COMPATIBLE MATERIALS PROCESS FACILITY
ROOM W131
LOCATION: BUILDING 4711
SIZE: 26'L X 25'W X 10'H
CLASS: 100K

TEMPERATURE RECORDED: 72 F
HUMIDITY RECORDED: 32.5% RH
AIR SAMPLES RECORDED:

CUM. COUNT MICRON SIZE	COUNT-ONE CU FT	CUM. COUNT MICRON SIZE	COUNT-ONE CU FT
1st .3	10167	.5	3011
1.0	410	2.0	264
5.0	86	10.0	41
2nd .3	9801	.5	2720
1.0	333	2.0	192
5.0	59	10.0	28
3rd .3	10095	.5	2747
1.0	293	2.0	170
5.0	40	10.0	18
4th .3	9936	.5	2560
1.0	183	2.0	79
5.0	18	10.0	5

RECOMMENDATIONS:

1.) INSTALL NEW CLEANROOM DROP CEILING USING ARMSTRONG OR EQUIVALENT TILES.

2.) FLOOR NEEDS TO BE CLEANED.

3.) STAINLESS STEEL SINKS AND FACETS NEED TO BE CLEANED.

4.) REMOVE PAPERS AND CARD BOARD FROM THE ROOM.

5.) EQUIPMENT THAT IS NOT BEING USED SHOULD BE STORED IN A CABINET.

6.) INSTALL LARGE CLEANROOM STORAGE CABINET.

7.) INSTALL TEN HEPA FILTERS IN THE CEILING. INCREASE FILTERED AIR CHANGE RATE TO 5,000 CFM.

8.) INSTALL TWELVE CLEANROOM LIGHTS.

9.) MAINTENANCE NEEDS TO BE DONE DAILY.

DRY FILM LUBRICATION
ROOM 118
LOCATION: BUILDING 4760
SIZE: 21'L X 12'W X 10'H
CLASS: 100K

TEMPERATURE RECORDED: 76.7 F
HUMIDITY RECORDED: 26.3% RH
AIR SAMPLE NOT RECORDED

THIS ROOM HAS BEEN RECENTLY UP GRADED AND PAINTED.

RECOMMENDATIONS:

1.) SINK IS IN VERY BAD CONDITION AND NEEDS TO BE REPLACED.

2.) REPLACE SCALE WITH NEW DIGITAL SCALE.

3.) SKIN THE BLOCK WALL USING HARD BOARD WITH BAKED MELAINE OR EQUAL.

4.) INSTALL MAGNA HELI GAUGE TO MONITOR PRESSURE.

5.) INSTALL CLEANROOM COMPATIBLE CEILING USING ARMSTRONG MYLAR OR EQUAL.

6.) REPLACE TWO SWINGING DOORS WITH NEW CLEANROOM DOORS.

7.) INSTALL CLEANROOM LIGHTS AND HEPA FILTER SYSTEM IN THE CEILING.

8.) IF GARMENTS ARE REQUIRED IN THIS ROOM A STORAGE CABINET AND GARMENT HOOKS SHOULD BE INSTALLED.

9.) ADD ADDITIONAL RETURN VENTS NEAR FLOOR.

10.) NEED STAINLESS STEEL TABLES AND CLEANROOM CHAIRS.

MLI BLANKET FAB SHOP
ROOM 201
LOCATION: BUILDING 4760
SIZE: 28'L X 19'W X 10'H
CLASS: 100K

TEMPERATURE RECORDED: 76.8 F
HUMIDITY RECORDED: 23% RH
AIR SAMPLE NOT RECORDED

THIS ROOM HAS BEEN UP GRADED RECENTLY. (ROOM WAS EMPTY)

RECOMMENDATIONS:

1.) INSTALL A NEW CLEANROOM COMPATIBLE CEILING WITH CLEANROOM LIGHTS AND HEPA FILTER SYSTEMS THAT ARE FLUSH TO THE CEILING. CEILING MATERIAL SHOULD BE ARMSTRONG MYLAR OR EQUAL.

2.) INSTALL ADDITIONAL RETURN VENTS NEAR THE FLOOR.

3.) INSTALL MAGNA HELI GAUGE TO MONITOR PRESSURE.

4.) ENTRY ROOM SHOULD HAVE GARMENT HOOKS AND STORAGE CABINET IF GARMENTS ARE REQUIRED.

5.) WHEN THE ROOM IS FURNISHED MAKE SURE THAT STAINLESS STEEL TABLES, CLEANROOM CHAIRS AND ALL OTHER TOOLS, ETC. ARE CLEANROOM COMPATIBLE.

NTS COULD NOT SURVEY THE SUBSCALE SOLID ROCKET MOTOR PROCESSING FACILITY, THE MODULAR CLEANROOM SRB COMPOSITES FACILITY, OR THE MODULAR CLEANROOM SS COMPOSITES FACILITY LOCATED IN BUILDING 4707 BECAUSE THE FACILITIES WERE NOT AVAILABLE AS OF NOVEMBER 5, 1990.

5.0 HEAT LOADS AND SIZING ANALYSIS (INPUTS, OUTPUTS, HEAT LOADS, AND HVAC SCHEMATICS)

THE FOLLOWING PAGES SHOW NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H, INPUTS, OUTPUTS, HEATLOADS, AND HVAC SCHEMATIC FOR ROOMS A104AB, A104A, A106, A106A, A107, B119, B122, B124, 120B, HIGH BAY LARGE, HIGH BAY SMALL, 124, 121, AND 129.

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT NAME		MUA HUM MIN (%RH)	40.0
ROOM NAME	A104AB	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	24.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	20.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	8.7	PROCESS EXHAUST (CFM)	0.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	2
ROOM CLASS	30000	DOORS	2
FOOTCANDLES	100	WINDOWS	1
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	3600.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	51.7	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	9	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	216.0	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	216.0	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	1130.6	COIL BYPASS CFM	914.6
AREA (SQ. FT)	480.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	8		

HEATLOAD:	SENSIBLE:	LATENT:	MINIMUM SENSIBLE:	LATENT:
ROOF AND FLOOR:	3993.8	0.0	0.0	0.0
SIDEWALLS:	2983.4	0.0	0.0	0.0
DOORS & WINDOWS:	479.5	0.0	0.0	0.0
A/C,HEPA & DUCTING:	4765.5	0.0	0.0	0.0
LIGHTS:	5897.7	0.0	0.0	0.0
RECIRC FAN:	7200.0	0.0	7200.0	0.0
MUA FAN:	1700.0	0.0	1700.0	0.0
PEOPLE:	730.0	770.0	0.0	0.0
PROCESS EQUIPMENT:	0.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	2102.9	0.0	2102.9
MAKEUP AIR:	6298.6	7032.6	-13297.6	0.0
	34048.5	9905.5	-4397.0	2102.9

TOTAL BTU/HR= 43954.0 = 3.7 TONS

12850	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
1 (LARGE)	=	PROBABLE NUMBER OF COILS
4.7	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
6.6	=	HUMIDIFIER LOAD IN LBS/HR
29	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
5	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
44	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	A104A	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	14.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	11.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	8.7	PROCESS EXHAUST (CFM)	0.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	2
ROOM CLASS	30000	DOORS	4
FOOTCANDLES	100	WINDOWS	1
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	1155.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	51.7	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	3	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	69.3	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	69.3	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	491.1	COIL BYPASS CFM	421.8
AREA (SQ. FT)	154.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	3		

HEATLOAD:	SENSIBLE:	LATENT:	MINIMUM SENSIBLE:	LATENT:
ROOF AND FLOOR:	1230.7	0.0	0.0	0.0
SIDEWALLS:	1555.2	0.0	0.0	0.0
DOORS& WINDOWS:	865.1	0.0	0.0	0.0
C,HEPA& DUCTING:	2659.5	0.0	0.0	0.0
LIGHTS:	1965.9	0.0	0.0	0.0
RECIRC FAN:	2310.0	0.0	2310.0	0.0
MUA FAN:	0.0	0.0	0.0	0.0
PEOPLE:	730.0	770.0	0.0	0.0
PROCESS EQUIPMENT:	0.0	0.0	0.0	0.0
ADDIT'NLLAT CAP:	0.0	478.0	0.0	478.0
MAKEUP AIR:	2020.8	2256.3	-4266.1	0.0
	13337.1	3504.3	-1956.1	478.0	478.0

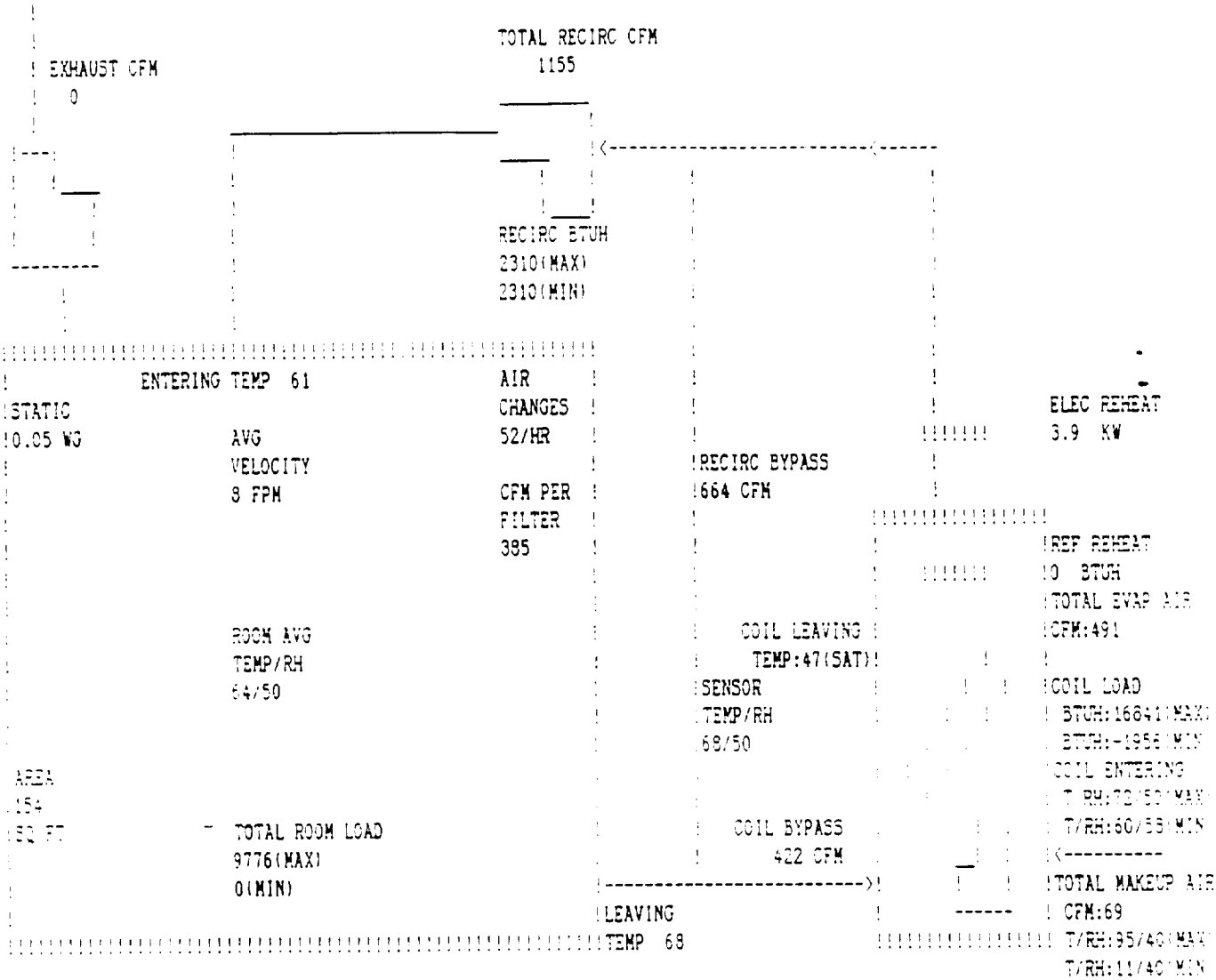
TOTAL BTU/HR= 16841.4 = 1.4 TONS

PRECEDING PAGE BLANK NOT FILMED

```
0           =     REFRIGERANT REHEAT CAPACITY IN BTU/HR
1 (SMALL)   =     PROBABLE NUMBER OF COILS
3.9         =     KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
2.1         =     HUMIDIFIER LOAD IN LBS/HR
ERR         =     ESTIMATED FULL LOAD AMPS (PRIMARY)
2           =     ESTIMATED FULL LOAD AMPS (LIGHTING)
25          =     ESTIMATED FULL LOAD AMPS (OUTLETS)
```

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 11/14 JOB NUMBER NOT KNOWN-1

CLEANROOM HVAC SCHEMATIC
A104



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&FLOOR	1231	0	0	0
WALLS	2420	0	0	0
LIGHTS	1966	0	0	0
FILTERS&DUCTS	2660	0	0	0
PEOPLE	730	770	0	0
PROCESS	0	0	0	0
TOTALS	9006	770	0	0

2 LBS/HR HUMIDIFIER LOAD

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	A106	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	46.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	38.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	10.0	PROCESS EXHAUST (CFM)	0.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	4
ROOM CLASS	30000	DOORS	2
FOOTCANDLES	100	WINDOWS	2
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	13110.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	45.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	34	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	786.6	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	786.6	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	3843.1	COIL BYPASS CFM	3056.5
AREA (SQ. FT)	1748.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	27		

HEATLOAD:	SENSIBLE	LATENT	MINIMUM SENSIBLE	MINIMUM LATENT
ROOF AND FLOOR:	14628.6	0.0	0.0	0.0
SIDEWALLS:	6609.6	0.0	0.0	0.0
DOORS & WINDOWS:	573.5	0.0	0.0	0.0
A/C,HEPA& DUCTING:	16777.8	0.0	0.0	0.0
LIGHTS:	22280.1	0.0	0.0	0.0
RECIRC FAN:	26220.0	0.0	26220.0	0.0
MUA FAN:	11200.0	0.0	11200.0	0.0
PEOPLE:	1460.0	1540.0	0.0	0.0
PROCESS EQUIPMENT:	0.0	0.0	0.0	0.0
ADDIT'NLLAT CAP:	0.0	8225.7	0.0	8225.7
MAKEUP AIR:	22937.3	25610.5	-48423.0	0.0
	122686.8	35376.2	-11003.1	8225.7

TOTAL BTU/HR= 158063.0 = 13.2 TONS

31000	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
2 (LARGE)	=	PROBABLE NUMBER OF COILS
16.8	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
24.1	=	HUMIDIFIER LOAD IN LBS/HR
99	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
20	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
84	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	A106A	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	20.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	16.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	10.0	PROCESS EXHAUST (CFM)	0.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	4
ROOM CLASS	30000	DOORS	1
FOOTCANDLES	100	WINDOWS	0
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	2400.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	45.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	7	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	144.0	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	144.0	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	875.2	COIL BYPASS CFM	731.2
AREA (SQ. FT)	320.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	5		

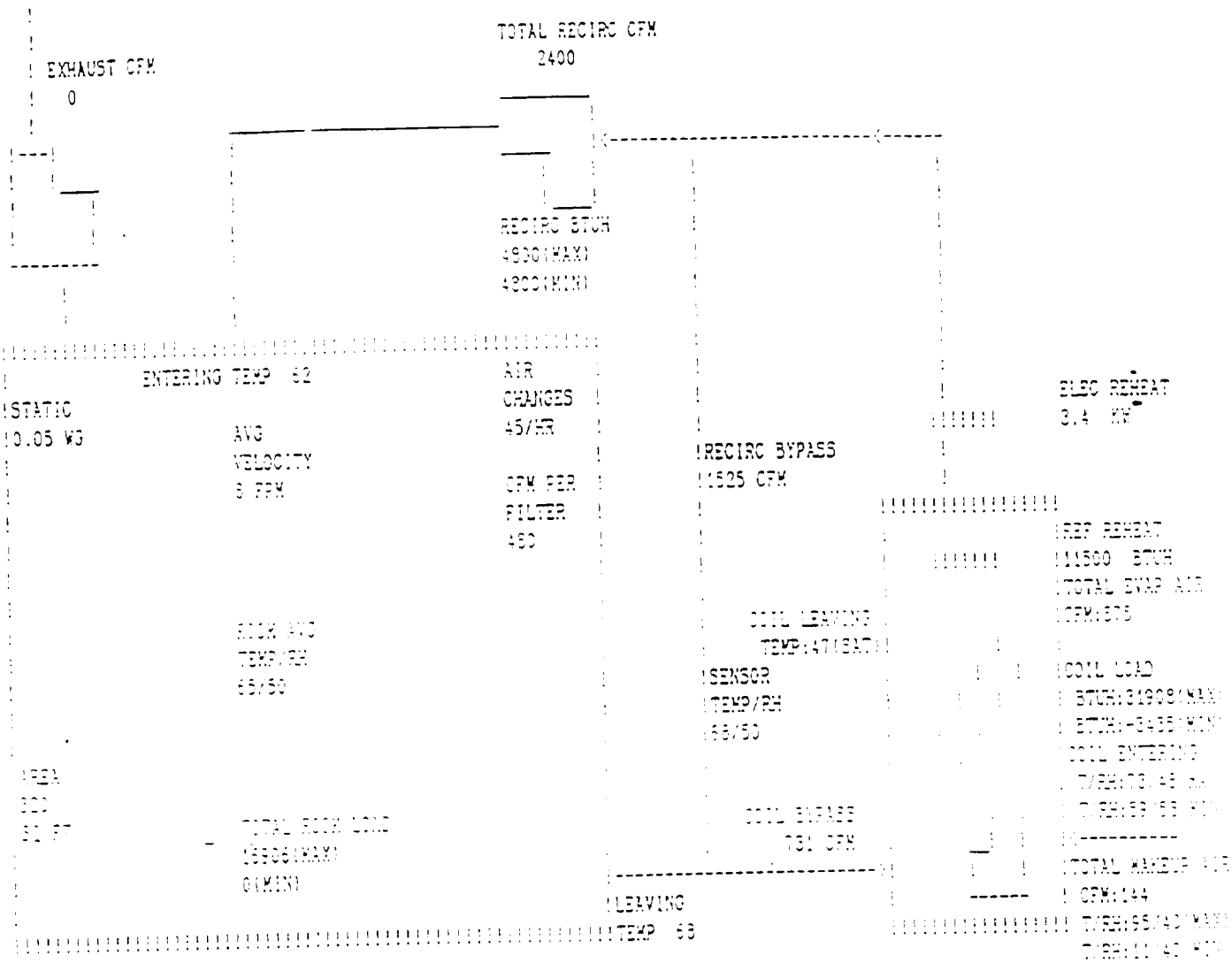
HEATLOAD:	SENSIBLE	LATENT	MINIMUM SENSIBLE	MINIMUM LATENT
ROOF AND FLOOR:	2600.6	0.0	0.0	0.0
SIDEWALLS:	2786.4	0.0	0.0	0.0
DOORS & WINDOWS:	192.8	0.0	0.0	0.0
A/C,HEPA& DUCTING:	3739.5	0.0	0.0	0.0
LIGHTS:	4587.1	0.0	0.0	0.0
RECIRC FAN:	4800.0	0.0	4800.0	0.0
MUA FAN:	630.0	0.0	630.0	0.0
PEOPLE:	1460.0	1540.0	0.0	0.0
PROCESS EQUIPMENT:	0.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	684.0	0.0	684.0
MAKEUP AIR:	4199.0	4688.4	-8864.6	0.0
	24995.4	6912.5	-3434.6	684.0

TOTAL BTU/HR= 31907.90= 2.7 TONS

11500	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
1 (SMALL)	=	PROBABLE NUMBER OF COILS
3.4	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
4.4	=	HUMIDIFIER LOAD IN LBS/HR
26	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
4	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
36	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 11/14 JOB NUMBER
NOT KNOWN-1

CLEANROOM HVAC SCHEMATIC
A106A



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&PLENUM	2501	0	0	0
WALLS	1979	0	0	0
LIGHTS	4567	0	0	0
FILTERS&DUCTS	3740	0	0	0
PEOPLE	1460	1540	0	0
PROCESS	0	0	0	0
TOTALS	15366	1540	0	0

4 LBS/HR HUMIDIFIER LOAD

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	1.6
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	A107	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	20.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	30.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	10.0	PROCESS EXHAUST (CFM)	650.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	2
ROOM CLASS	30000	DOORS	2
FOOTCANDLES	100	WINDOWS	2
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	4500.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	45.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	12	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	270.0	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	920.0	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	1666.3	COIL BYPASS CFM	731.2
AREA (SQ. FT)	600.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	10		

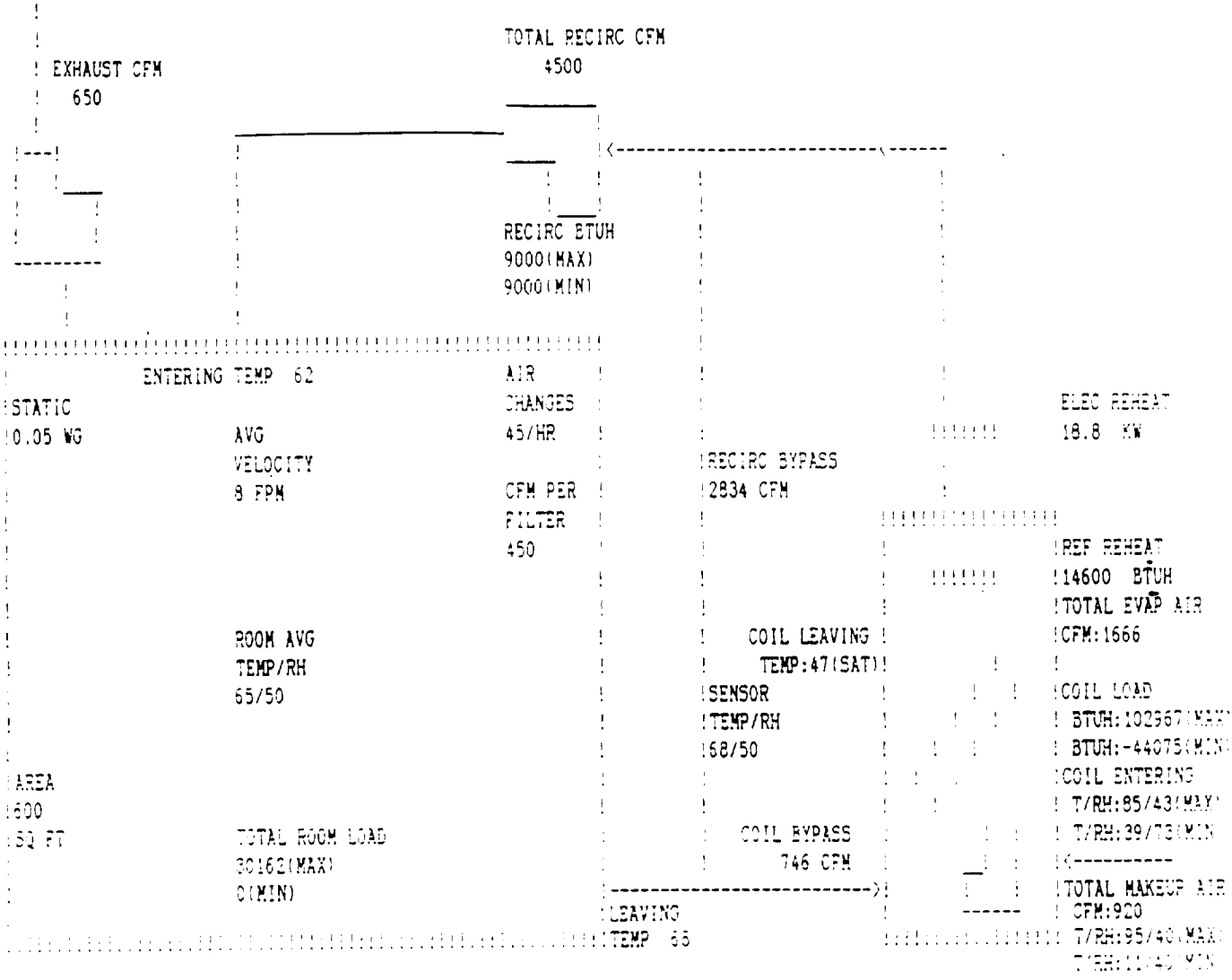
HEATLOAD:	SENSIBLE	MINIMUM LATENT	SENSIBLE	LATENT
ROOF AND FLOOR:	4922.6	0.0	0.0	0.0
SIDEWALLS:	3996.0	0.0	0.0	0.0
DOORS & WINDOWS:	573.5	0.0	0.0	0.0
A/C,HEPA& DUCTING:	5845.5	0.0	0.0	0.0
LIGHTS:	7863.6	0.0	0.0	0.0
RECIRC FAN:	9000.0	0.0	9000.0	0.0
MUA FAN:	3560.0	0.0	3560.0	0.0
PEOPLE:	730.0	770.0	0.0	0.0
PROCESS EQUIPMENT:	5460.8	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	3464.1	0.0	3464.1
MAKEUP AIR:	26827.2	29953.8	-56635.2	0.0
	68779.2	34187.9	-44075.2	3464.1

TOTAL BTU/HR= 102967.0 = 8.6 TONS

14600	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
1 (LARGE)	=	PROBABLE NUMBER OF COILS
18.8	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
28.2	=	HUMIDIFIER LOAD IN LBS/HR
84	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
7	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
50	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 11/13 JOB NUMBER
NOT KNOWN-1

CLEANROOM HVAC SCHEMATIC
A107



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&FLOOR	4923	0	0	0
WALLS	4569	0	0	0
LIGHTS	7864	0	0	0
FILTERS&DUCTS	5846	0	0	0
PEOPLE	730	770	0	0
PROCESS	5461	0	0	0
TOTALS	29392	770	0	0

28 LBS/HR HUMIDIFIER LOAD

ORIGINAL PAGE IS
OF POOR QUALITY

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	3.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	B119	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	75.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	38.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	10.0	PROCESS EXHAUST (CFM)	1200.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	4
ROOM CLASS	30000	DOORS	4
FOOTCANDLES	100	WINDOWS	4
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	21375.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	45.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	54	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	1282.5	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	2482.5	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	6936.1	COIL BYPASS CFM	4453.6
AREA (SQ. FT)	2850.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	43		

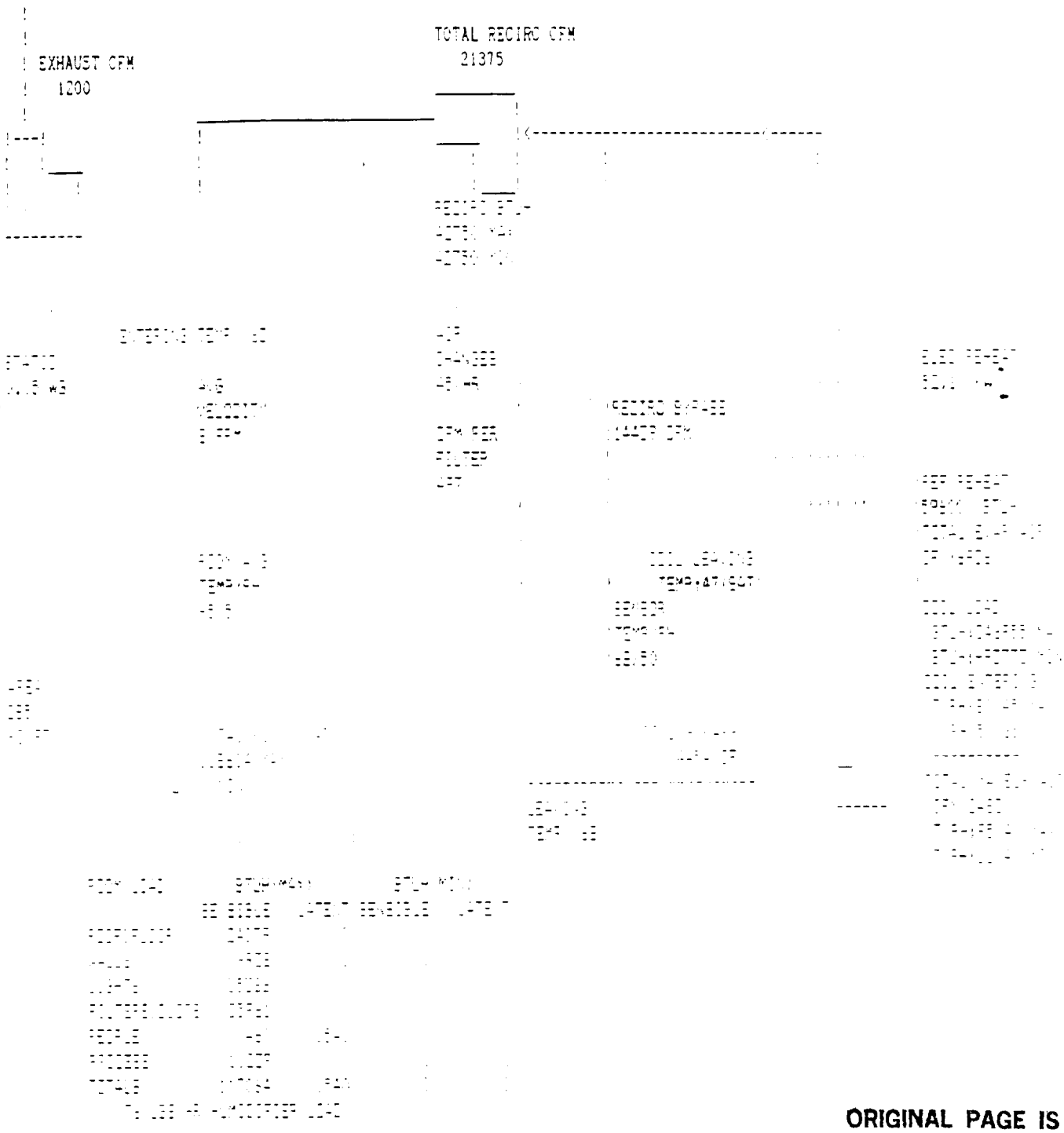
HEATLOAD:	SENSIBLE	MINIMUM LATENT	SENSIBLE	LATENT
ROOF AND FLOOR:	24079.1	0.0	0.0	0.0
SIDEWALLS:	8791.2	0.0	0.0	0.0
DOORS & WINDOWS:	1147.0	0.0	0.0	0.0
A/C,HEPA& DUCTING:	35961.3	0.0	0.0	0.0
LIGHTS:	35386.0	0.0	0.0	0.0
RECIRC FAN:	42750.0	0.0	42750.0	0.0
MUA FAN:	16300.0	0.0	16300.0	0.0
PEOPLE:	1460.0	1540.0	0.0	0.0
PROCESS EQUIPMENT:	10239.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	16085.0	0.0	16085.0
MAKEUP AIR:	72389.7	80826.4	-152822.7	0.0
	248503.3	98451.5	-93772.7	16085.0

TOTAL BTU/HR= 346954.8 = 28.9 TONS

59600	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
4 (LARGE)	=	PROBABLE NUMBER OF COILS
52.1	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
76.0	=	HUMIDIFIER LOAD IN LBS/HR
242	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
31	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
113	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 11/19 JOB NUMBER
999-1

CLEANROOM HVAC SCHEMATIC
B119



ORIGINAL PAGE IS
OF POOR QUALITY

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	B122	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	14.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	13.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	10.0	PROCESS EXHAUST (CFM)	0.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	2
ROOM CLASS	30000	DOORS	1
FOOTCANDLES	100	WINDOWS	1
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	1365.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	45.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	4	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	81.9	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	81.9	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	542.5	COIL BYPASS CFM	460.6
AREA (SQ. FT)	182.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	3		

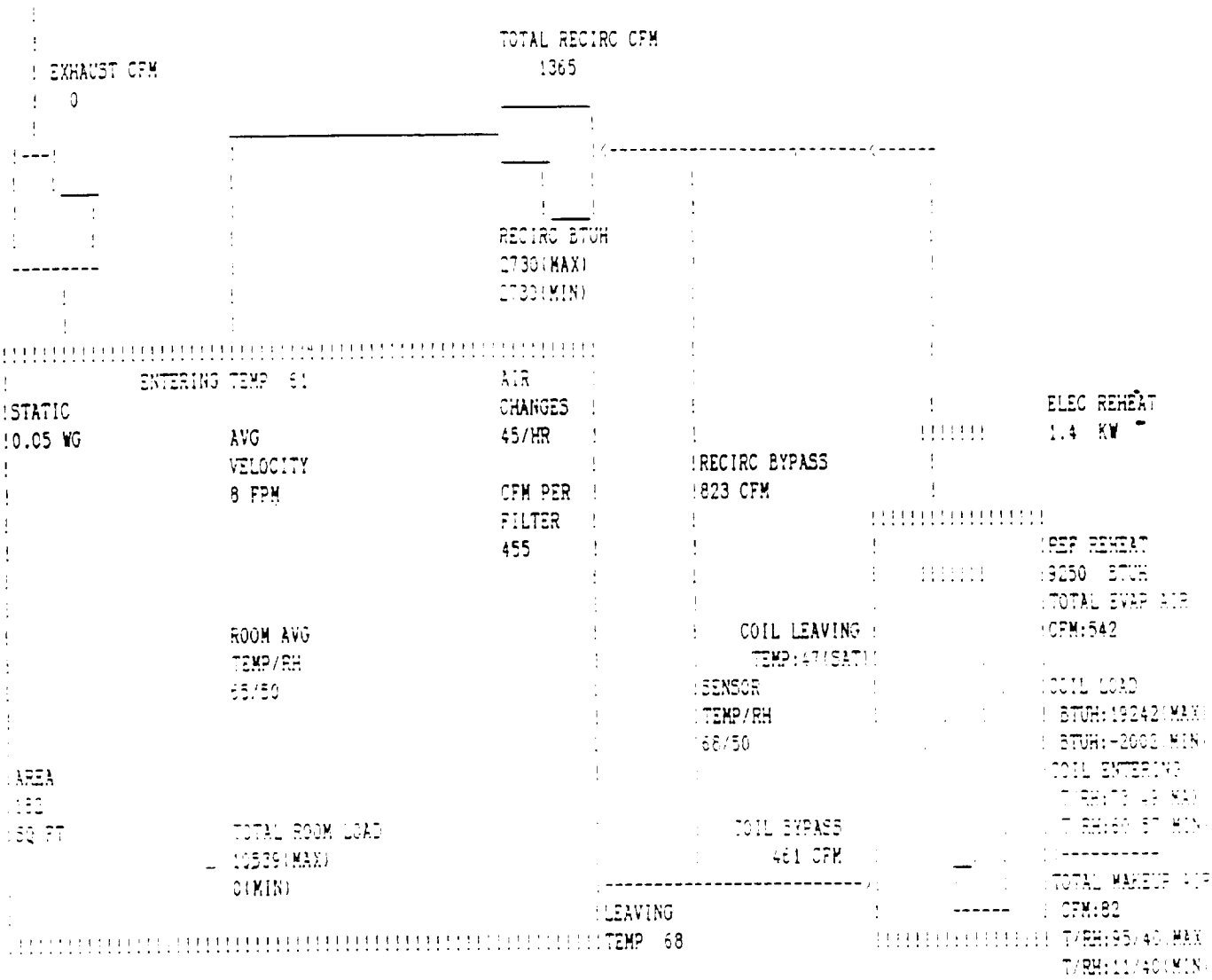
HEATLOAD:	SENSIBLE	LATENT	MINIMUM SENSIBLE	MINIMUM LATENT
ROOF AND FLOOR:	1462.9	0.0	0.0	0.0
SIDEWALLS:	2008.8	0.0	0.0	0.0
DOORS & WINDOWS:	286.7	0.0	0.0	0.0
A/C,HEPA& DUCTING:	2659.5	0.0	0.0	0.0
LIGHTS:	2621.2	0.0	0.0	0.0
RECIRC FAN:	2730.0	0.0	2730.0	0.0
MUA FAN:	310.0	0.0	310.0	0.0
PEOPLE:	730.0	770.0	0.0	0.0
PROCESS EQUIPMENT:	0.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	608.5	0.0	608.5
MAKEUP AIR:	2238.2	2666.5	-5041.8	0.0
	15197.3	4045.0	-2001.8	608.5

TOTAL BTU/HR= 19242.3 = 1.6 TONS

9250	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
1 (SMALL)	=	PROBABLE NUMBER OF COILS
1.4	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
2.5	=	HUMIDIFIER LOAD IN LBS/HR
ERR	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
2	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
27	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 11/13 JOB NUMBER
NOT KNOWN-1

CLEANROOM HVAC SCHEMATIC
B122



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&FLOOR	1463	0	0	0
WALLS	2196	0	0	0
LIGHTS	3621	0	0	0
FILTERS&DUCTS	2660	0	0	0
PEOPLE	730	770	0	0
PROCESS	0	0	0	0
TOTALS	9769	770	0	0

3 LBS/HR HUMIDIFIER LOAD

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	B124	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	22.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	12.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	10.0	PROCESS EXHAUST (CFM)	0.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	0
ROOM CLASS	4000	DOORS	2
FOOTCANDLES	100	WINDOWS	2
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	13200.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	300.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	5	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	118.8	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	118.8	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	1879.0	COIL BYPASS CFM	1760.2
AREA (SQ. FT)	264.0	AIR VELOCITY (FPM)	50.0
ESTIMATED FILTERS	21		

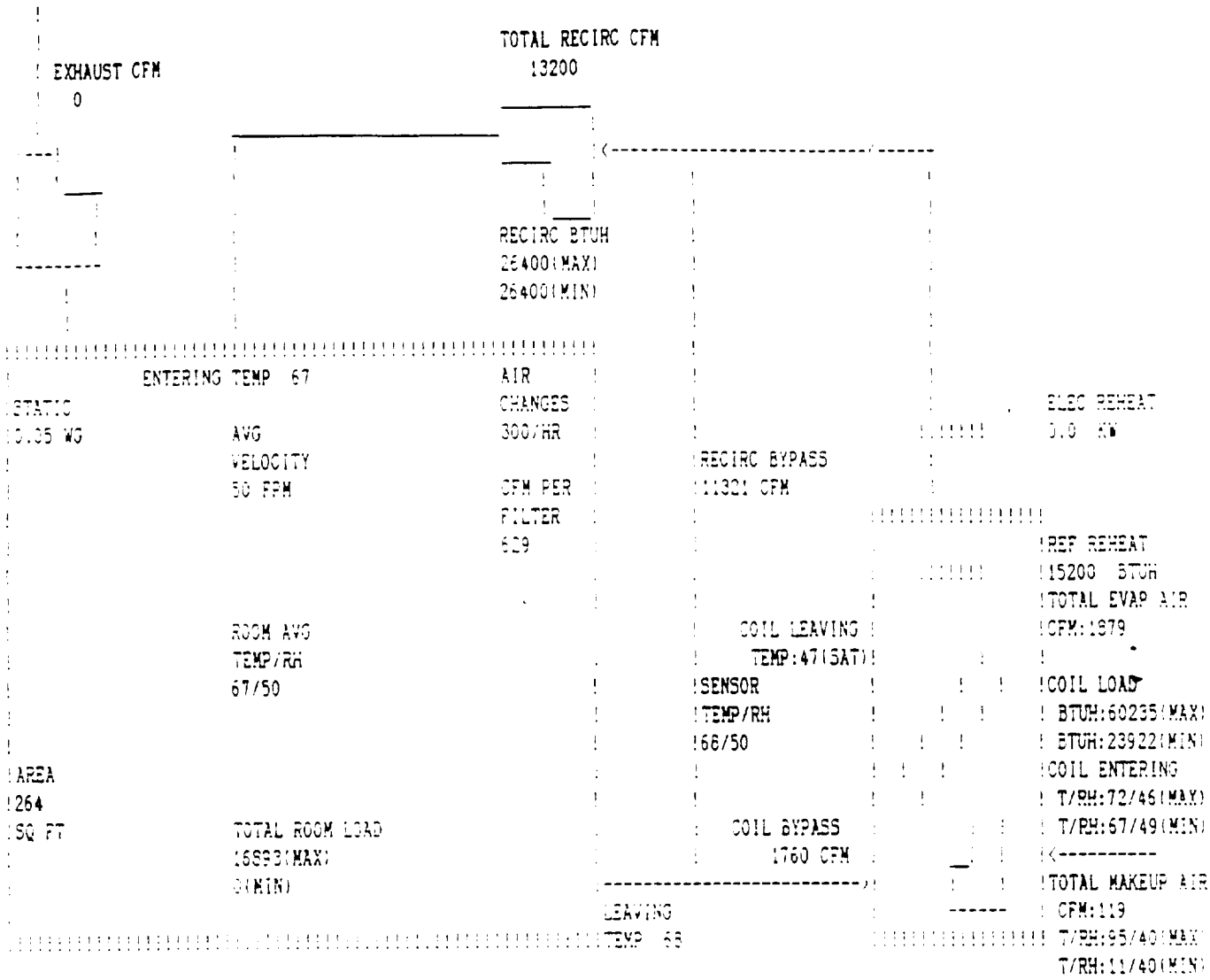
HEATLOAD:	SENSIBLE	LATENT	MINIMUM SENSIBLE	MINIMUM LATENT
ROOF AND FLOOR:	650.2	0.0	0.0	0.0
SIDEWALLS:	2419.2	0.0	0.0	0.0
DOORS & WINDOWS:	573.5	0.0	0.0	0.0
A/C,HEPA& DUCTING:	9973.8	0.0	0.0	0.0
LIGHTS:	3276.5	0.0	0.0	0.0
RECIRC FAN:	26400.0	0.0	26400.0	0.0
MUA FAN:	4835.0	0.0	4835.0	0.0
PEOPLE:	0.0	0.0	0.0	0.0
PROCESS EQUIPMENT:	0.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	4774.6	0.0	4774.6
MAKEUP AIR:	3464.2	3867.9	-7313.3	0.0
	51592.3	8642.5	23921.7	4774.6

TOTAL BTU/HR= 60234.9 = 5.0 TONS

15200	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
1 (LARGE)	=	PROBABLE NUMBER OF COILS
	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
4.6	=	HUMIDIFIER LOAD IN LBS/HR
37	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
3	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
34	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 11/14 JOB NUMBER
NOT KNOWN-1

CLEANROOM HVAC SCHEMATIC
B124



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&FLOOR	650	0	0	0
WALLS	2493	0	0	0
LIGHTS	3776	0	0	0
FILTERS&DUCTS	9974	0	0	0
PEOPLE	0	0	0	0
PROCESS	0	0	0	0
TOTALS	16893	0	0	0

0 LBS/HR HUMIDIFIER LOAD

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	120B	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	55.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	38.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	25.0	PROCESS EXHAUST (CFM)	0.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	10
ROOM CLASS	30000	DOORS	4
FOOTCANDLES	100	WINDOWS	2
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	110
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	15675.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	18.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	43	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	940.5	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	940.5	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	5979.6	COIL BYPASS CFM	5039.1
AREA (SQ. FT)	2090.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	32		

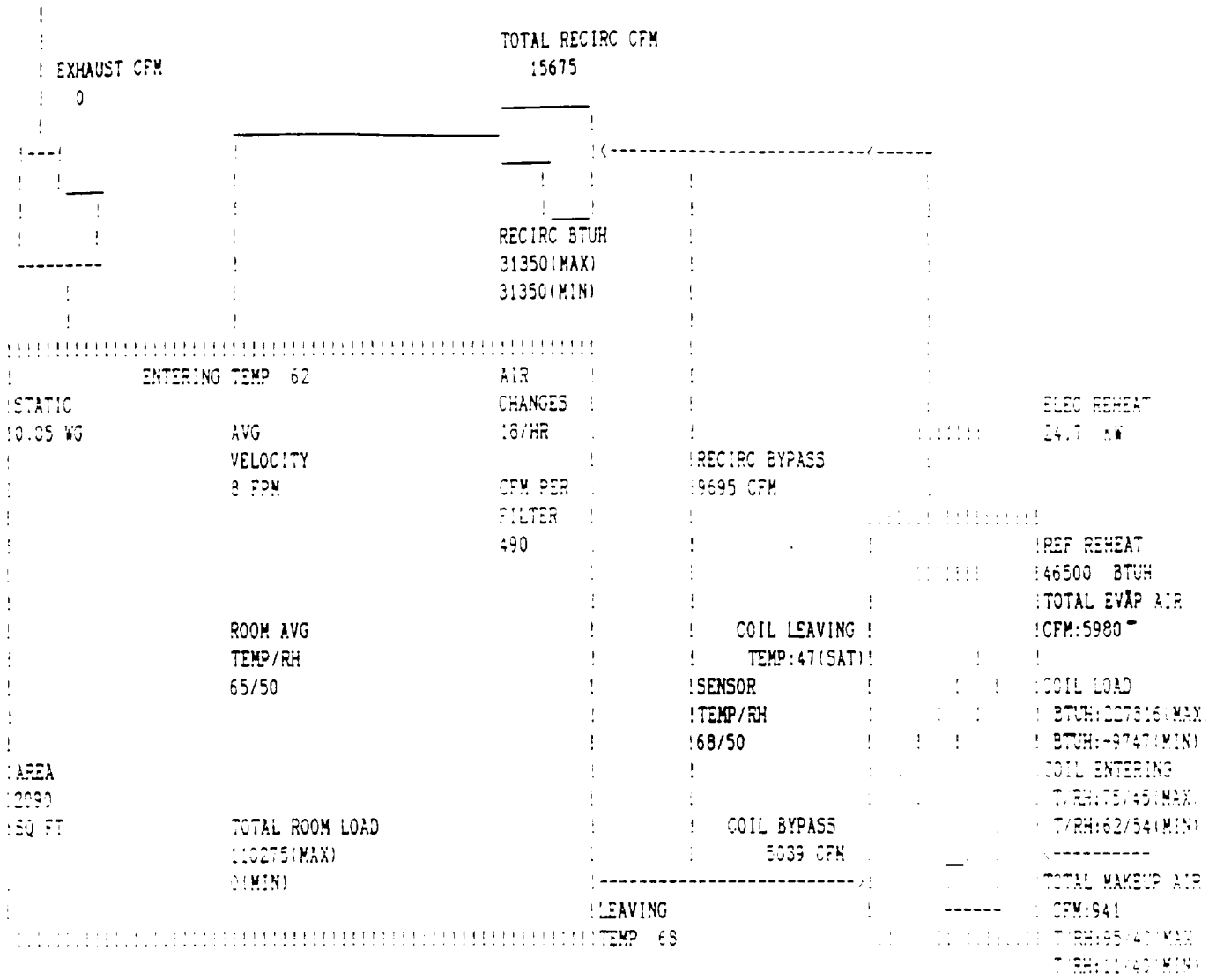
HEATLOAD:	SENSIBLE	LATENT	MINIMUM SENSIBLE	MINIMUM LATENT
ROOF AND FLOOR:	17298.9	0.0	0.0	0.0
SIDEWALLS:	19440.0	0.0	0.0	0.0
DOORS & WINDOWS:	959.0	0.0	0.0	0.0
A/C,HEPA& DUCTING:	19834.2	0.0	0.0	0.0
LIGHTS:	28177.7	0.0	0.0	0.0
RECIRC FAN:	31350.0	0.0	31350.0	0.0
MUA FAN:	16800.0	0.0	16800.0	0.0
PEOPLE:	3650.0	3850.0	0.0	0.0
PROCESS EQUIPMENT:	17065.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	11344.5	0.0	11344.5
MAKEUP AIR:	27425.0	30621.3	-57897.2	0.0
	181999.8	45815.8	-9747.2	11344.5

TOTAL BTU/HR= 227815.6 = 19.0 TONS

46500	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
3 (LARGE)	=	PROBABLE NUMBER OF COILS
24.7	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
28.8	=	HUMIDIFIER LOAD IN LBS/HR
140	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
57	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
93	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 03/26 JOB NUMBER
999-1

CLEANROOM HVAC SCHEMATIC
0



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&FLOOR	17099	0	0	0
WALLS	20399	0	0	0
LIGHTS	28178	0	0	0
FILTERS&DUCTS	19834	0	0	0
PEOPLE	3650	3850	0	0
PROCESS	17065	0	0	0
TOTALS	106425	3850	0	0

39 LBS/HR HUMIDIFIER LOAD

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	HIGH BAY LARGE	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	46.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	28.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	10.0	PROCESS EXHAUST (CFM)	0.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	4
ROOM CLASS	100000	DOORS	4
FOOTCANDLES	100	WINDOWS	2
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	0.0	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	6440.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	30.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	25	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	579.6	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	579.6	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	2518.0	COIL BYPASS CFM	1938.4
AREA (SQ. FT)	1288.0	AIR VELOCITY (FPM)	5.0
ESTIMATED FILTERS	19		

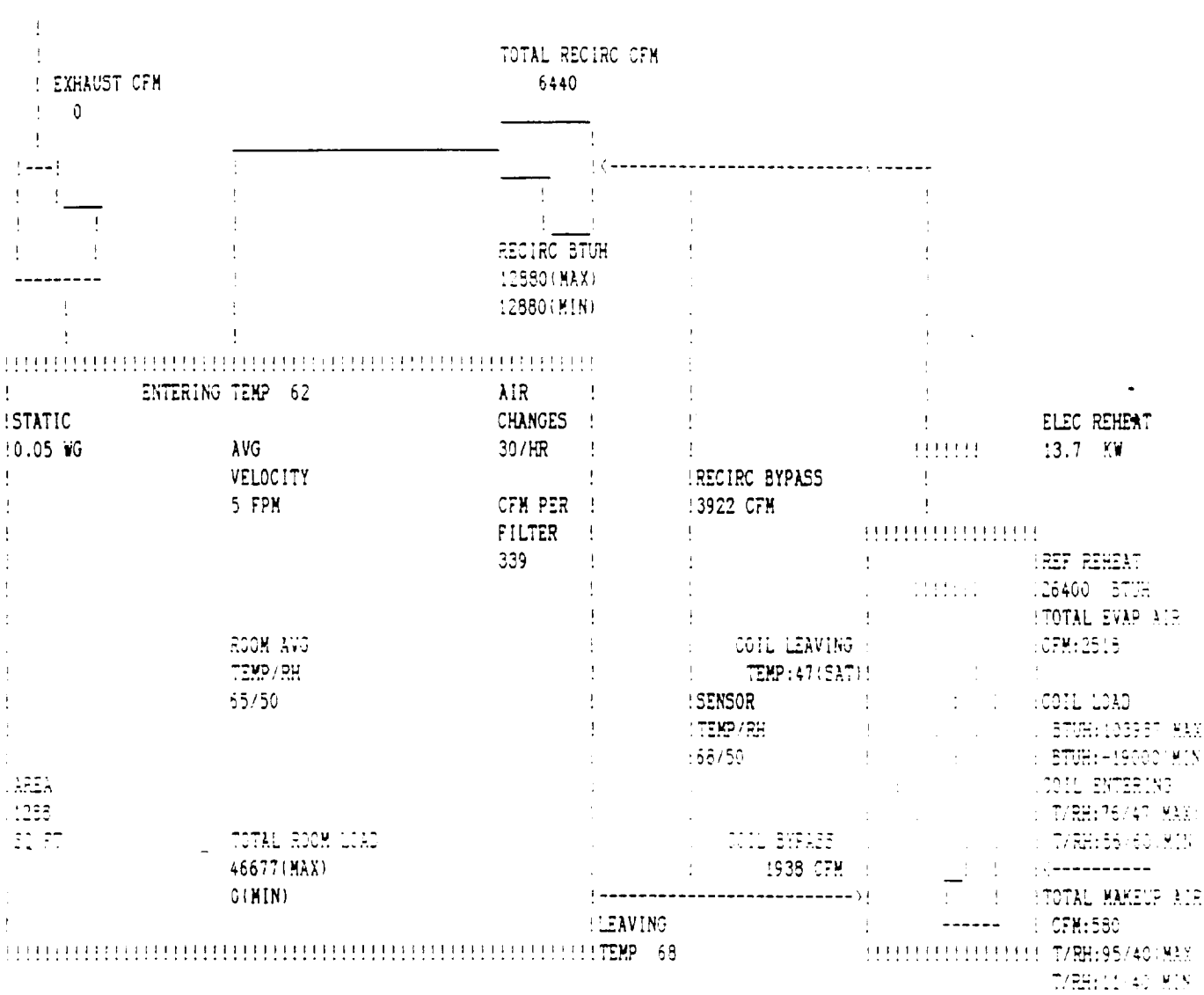
HEATLOAD:	SENSIBLE	LATENT	MINIMUM SENSIBLE	MINIMUM LATENT
ROOF AND FLOOR:	10867.0	0.0	0.0	0.0
SIDEWALLS:	6069.6	0.0	0.0	0.0
DOORS & WINDOWS:	959.0	0.0	0.0	0.0
A/C,HEPA& DUCTING:	9398.7	0.0	0.0	0.0
LIGHTS:	16382.4	0.0	0.0	0.0
RECIRC FAN:	12880.0	0.0	12880.0	0.0
MUA FAN:	3800.0	0.0	3800.0	0.0
PEOPLE:	1460.0	1540.0	0.0	0.0
PROCESS EQUIPMENT:	0.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	4858.4	0.0	4858.4
MAKEUP AIR:	16901.1	18870.9	-35680.2	0.0
	78717.8	25269.3	-19000.2	4858.4

TOTAL BTU/HR= 103987.1 = 8.7 TONS

26400	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
2 (LARGE)	=	PROBABLE NUMBER OF COILS
13.7	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
17.7	=	HUMIDIFIER LOAD IN LBS/HR
73	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
14	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
74	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 11/14 JOB NUMBER
NOT KNOWN-1

CLEANROOM HVAC SCHEMATIC
HIGH BAY LARGE TENT



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&FLOOR	10867	0	0	0
WALLS	7029	0	0	0
LIGHTS	16382	0	0	0
FILTERS&DUCTS	9399	0	0	0
PEOPLE	1460	1540	0	0
PROCESS	0	0	0	0
TOTALS	45137	1540	0	0

18 LBS/HR HUMIDIFIER LOAD

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	HIGH BAY SMALL	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	18.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	12.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	10.0	PROCESS EXHAUST (CFM)	0.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	0
ROOM CLASS	100000	DOORS	1
FOOTCANDLES	100	WINDOWS	1
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	0.0	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	1080.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	30.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	5	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	97.2	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	97.2	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	563.4	COIL BYPASS CFM	466.2
AREA (SQ. FT)	216.0	AIR VELOCITY (FPM)	5.0
ESTIMATED FILTERS	4		

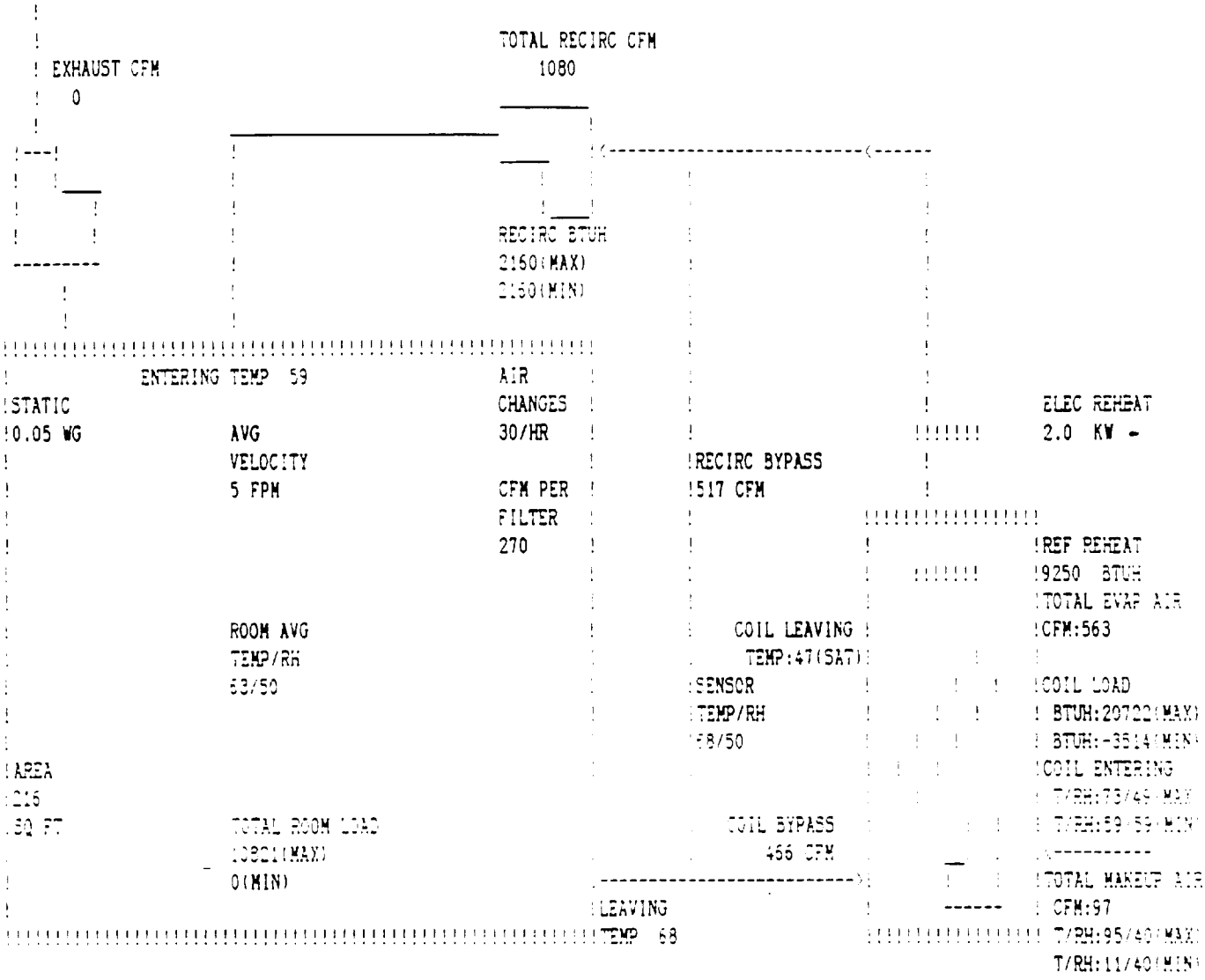
HEATLOAD:	SENSIBLE	LATENT	MINIMUM SENSIBLE	MINIMUM LATENT
ROOF AND FLOOR:	1671.8	0.0	0.0	0.0
SIDEWALLS:	2268.0	0.0	0.0	0.0
DOORS & WINDOWS:	286.7	0.0	0.0	0.0
A/C,HEPA& DUCTING:	3318.3	0.0	0.0	0.0
LIGHTS:	3276.5	0.0	0.0	0.0
RECIRC FAN:	2160.0	0.0	2160.0	0.0
MUA FAN:	310.0	0.0	310.0	0.0
PEOPLE:	1460.0	1540.0	0.0	0.0
PROCESS EQUIPMENT:	0.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	1431.6	0.0	1431.6
MAKEUP AIR:	2834.4	3164.7	-5983.6	0.0
	16125.7	4596.3	-3513.6	1431.6

TOTAL BTU/HR= 20722.0 = 1.7 TONS

9250	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
1 (SMALL)	=	PROBABLE NUMBER OF COILS
2.0	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
3.0	=	HUMIDIFIER LOAD IN LBS/HR
ERR	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
3	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
30	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 11/14 JOB NUMBER
NOT KNOWN-1

CLEANROOM HVAC SCHEMATIC
HIGH BAY SMALL TENT



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&FLOOR	1672	0	0	0
WALLS	0555	0	0	0
LIGHTS	3276	0	0	0
FILTERS&DUCTS	3318	0	0	0
PEOPLE	0	0	0	0
PROCESS	0	0	0	0
TOTALS	10821	0	0	0

3 LBS/HR HUMIDIFIER LOAD

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	124	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	80.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	66.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	25.0	PROCESS EXHAUST (CFM)	0.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	8
ROOM CLASS	30000	DOORS	2
FOOTCANDLES	100	WINDOWS	2
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	110
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	39600.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	18.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	107	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	2376.0	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	2376.0	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	12633.4	COIL BYPASS CFM	10257.8
AREA (SQ. FT)	5280.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	80		

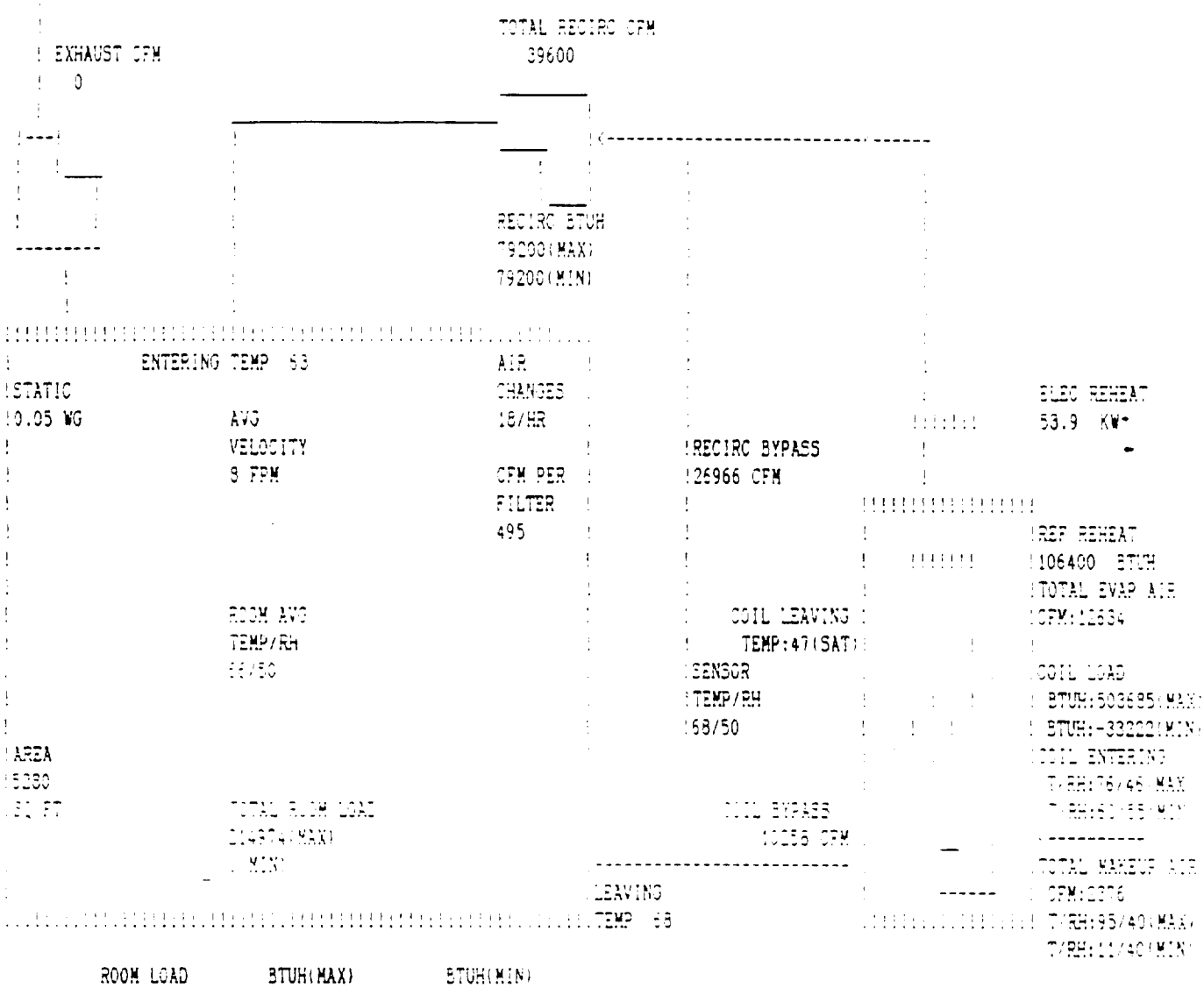
HEATLOAD:	SENSIBLE	LATENT	MINIMUM SENSIBLE	MINIMUM LATENT
ROOF AND FLOOR:	43932.2	0.0	0.0	0.0
SIDEWALLS:	29916.0	0.0	0.0	0.0
DOORS & WINDOWS:	573.5	0.0	0.0	0.0
A/C,HEPA& DUCTING:	64435.5	0.0	0.0	0.0
LIGHTS:	70116.7	0.0	0.0	0.0
RECIRC FAN:	79200.0	0.0	2160.0	0.0
MUA FAN:	33845.0	0.0	310.0	0.0
PEOPLE:	2920.0	3080.0	0.0	0.0
PROCESS EQUIPMENT:	0.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	29023.3	0.0	29023.3
MAKEUP AIR:	69284.2	77359.0	-146266.6	0.0
	394223.1	109462.2	-33221.6	29023.3

TOTAL BTU/HR= 503685.3 = 42.0 TONS

106400	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
7 (LARGE)	=	PROBABLE NUMBER OF COILS
53.9	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
72.7	=	HUMIDIFIER LOAD IN LBS/HR
332	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
143	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
146	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 03/26 JOB NUMBER
999-1

CLEANROOM HVAC SCHEMATIC
124



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&FLOOR	43932	0	0	0
WALLS	30459	0	0	0
LIGHTS	77417	0	0	0
FILTERS&DUCTS	64436	0	0	0
PEOPLE	2920	3080	0	0
PROCESS	0	0	0	0
TOTALS	211894	3080	0	0

*3 LBS/HR HUMIDIFIER LOAD

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	121	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	80.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	70.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	33.0	PROCESS EXHAUST (CFM)	1500.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	10
ROOM CLASS	30000	DOORS	4
FOOTCANDLES	100	WINDOWS	4
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	110
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

TOTAL RECIRC CFM	42000.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	13.6	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	114	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	2520.5	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	4020.0	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	23218.1	COIL BYPASS CFM	19198.1
AREA (SQ. FT)	5600.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	85		

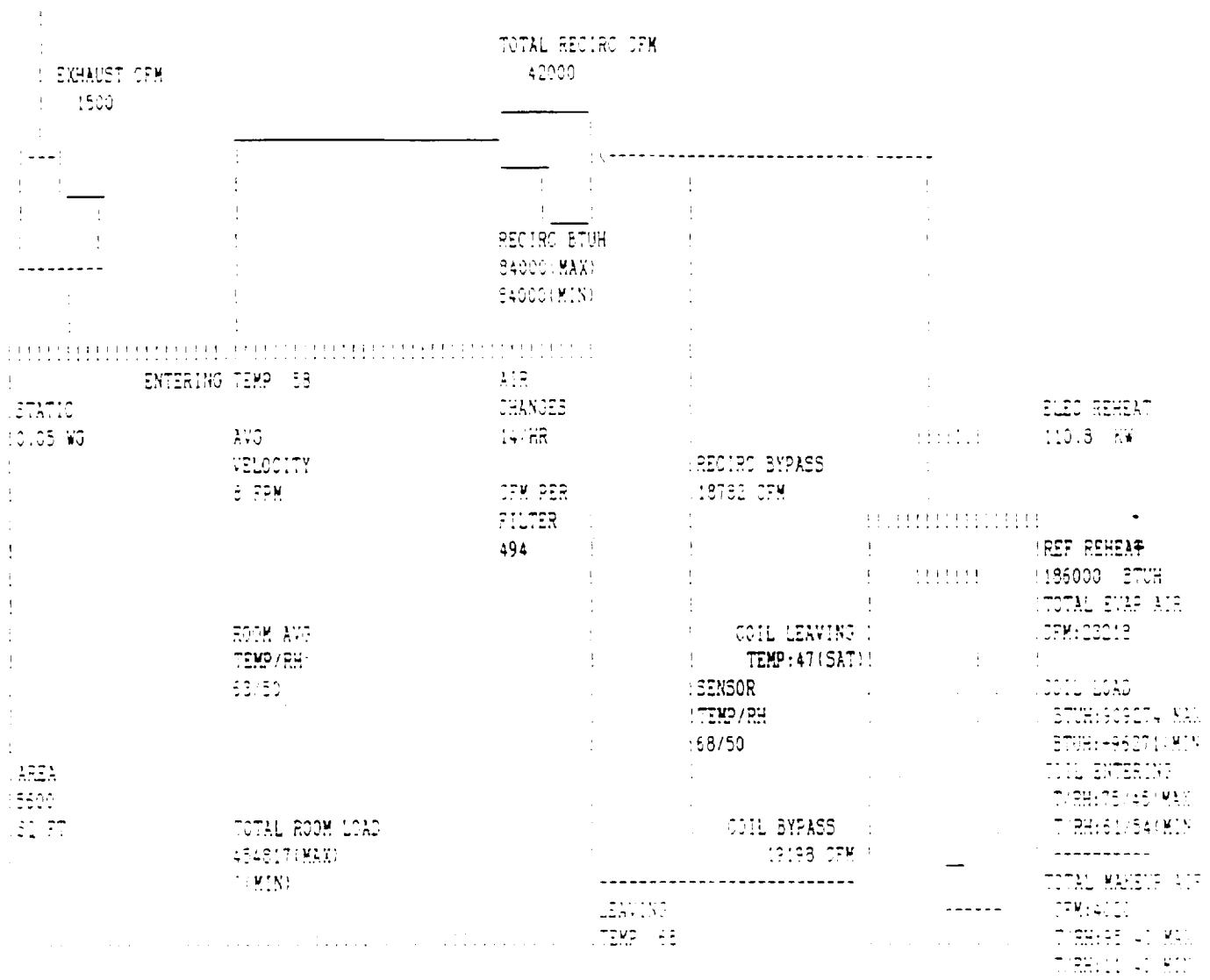
HEATLOAD:	SENSIBLE	LATENT	MINIMUM SENSIBLE	MINIMUM LATENT
ROOF AND FLOOR:	46532.9	0.0	0.0	0.0
SIDEWALLS:	41148.0	0.0	0.0	0.0
DOORS & WINDOWS:	1147.0	0.0	0.0	0.0
A/C,HEPA& DUCTING:	65353.5	0.0	0.0	0.0
LIGHTS:	74703.7	0.0	0.0	0.0
RECIRC FAN:	84000.0	0.0	84000.0	0.0
MUA FAN:	67200.0	0.0	67200.0	0.0
PEOPLE:	3650.0	3850.0	0.0	0.0
PROCESS EQUIPMENT:	218432.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	55148.8	0.0	55148.8
MAKEUP AIR:	117223.2	130885.1	-247471.2	0.0
	719390.3	189883.9	-96271.2	55148.8

TOTAL BTU/HR= 909274.2 = 75.8 TONS

186000	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
12 (LARGE)	=	PROBABLE NUMBER OF COILS
110.8	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
123.0	=	HUMIDIFIER LOAD IN LBS/HR
626	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
152	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
150	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H
REL(8/22/90): DATE 03/26 JOB NUMBER
999-1

CLEANROOM HVAC SCHEMATIC



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&FLOOR	46533	0	0	0
WALLS	42295	0	0	0
LIGHTS	74704	0	0	0
FILTERS&DUCTS	65354	0	0	0
PEOPLE	3650	3650		
PROCESS	216432	0	0	0
TOTALS	450967	3650	0	0

100 LBS/HR HUMIDIFIER LOAD

NTS AND CLESTRA CLEANROOM TECHNOLOGY MODULE SELECTION-VERSION 90-H

INPUTS: DATE: 1-NOV-90 BY: BASEM

CLEANROOM SURVEY		PROCESS SENSIBLE (KW)	0.0
CUSTOMER	NASA	PROCESS LATENT (KW)	0.0
CITY	HUNTSVILLE	ROOM TEMP (F)	68.0
STATE	AL	ROOM HUMIDITY (%RH)	50.0
CONTACT NAME	MAX SHARPE	MUA TEMP (F)	95.0
CONTACT PHONE		MUA TEMP MIN (%RH)	40.0
ROOM NAME	129	MUA TEMP MIN (F)	11.0
ROOM NUMBER (#)	1	MUA HUM MIN (%RH)	40.0
ROOM LENGTH (FT)	41.0	AMBIENT TEMP (F)	95.0
ROOM WIDTH (FT)	22.0	AMBIENT HUMIDITY (%RH)	40.0
ROOM HEIGHT (FT)	10.0	PROCESS EXHAUST (CFM)	400.0
ROOM STATIC (WC)	0.05	PEOPLE (#)	6
ROOM CLASS	30000	DOORS	2
FOOTCANDLES	100	WINDOWS	2
LIGHT (W,Y)	W	AC POWER (230,460,600)	460
CEILING (T,P,C)	T	LIGHT POWER (110,277,347)	277
WALL(CLESTRA, CCT)	CCT	DEWPOINT DEPRESSION (F)	2.0
SP. VELOCITY(FPM)	7.5	MORE INPUT? (1,2,N)	N

OUTPUTS:

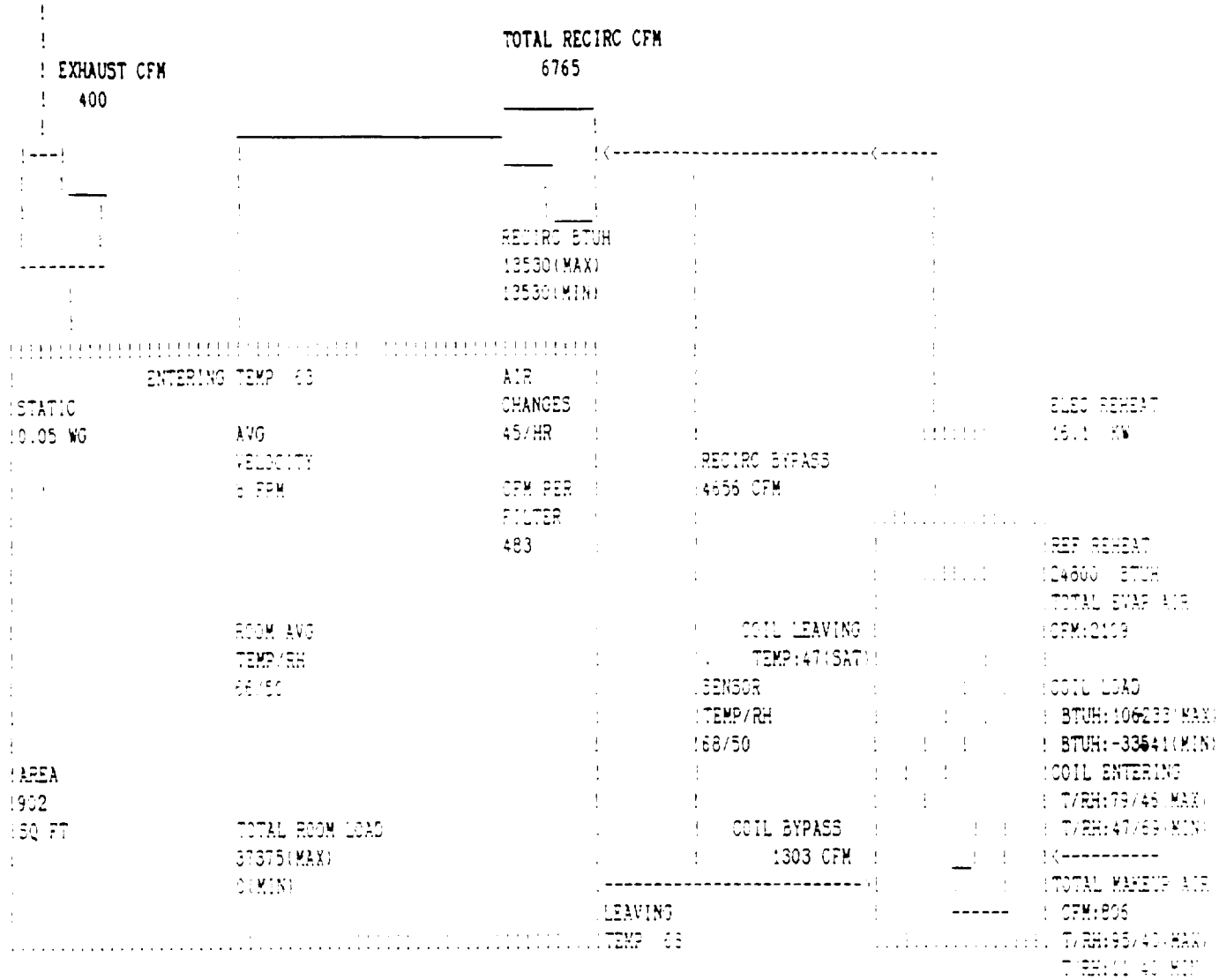
TOTAL RECIRC CFM	6765.0	ROOM DEWPOINT (F)	48.7
AIR CHANGES/HR	45.0	REQUIRED COIL LAT (F)	46.7
LIGHTS (FIXTURES	18	SUMMER MUA GRAINS	98.6
CFM FOR PRESSURE	405.9	COIL LEAVING GRAINS	46.9
TOTAL MUA CFM	805.9	ROOM GRAINS	50.7
TOTAL EVAP AIR CFM	2109.1	COIL BYPASS CFM	1303.2
AREA (SQ. FT)	902.0	AIR VELOCITY (FPM)	7.5
ESTIMATED FILTERS	14		

HEATLOAD:	SENSIBLE	LATENT	MINIMUM SENSIBLE	MINIMUM LATENT
ROOF AND FLOOR:	7500.1	0.0	0.0	0.0
SIDEWALLS:	5119.2	0.0	0.0	0.0
DOORS & WINDOWS:	573.5	0.0	0.0	0.0
A/C,HEPA& DUCTING:	7886.7	0.0	0.0	0.0
LIGHTS:	11795.3	0.0	0.0	0.0
RECIRC FAN:	13530.0	0.0	13530.0	0.0
MUA FAN:	2540.0	0.0	2540.0	0.0
PEOPLE:	2190.0	2310.0	0.0	0.0
PROCESS EQUIPMENT:	218432.0	0.0	0.0	0.0
ADDIT'NL LAT CAP:	0.0	3049.3	0.0	3049.3
MAKEUP AIR:	23500.0	26238.9	-49611.2	0.0
	74634.8	31598.2	-33541.2	3049.3

TOTAL BTU/HR= 106233.0 = 8.9 TONS

24800	=	REFRIGERANT REHEAT CAPACITY IN BTU/HR
2 (LARGE)	=	PROBABLE NUMBER OF COILS
16.1	=	KW ELECTRIC REHEAT REQUIRED FOR MINIMUM LOAD
24.7	=	HUMIDIFIER LOAD IN LBS/HR
78	=	ESTIMATED FULL LOAD AMPS (PRIMARY)
10	=	ESTIMATED FULL LOAD AMPS (LIGHTING)
63	=	ESTIMATED FULL LOAD AMPS (OUTLETS)

CLEANROOM HVAC SCHEMATIC
129



ROOM LOAD	BTUH(MAX)		BTUH(MIN)	
	SENSIBLE	LATENT	SENSIBLE	LATENT
ROOF&FLOOR	7500	0	0	0
WALLS	5693	0	0	0
LIGHTS	11715	0	0	0
FILTER&DUCTS	7337	0	0	0
PEOPLE	2191	2910	0	0
PROCESS	0	0	0	0
TOTALS	35065	2910	0	0

68 LBS/HR HUMIDIFIER LOAD

ORIGINAL PAGE IS OF POOR QUALITY

C-2

6.0 APPENDIX

SUMMARY OF ENGINEERING DRAWINGS

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
10-26-82	FAC-X-4711	M1	RM W129 RM W131	Rehabitation and Modification of Development Processes Laboratory	Part "A" New Revised Floor Plan-A/C and Plumbing	South half floor plan shows two HEPA AC units, one for 129, one for 131.
10-26-82	FAC-X-4711	M5	129/W131	Rehabitation and Modification of Development Processes Laboratory	Large Scale Mizzanin Floor Plan	Shows air handling units for 129 and 131.
10-26-82	FAC-X-4711	M6	129/W131	Rehabitation and Modification of Development Processes Laboratory	Air Handling Unit Schedule	Spec's for AH3 and AH4 air handling systems for 129 and 131.
10-26-82	FAC-X-4711	M7	W129/W131	Rehabitation and Modification of Development Processes Laboratory	Control Schematic-AH15	Control diagram for air handling unit, Room 129-131.
11-3-88	FAC-X-4760	M1	RM 118 Dry Film Lub	Building 4760 Modify Rooms 118 and 201	Rm. 118 Plans-Section Detail	HVAC and exhaust hood layout.
11-3-88	FAC-X-4760	M2	RM 201 MLI Blanket	Building 4760 Modify Rooms 118 and 201	Rm. 201 Plans-Section Detail	HVAC duct work layout.
11-3-88	FAC-X-4760	M3	RM 118/RM 201	Building 4760 Modify Rooms 118 and 201	Rm. 118/201 AHU Control Diagram	HVAC control diagram.
11-3-88	FAC-X-4760	M4	RM 118/RM 201	Building 4760 Modify Rooms 118 and 201	Rm 118/201 Piping Plans Schedules Details	HVAC specs GN2 piping
1962	FE-A-4707	M1	RM 129	Building 4707 Modification for Experimental, Aluminum Honeycomb Facility	Rm 129 Mechanical Floor Plan and Details	Shows floor plan and HVAC in 1962 modifiec in 1967 added humidifier and controls to layup room.
1962	FE-A-4707	M3	RM 129	Building 4707 Modification for Experimental, Aluminum Honeycomb Facility	Rm. 129 Mechanical Schedules and Details	1962 Schedule for air handling units.

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
10-2-66	I&D-S-4707	M1	Room 129 4707	Install Humidifier for Clean Rooms	Mechanical and Electrical, Plan and Detail	Drawing appears to apply to three no longer existent portable rooms.
3-30-67	FAC-A-4707	NREF	Composite Layup Lab RM 129	System for Adding Moisture in Layup Room	Rm. 129 Composite Layup	Install steam for humidity.
11-1-69	FAC B-4707	M1	HV and AC	Mod _ Clean Room #4	HVAC Mod, Room 129, Composite Layup Lab	Replaced heating coil, restore positive pressure control, modify humidity control.
11-6-81	FAC-CF 4707	M1 of 1	4707 Adjacent to Layup Room	Building 4707 Install New Exhaust Fan	Install Exhaust Fan	Install fan in Rm. 128 adjacent to Rm. 129.
12-21-83	FAC-BA-4707	M1	RM 124 Tape Wrap Cell	Modification for Composite Research and Development Lab (4707)	Schedules and Controls	AC specs.
12-21-83	FAC-BA-4707	M2	RM 124 Tape Wrap Cell	Modification for Composite Research and Development Lab (4707)	Rm. 124 Floor Plan	Basic floor plan possibly outdated, should verify.
12-21-83	FAC-BA-4707	M3	RM 124 Tape Wrap Cell	Modification for Composite Research and Development Lab (4707)	Rm. 124 Details & Section	AC-1 section.
12-21-83	FAC-BA-4707	M4	RM 124 Tape Wrap Cell	Modification for Composite Research and Development Lab (4707)	Rm. 124 Specifications	AHU and filter specs.
2-7-86	FAC-BS-4707	M1 Composite Lay-up Lab	RM 129	Building 4707 Alcove Enclosure and Piping Vacuum System	Rm. 129 Removal Plans-Chilled Water lay-up lab revised 4-12-90	1986 modification to HVAC composite. Humidity control modified.
2-7-86	FAC-BS-4707	M2	RM 129	Building 4707 Alcove Enclosure and Piping Vacuum System	Rm. 129 Floor Plan Piping Schematics	Shows piping schematics and AHU schematic
2-7-86	FAC-BS-4707	M3	RM 129 Composite Lay up Lab	Building 4707 Alcove Enclosure and Humidity Control	Rm. 129 Steam Partial Plan Schematic	Summer steam supply fume duct CFM Revised 4-12-90

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
2-7-86	FAC-BS-4707	M4	RM 129 Composite Lay-up Lab	Building 4707 Alcove Enclosure and Humidity Control	Rm. 129 Systems Schematics-Controls	AHU-1 control system schematic control Legend legend control device schedule.
2-7-86	FAC-BS-4707	M5	RM 129 Composite Lay-up Lab	Building 4707 Alcove Enclosure and Humidity Control	Rm. 129 Equipment Notes Schedule-	HVAC specs. Controls
5-2-86	FAC-BU-4707	M1	RM 120B Tape Wrapping Facility (4707)	Modification for Composite Tape	Rm. 120B Symbols-Schedules and Details	Electric coil schedule, humidifier, evaporator pressure regulator, reciprocating compressor, dehumidifier, air cooled condenser, pre-cooling coil, air distribution, steam humidifier, piping, compressed air.
5-2-86	FAC-BU-4707	M2	RM 120B Tape Wrapping Facility (4707)	Modification for Composite Tape	Rm. 120B Ground and Second Level Plans	Cutting room and second floor, HVAC-air handling, unit schedule, design conditions, outside, lab, cutting room, tech. support.
5-2-86	FAC-BU-4707	M3	RM 120B Tape Wrapping Facility (4707)	Modification for Composite Tape	Rm. 120B Third Level Plan	Modify duct work and install charcoal filter. Replace AHU motor (10 HP/1800 RPM).
5-2-86	FAC-BU-4707	M4	RM 120B Tape Wrapping Facility (4707)	Modification for Composite Tape	Rm. 120B System Flow Schematic and Piping Diagram	HVAC schematic and specs.
2-21-90	FAC-BU-4707	M5	RM 120B Tape Wrapping Facility (4707)	Modification for Composite Tape	Platform Details platform for filter	Revision 1 added to package 2-90
1987	FAC-CH-4707	M1	RM 121 Tape Laying Pultrusion	Modification for Productivity Enhancement Laboratory, Building 4707	Rm. 121 Legend	Legend (Mechanical and Control)

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
1987	FAC-CH-4707	M2	RM 121 Tape Laying Pultrusion	Modification for Productivity Enhancement Laboratory, Building 4707	Rm. 121 Partial First Floor Plan HVAC	Duct work and gives assumed heat generation rates for pultrusion machine and tape laying machine.
1987	FAC-CH-4707	M3	RM 121 Tape Laying Pultrusion	Modification for Productivity Enhancement Laboratory, Building 4707	Rm. 121 Mezzanine and Mechanical Plan	AHU-2 installation and duct work. HVAC
1987	FAC-CH-4707	M4	RM 121 Tape Laying Pultrusion	Modification for Productivity Enhancement Laboratory, Building 4707	Rm. 121 Schedules	AHU specs, dehumidifier specs.
1987	FAC-CH-4707	M5	RM 121 Tape Laying Pultrusion	Modification for Productivity Enhancement Laboratory, Building 4707	Rm. 121 Details	Column details, steam heating coils.
1987	FAC-CH-4707	M6	RM 121 Tape Laying Pultrusion	Modification for Productivity Enhancement Laboratory, Building 4707	Rm. 121 Flow Schematic and Details	Chiller specs and AHU-1 (18445 CFM).
1987	FAC-CH-4707	M7	RM 121 Tape Laying Pultrusion	Modification for Productivity Enhancement Laboratory, Building 4707	Rm. 121 Mezzanine and Mechanical Plan-Temperature Controls Systems	AHU-1 and AHU-2 control sequences and control schematics.
1987	FAC-CH-4707	M9	RM 121 Tape Laying Pultrusion	Modification for Productivity Enhancement Laboratory, Building 4707	Rm. 121 Partial First Floor Plumbing	Shows cabinets and equipment. and Piping
1987	FAC-CH-4707	M10	RM 121 Tape Laying Pultrusion	Modification for Productivity Enhancement Laboratory, Building 4707	Rm. 121 Detail, Legend, Mech. Room, Part Plan and Part Site Plan	Compressed air drop detail, mechanical room plan, AHU-1 installation, part site plan
3-10-88	FAC-CK-4707	NREF	RM 121 Tape Laying	Tape Wrapper CO2 Storage	Rm. 121 Tape Laying Liquid Installation	Install piping to tape wrapper machine.
4-5-88	FAC CV-4707	E1	RM 121 Tape Laying	Building 4707 Modification to Filament Winding Utility Room	Electrical Plans and Details	Not part of clean room. Additional mechanical, electrical architectual drawings for this mod M1, M2, A.
2-28-89	FAC CK-4705	M1	B120 B	Breathing Air Filters/Monitors	Control Diagram, MGA Station	Shows installation of new breathing air in Room B120 B

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
1-25-77	FAC-AI-4705	M1	RM 106 4705	Building 4705 Modification to Valve Clinic	Plans-Sections	Shows mods to 2900 CFM and 900 CFM exhaust hoods could be in 106A or B or 104).
1-25-77	FAC-AI-4705	M2	RM 106 4705	Building 4705 Modification to Valve Clinic	Section Detail	Damper control diagram.
9-19-60	SFC-53	AC-2	RM A106 4705	Add-on to Missile Assembly Bld. 4505 and 4506	Air Conditioning and Ventilation	1960 HVAC specs and ducting for 106 and 104
9-19-60	SFC-54	AC-3	RM A106 4705	Add-on to Missile Assembly Bld. 4505 and 4506	Air Conditioning and Ventilation Details	1960 HVAC specs and ducting for 106 and 104
5-6-63	FE-D-4705	M1	RM A106 4705	Bldg. No. 4705 Valve Clinic Modifications	Mechanical Removal Plan	Removal of old duct work.
5-6-63	FE-D-4705	M2.1	RM A106	Bldg. No. 4705 Valve Clinic Modifications	Flow Diagram and Schedules	HVAC specs, exhaust CFM schematics.
5-6-63	FE-D-4705	M3.1	RM A106 & A104	Bldg. No. 4705 Valve Clinic Modifications	Equipment Layout and Schedule	Tables, fume hoods, etc.
5-6-63	FE-D-4705	M4.1	RM A106 & A104	Bldg. No. 4705 Valve Clinic Modifications	AC Equipment Room Plans Sections and Details	Cooling tower and HVAC installation.
5-6-63	FE-D-4705	M5.1	RM 106 & 104	Bldg. No. 4705 Valve Clinic Modifications	Mechanical Duct Layout and Miscellaneous Details	Design flow rates, clean bench hookup.
5-6-63	FE-D-4705	M6.1	RM 106 & 104	Bldg. No. 4705 Valve Clinic Modifications	Mechanical-Return Air and Exhaust Air Plans and Details	Return duct plan, design static pressure, note on drawing says system modified twice since this drawing.
5-6-63	FE-D-4705	M7.1	RM 106 & 104	Bldg. No. 4705 Valve Clinic Modifications	Plans Sections and Details	Duct sections and floor plan.
5-6-63	FE-D-4705	M8	RM 106 & 104	Bldg. No. 4705 Valve Clinic Modifications	Air, Shower, Plans and Sections	Air shower plans and sections.

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
3-31-89	FAC-CM-4705	M1	RM B120B & B122	Modifications to Room B-120	Removal Plan-HVAC Plan - Notes	Installation of new HVAC supply diffuser schedule. Diffuser specs.
3-31-89	FAC-CM-4705	M2	B120B	Modifications to Room B-120	Sections Partial Plan	Degreaser exhaust hood specs.
3-31-89	FAC-CM-4705	M3	B120B	Modifications to Room B-120	Piping Plans, Controls, and Schedules	Humidity and temp. control sequence.
6-20-80 - 2-22-84	FAC-AS-4705	X1	All 4705	Rehabilitation and Modification Building 4705	Location Map and Index of Drawings	Site Location a Master Plan
6-20-80 - 2-22-84	FAC-AS-4705	A2	All AXXX 4705	Rehabilitation and Modification Building 4705	Part Plan, 1st Floor, Col. #11-21 - Architectural	Shows floor plan for rooms on 4705 east side. Room 104 has since been divided.
6-20-80 - 2-22-84	FAC-AS-4705	A3	None	Rehabilitation and Modification Building 4705	Part Plans, 1st Floor, Col. #21-24	No clean rooms on drawing.
6-20-80 - 2-22-84	FAC-AS-4705	A4	None	Rehabilitation and Modification Building 4705	Part Plans, 2nd Floor, Col. #11-14	No clean rooms on drawing.
6-20-80 - 2-22-84	FAC-AS-4705	A5	None	Rehabilitation and Modification Building 4705	Part Plans, 2nd Floor, Col. #14-24	No clean rooms on drawing.
6-20-80 - 2-22-84	FAC-AS-4705	M1	All A*** 4705	Rehabilitation and Modification Building 4705	Part Plan, 1st Floor, Col. #1-11 - Mechanical	Scope of mechanical work. Remove some AHU's and install new ones. Install new A/C3 & A/C9, A/C4 and A/C8. Most of this work appears to be south of clean rooms.
6-20-80 - 2-22-84	FAC-AS-4705	M2	All A*** 4705	Rehabilitation and Modification Building 4705	Part Plan, 1st Floor, Col. #11-21 - Mechanical	Air handling units and ductwork for east side clean rooms.
6-20-80 - 22-84	FAC-AS-4705	M3	None	Rehabilitation and Modification Building 4705	Part Plan, 1st Floor, Mechanical	Air handling units A/C8 and A/C4 not in 2-clean room area.

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
6-20-80 22-84	FAC-AS-4705	M3 Revised	B120, B121, B122, B119, B124	Rehabilitation and Modification Building 4705	Part Plan, 1st Floor, Col. #21-24	T-stat and damper locations. Ducting and some AHU info.
6-20-80 22-84	FAC-AS-4705	M4	None	Rehabilitation and Modification Building 4705	Part Plan, 2nd Floor, Col. #11-14	A/C6, A/C5, duct work and design flows for upstairs above southeast clean rooms.
6-20-80 22-84	FAC-AS-4705	M5	None	Rehabilitation and Modification Building 4705	Part Plan, 2nd Floor, Col. #14-24	A/C7, A/C16, A/C15, A/C14, A/C12, A/C11 and A/C4. Duct work and design flows for upstairs above northeast clean rooms.
6-20-80 22-84	FAC-AS-4705	M6	None	Rehabilitation and Modification Building 4705	Floor Plan, Col. #1-16	Steam heaters and heater schedule south end of building. Floor plan.
6-20-80 22-84	FAC-AS-4705	M7	None	Rehabilitation and Modification Building 4705	Floor Plan, Col. #16-113	Floor plan North.
6-20-80 22-84	FAC-AS-4705	M8	All 4705	Rehabilitation and Modification Building 4705	Schedules	Central station A/C units-specs. A/C1-A/C9. Electrical equipment and control. Registers, grills and diffusers. Condensate receiver and pump.
6-20-80 22-84	FAC-AS-4705	M9	General	Rehabilitation and Modification Building 4705	Details	Central station A/C unit conn. Hot water coil detail. Other details.
6-20-80 22-84	FAC-AS-4705	M9 Revised/84	General	Rehabilitation and Modification Building 4705	Details	Duct work and other details.
6-20-80	FAC-AS-4705	M10	General	Rehabilitation and Modification Building 4705	Details	Details of register/grill connection in exposed duct. Detail of damper operation, ceiling diffusers in lateral take off, other details

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
6-20-80	FAC-AS-4705	M10 Revised/84	General	Rehabilitation and Modification Building 4705	Details	Detail of Register/grill connection in exposed duct. Detail of damper operation ceiling diffusers in lateral take off, other details.
6-20-80	FAC-AS-4705	M11	General	Rehabilitation and Modification Building 4705	Controls, Details and Schedules	Chilled water valves, steam valves, H.W. valves sequence of control. Air handling units schedule #8.
6-20-80	FAC-AS-4705	M11 Revised/84	General	Rehabilitation and Modification Building 4705	Controls, Details and Schedules	A/C control diagram (typical A/C2-A/C8). Sequence of control.
6-20-80	FAC-AS-4705	E1	None	Rehabilitation and Modification Building 4705	Part Plan. 1st Floor	Floor plan electrical south east.
6-20-80	FAC-AS-4705	E2	All 4705	Rehabilitation and Modification Building 4705	Part Plan. 1st Floor, Col. 11-21	Floor plan electrical.
6-20-80	FAC-AS-4705	E5	None	Rehabilitation and Modification Building 4705	Floor Plan, Col. #11-16	Electrical
6-20-80	FAC AS-4705	E6	All 4705	Rehabilitation and Modification Building 4705	Floor Plan, Col. #16-113	Electrical
6-26-85	FAC-BR-4705	A1	None	Rehabilitation Modification Shop Building 4705	Overall Floor Plan	Total building first floor plan.
6-26-85	FAC-BR-4705	A2	4705 East Rooms	Rehabilitation Modification Shop Building 4705	Demolition Plans and Notes	Move utilities. Move some electrical outlets.
6-26-85	FAC-BR-4705	A3	None	Rehabilitation Modification Shop Building 4705	Floor Plan and Notes	Shows 1st floor south of clean rooms.

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
6-26-85	FAC-BR-4705	A4	4705 East Rooms	Rehabilitation Modification Shop Building 4705	Floor Plans and Toilet Elevations	Shows mod to subdivide room 104, new electrical Rm. A107.
6-26-85	FAC-BR-4705	A5	4705 East Rooms	Rehabilitation Modification Shop Building 4705	Finish Schedule and Millwork	Floor, base, walls, ceiling materials and finish.
6-26-85	FAC-BR-4705	A11	4705 East Rooms	Rehabilitation Modification Shop Building 4705	Ceiling Plan and Details	Base detail and trim detail.
6-26-85	FAC-BR-4705	M1	4705 B120 B	Rehabilitation Modification Shop Building 4705	Potting Shop HVAC	HVAC, control sequence and supply fan for B120 B, fume hoods and air flow bench.
6-26-85	FAC-BR-4705	M2	None	Rehabilitation Modification Shop Building 4705	Rest Room - Plumbing and HVAC	2nd floor HVAC.
6-26-85	FAC-BR-4705	M3	East Side Office	Rehabilitation Modification Shop	New Office Areas	Existing AC unit elevation section. A/C unit #6.
6-26-85	FAC-BR-4705	M4	4705 East Rooms	Rehabilitation Modification Shop	Duct Work Demolition Plan	*Shows all ducts for clean rooms A104, A104 A, A106, A106 A, A107.
6-26-85	FAC-BR-4705	M5	4705 East Rooms	Rehabilitation Modification Shop	Clean Room-Supply Air Duct	*Supply air duct work for clean rooms A104, A104 A, A106, A106 A, A107, fan schedule, A/H1 location, diffuser schedule, electric ducts, heaters, schedule.
6-26-85	FAC-BR-4705	M6	4705 East Rooms	Rehabilitation Modification Shop	Clean Room Return and Exhaust Duct Plan	Return air, fans, ducts, static pressure regulator, flow rates.
4-28-89	FAC-CM 4705	A1	4705 B120, B120 B	Building 4705 Modifications to RM B120	Architectural Floor Plan, Schedules, Notes	Current and proposed floor plan for electrical shop, RM B120.
4-28-89	FAC CM 4705	A2	4705 B120, B120 B	Building 4705 Modifications to RM B120	*Reflected Ceiling Plan, Notes & Details	Filter support details, duct plan.

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
4-28-89	FAC-CM-4705	M1	4705 B120, B120 B	Building 4705 Modifications to RM B120	Removal Plan, HVAC Plan-Notes	Duct work and diffuser schedule, RM B120 and B120 B.
4-28-89	FAC-CM-4705	M2	4705 B120, B120 B	Building 4705 Modifications to RM B120	Modifications to RM B120	HVAC sections and proposed fume hood details.
4-28-89	FAC-CM-4705	M3	4705 B120, B120 B	Building 4705 Modifications to RM B120	Piping Plan-Controls Schedules	Controls legend and schedules, HVAC specs.
4-28-89	FAC-CM-4705	E1	4705 B120, B120 B	Building 4705 Modifications to RM B120	New Lighting Plan	Lighting plan and electrical notes.
4-28-89	FAC-CM-4705	E2	4705 B120, B120 B	Building 4705 Modifications to RM B120	New Power Plan	Electrical Outlets.
4-20-87	FAC-BW-4705	M1	4705, B119, B24, B122	Building 4705 Install Condisate Return Units	Condisate Return Piping, Air Supply, Sections	Floor plan and major equipment plot plans. Room: B119.
5-31-88	FAC-CD-4705	A1	4705 B122	Modify RM 124 for Ladies Use	Partial 1st Floor Plan (West Side)	Changing Room.
8-31-88	FAC-CF-4705	M1	4705 B122, B119	Building 4705, HEPA Filter, Cleaning Facility	Framing Plan, Section	Install new HEPA filter for B119.
2-7-85	FAC-BS-4705	M1	4705 West Side	Mods. to DI Water System	Plans, Sections-Piping Diagram	DI water for B119, Not in clean room.
2-7-85	FAC-BS-4705	E1	4705 West Side	Mods. to DI Water System	Plan and Diagram	Control diagram.
11-27-87	FAC-BZ-4705	L1	4705 A104 B	Building 4705 Duct Heater Replacement RM A104 B	Electrical/Mechanical Plan	Install new electrical duct heater in RM A104 B duct work.
3-17-77	FAC-AI-4705	M1	4705, A106, A104	Modifications to Valve Clinic	Plans, Sections	Vapor blast and fume hood details.
3-17-77	FAC-AI-4705	M2	4705, A106, A104	Modifications to Valve Clinic	Sections, Details	Fume hoods and heating unit
5-2-83	FAC-BI-4705	A1	4705 Booth S	Building 4705, 100K Clean Room	Details, Plans and Cranes	Full plans for both 4705 portable booths.
5-2-83	FAC-BI-4705	A2	4705 Booth S	Double Air Lock Building 4705	Air Lock	Detail for Portable Air Lock

SUMMARY OF ENGINEERING DRAWINGS FOR BUILDINGS 4705, 4707, 4711, 4760 CLEAN ROOM FACILITIES

DATE	DRAWING #	REF #	CLEAN ROOM(S)	NAME	TITLE	NOTE
5-2-83	FAC-BE-4705	AC1	4705 Booth S	Honey Comb Env. Control Room	Ducting	Duct work details for 4705 booths.
5-2-83	FAC-BE-4705					
5-2-83	FAC-BE-4705	NFF	4705 Booth S	Honey Comb Lay Up Rooms AC & Curtain Location	Ducting	Duct work details for 4705 booths.