

Method and Apparatus for Providing a Purified Resource

5

Field of Invention

The present invention relates to manufacturing
10 facilities and more specifically to the control of the purity
of resources in manufacturing facilities.

Background of the Invention

Many manufacturing facilities which use multistep
processing of materials to produce products have a similar
15 resource at two or more steps. Some resources are used as a
part of the manufacturing process, while other resources,
such as air, may be present and can affect the process, but
are not intended to be used by the process. In the case of
air, it may be used by one process step, but merely present
20 at another. Whether the resource is used or not, it is often
desirable to control impurities which can otherwise
contaminate the results of the manufacturing process.

For example, the manufacture of semiconductors from
silicon wafers is a multistep process that is sensitive to
25 impurities in the ambient air. At some steps in the process,
the ambient air is relied upon to oxidize the silicon. At
other steps in the process, ambient air is not used. At
still other steps in the process, the existence of any
ambient air actually disrupts the process step. In these
30 latter types of steps, the process is performed in a vacuum,
the achievement of which is an expensive, time consuming step
as wafers are loaded by an operator who cannot work in a
vacuum into equipment which must create a vacuum to operate.

In semiconductor fabricating facilities, or "fabs,"
35 particulate matter is a concern, because it interferes with
the photolithographic, implant, etch or other processes that

are used to form extremely tiny patterns on the wafers which are used to create the circuitry on the semiconductor. Because the patterns formed onto the silicon are so tiny, such processes requires extreme precision, and dust or pollen could dramatically alter the patterns created, causing the failure of the resulting semiconductor product. As operators of the equipment enter the fab, they carry this particulate matter with them which they stir up in the air as they move about the fab.

10 To combat the particulate problems, the air in prior art fabs was controlled to eliminate particulate matter, a process for which fabs are often referred to as "cleanrooms." Referring now to Figure 1, a conventional fab is shown. The work area of the fab 100 has processing machines 120B, 120C, 15 122B, 122C, 124B, 124C, 126B, 126C on which or in which semiconductors are manufactured. Outside air 108 is cleaned of most particulate matter and pumped into the fab 100 by make up air handler unit 104 via inlet 132. One purpose a make up air handler unit 104 serves is to replace air that is 20 lost accidentally through leakage in the walls, floor and ceiling of the work area of the fab 100. Make up air handler unit also resupplies oxygen lost by the breathing of the operators in the work area of the fab 100 and by the operation of some of the processing equipment 120B, 120C, 25 122B, 122C, 124B, 124C, 126B, 126C in the work area of the fab 100. Make up air handler unit 104 also resupplies air lost purposely through outlet 136 to outside air 109. Air contaminated with particulate matter is allowed to escape to outside air 109 in order to replace it with cleaner air from 30 make up air handler unit 104, a process which serves to clean the air in the work area of the fab 100. Additionally, make up air handler unit 104 serves to pressurize the work area of the fab 100 in order to keep dust from entering the fab 100 from holes and cracks in the walls, floor and ceiling. Outlet

136 may contain a pressure controlled valve or fan to help ensure this pressurizing process is controlled.

To further clean the air in the work area of the fab 100, recirculation air handling unit 102 recirculates and
5 filters particles in the air in the work area of the fab 100 via inlet 130, outlet 134 and conduit or duct 110.

The purity of the air is a function of the volume of air in the fab 100, the purity of and volume of the air from make up air handler unit 104, the effectiveness of, purification
10 ability of, and volume of the air through, the recirculation air handling unit 102 and the generation of contamination from processing equipment 120B, 120C, 122B, 122C, 124B, 124C, 126B, 126C and other contamination, such as that brought in by the operators. If all of these factors are held to a
15 constant rate, the level of contaminants in the air resource will reach an equilibrium level. Reduction of contamination may be made by varying any of the factors.

Another form of impurity can affect the operation of the circuitry in a semiconductor. Molecular impurities,
20 particularly some organic molecules, metal ions, salts and heavy metals can affect the circuitry by interfering with the behavior of the various layers of the semiconductor device, which affect the characteristics of the semiconductor device. As device sizes in a semiconductors are reduced, the
25 disruption of the semiconductor by a stray molecule plays an increasing role in the failure rate of the semiconductors produced in the fab 100.

For example, processing equipment 120B, 122B, 124B, 126B may include equipment used to increase the oxidation layer of
30 the silicon used to manufacture semiconductors. Silicon exposed to air forms a layer of oxidation on its outer surface which can protect the silicon against molecular impurities. Naturally, this layer does not have adequate thickness to protect the silicon against the environmentally
35 available molecular impurities to which the semiconductor may

be exposed. However, the oxidized silicon may be driven deeper into the silicon by heating it. When the new layer of oxidation forms on the outer surface, the result is a thickened layer of oxidation that is adequate to protect the semiconductor against molecular impurities. Unfortunately, any molecular contamination on the surface of the silicon will also be driven into the silicon during this heating process.

Thus, the steps performed by processing equipment 120B, 122B, 124B, 126B are among the most sensitive to chemical impurities, yet produce very low levels of molecular contamination, mostly from contaminants introduced by other processing steps or other sources.

The molecular impurities may be introduced in the fab from the operators entering the fab and from the outside air introduced into the fab. In addition, the gases and chemicals used within some of the processing equipment 120C, 122C, 124C, 126C used in the fab itself to process the semiconductors, piping systems used to deliver these gases and chemicals, maintenance activities or accidents can also introduce a source of impurities in the ambient air in the fab. This equipment 120C, 122C, 124C, 126C may include vapor deposition equipment, ion implantation equipment, etch and other equipment which are used to deposit materials on , dope, clean or etch, the semiconductor wafer. Because these types of equipment 120C, 122C, 124C, 126C serve as a source of stray molecules to which other processing equipment 120B, 122B, 124B, 126B is most sensitive, the two types of processing equipment 120B, 122B, 124B, 126B, and 120C, 122C, 124C, 126C are incompatible.

While the recirculation air handling unit 102 and make up air handler unit 104 equipment were improved to help remove molecular impurities from the outside air 108 and from recirculated air from the work area of the fab 100, the processing equipment 120C, 122C, 124C, 126C which served as

an internal source of impurities remained a significant source.

The impact of this problem has been reduced in conventional chip fabricating facilities by separating the incompatible equipment in a "bay" and a "chase". The bay is a separate area of the fab that is used for processing steps that are most sensitive to impurities in a resources, while the chase is used for processing steps that are least sensitive to impurities in the resource. Referring now to Figures 1 and 2, the bay 100B contains processing equipment 120B, 122B, 124B, 126B and the chase 100C contains processing equipment 120C, 122C, 124C, 126C.

To maintain the purity of the air in each area 100B, 100C, each has its own make up air handler unit 104B, 104C supplying outside air 108. The particulate and molecular contamination in the outside air is filtered by make up air handler units 104B, 104C before pumping into bay 100B via inlet 132B and into chase 100C via inlet 132C. Recirculation air handling unit 102B, 102C recirculates and may filter particulate contamination only or particulate and molecular contamination via inlets 130B, 130C, outlets 134B, 134C and conduits 110B, 110C, which operate as inlet 130, outlet 134 and conduit 110 described above with reference to Figure 1. Because the air supply and recirculation air handling unit system in the bay 100B and chase 100C operate independently, the significant source of molecular impurities from processing equipment 120C, 122C, 124C, 126C in the chase 100C does not contaminate the air resource supplied to processing steps performed in the bay 100B.

Outlets 136B, 136C to outside air 109 may contain valves or fans as described above with reference to Figure 1, and may contain additional filtration equipment to lower the contamination of the outside air 109. Although the outlets 136, 136B, 136C to outside air 109 may be located at an area distant from inlets 132, 132B, 132C to outside air 108, cross

contamination may occur making such additional filtration desirable.

The two systems, one for the bay 100B and one for the chase 100C allow the bay 100B and the chase 100C to each attain an equilibrium level of particulate and molecular contaminants, similar to that described above with reference to Figure 1 for particulate contaminants. Because the bay 100B and the chase 100C operate as independent systems, the equilibrium levels are independent of each other, except for cross contamination of outside air.

In some types of semiconductor processing equipment 120B, 120C both are part of the same machine, and processing equipment 120B is incompatible with processing equipment 120C as described above. In such case, the bay 100B and the chase 100C may be adjacent to one another, the machine 120B and 120C is mounted into the wall separating the bay 100 and the chase 100C with the portion 120B of the machine most sensitive to contamination, such as a load port, located in, or having an door opening to, the bay 100B and the less sensitive portion 120C of the machine is located in the chase 100C.

Reducing molecular and particulate contamination is an expensive process. Nevertheless, as device sizes in semiconductors are reduced, impurities in the air in the bay 100B must be further reduced to maintain the yields of chips undamaged by contamination. It is desirable to minimize the contamination of the air in the bay for a given cost of purification of the air resource.

Summary of Invention

Purified air is fed into the bay, and at least a portion of the exhaust from the bay is fed into the chase. This allows the expense of the purification equipment to be focused on the bay, where the sensitivity to impurities is greatest. For example, the make up air handler unit air unit that would otherwise be used to purify and feed air into the

chase may instead be totally used to feed air into the bay, dramatically reducing the equilibrium level of contamination in the bay without the use of additional equipment. Although the chase receives air that is more contaminated than prior art methods, the relatively clean exhaust of the bay only marginally raises the level of contamination from that produced by the manufacturing processes in the chase. Additionally, because of the reduced susceptibility to contamination of the processes in the chase, the benefits of cleaner air in the bay outweigh the detriment of dirtier air in the chase.

Brief Description of the Drawings

Figure 1 is a block diagram of conventional air processing equipment in a conventional fab.

Figure 2 is a a block diagram of conventional air processing equipment in a fab employing a bay and a chase with a separated air flow for contamination control.

Figure 3 is a block diagram of air processing equipment in a fab employing a bay and a chase according to one embodiment of the present invention.

Figure 4 is a block diagram of air processing equipment in a fab employing a bay and a chase according to an alternate embodiment of the present invention.

Figure 5 is a block diagram of air processing equipment in a fab employing a bay and a chase according to an alternate embodiment of the present invention.

Figure 6 is a block diagram of air processing equipment in a fab employing a bay and a chase according to an alternate embodiment of the present invention.

Figure 7 is a block diagram of air processing equipment in a fab employing a bay and a chase according to an alternate embodiment of the present invention. Figure 8 is a flowchart illustrating a method of providing an air resource to a bay and a chase according to one embodiment of the present invention.

Detailed Description of a Preferred Embodiment

Manufacturing facilities use or have "resources" which are any material in solid, liquid or gas forms which are used in, or are incidental to, manufacturing of any material, and in which it is desirable to reduce contaminants to at least a threshold level. Resources which are incidental to a manufacturing facility may include resources which are ambient to the manufacturing process without being consumed by the manufacturing process, such as air in many manufacturing facilities, or water for cleansing a finished product. Whether the resource is used in the manufacturing process or is ambient to the process, as used herein a resource has the ability to affect a product manufactured by the process.

A resource may be a gas, liquid or solid form of any pure element in the periodic table of elements, a compound formed from such elements, or a mixture of one or more pure elements or compounds. Water is an example of a compound of hydrogen and oxygen in liquid form, while air is an example of a mixture of compounds such as water and carbon dioxide as well as pure elements such as oxygen, hydrogen and nitrogen.

One type of resource used in and ambient to a semiconductor fab is air. In a semiconductor manufacturing facility, air is a resource that is required by two areas of the fab, a bay and a chase. A "bay" is an area of a manufacturing facility in which processing occurs of materials or in steps having a greater susceptibility to contaminants in a resource than that of a different area of a manufacturing facility called a "chase" which is primarily closed off from the bay. For example, in a semiconductor fab, the bay 100B and chase 100C are separate rooms walled off from one another, with a doorway in between them. There may be equipment to prevent the air in the chase 100C from entering the bay 100B, such as pressurizing equipment in the bay 100B that maintains a higher pressure than that of the chase 100C. The bay 100B and the chase 100C need not be

separate rooms, as they may also be different areas of a piece of processing equipment that have the differing requirements of purity.

Referring now to Figure 3, an apparatus which provides
5 air to a bay **100B** and a chase **100C** according to one embodiment of the present invention is shown. A bay **100B** and a chase **100C** are provided with semiconductor processing equipment **120B**, **122B**, **124B**, **126B** in the bay **100B** and semiconductor processing equipment **120C**, **122C**, **124C**, **126C** in
10 the chase **100C**. Recirculation air handling unit **102B** performs the recirculation function in the bay **100B**, and recirculation air handling unit **102C** performs the recirculation function in the chase **100C** described above with reference to Figure 2. In one embodiment, recirculation air
15 handling units **102B** and **102C** are conventional cleanroom recirculation air handling units commercially available from Pace Company of Portland Oregon, or Accoustiflo, LLC of Boulder, Colorado and having the specifications set forth in Exhibit A, although the present invention can operate with
20 any recirculation air handling unit or with no recirculation air handling unit. The recirculation air handling unit may include particle filtration, chemical filtration or no filtration.

In one embodiment, make up air handling unit **104B** serves
25 to provide purified make up air from outside air **108** as described above with reference to make up air handling unit **104** of Figure 1. In one embodiment, make up air handling units **104B** and **104C** described below are conventional make up air handling units commercially available from Pace Company
30 of Portland Oregon or York International Corporation of York, Pennsylvania and having the specifications set forth in Exhibit B, although the present invention can operate with any source which supplies a relatively contaminant free resource. In one embodiment, the make up air handling unit
35 purifies the resource of most contaminants where the resource

is not supplied pure or nearly pure. In one embodiment, the purification of the air resource is provided by conventional HEPA air filter equipment 99.9995 percent efficient at 0.12 micron to 0.2 micron size contaminants. In other

5 embodiments, filtration is provided by conventional water wash equipment, conventional chemical filtration equipment such as carbon filtration equipment, conventional moisture condensation filter equipment. Such filtration equipment may be considered herein as part of the make up air handling

10 units **104B**, **104C** and is commercially available from the air handling unit **104B**, **104C** suppliers described above.

Passage **112**, which may be a duct, an opening, a damper, a fan or other similar device, connects the bay **100B** and the chase **100C** to provide the impure air from the bay **100B** to the

15 chase **100C**. In one embodiment, make up air handling unit **104C** is not in its position shown in Figure 2 feeding purified air into the chase **100C**, but instead positioned to provide increased flow of purified air into the bay **100B**. Although the make up air handling unit **104C** is shown in

20 Figure 3, the present invention would operate with only a single make up air handling unit **104B**. The Figure uses make up air handling unit **104C**, which supplied purified outside air to the chase **100C** in Figure 2 to illustrate that greater air handling capacity may be focused on the bay **100B** without

25 the need for more air handling equipment than is used in both the bay **100B** and chase **100C** of prior art systems. In one embodiment, outlet **136B** is not used to allow air to escape to the outside as described above with reference to Figure 2, so that the exhaust from the bay **100B** may instead fully flow

30 into the chase **100C**.

Referring now to Figure 4, an apparatus which provides clean air to a bay and a chase according to one embodiment of the present invention is shown. The outlet **136B** of Figure 2 which allows some of the air in the bay **100B** to be exhausted

35 to the outside is used in addition to the outlet **138B** to the

inlet 132C of the chase 100C so that some of the air in the bay 100B is passed to the air outside 109 and the remainder is passed to the chase 100C via conduit 112. In one embodiment, outlet 136B is located in the portion of the bay 5 100B with the highest detected level of contaminants as measured by a conventional ion chromatography or inductively coupled plasma - mass spectrometry techniques or other similar techniques, and outlets 134B, 138B are located in areas with lower measured contamination as measured by the 10 same techniques. The level of contamination of the air flowing to the chase 100C via duct 112 may be thus further reduced by the location of the outlet 138B.

Referring now to Figure 5, an apparatus which provides clean air to a bay and a chase according to one embodiment of 15 the present invention is shown. The apparatus shown in Figure 5 operates similarly to that of Figure 4, with the addition of a moveable tube 137B having inlet 139B to allow the source of air to conduit 112 to be repositioned more easily as contaminant levels change, for example through the 20 replacement or shut down of equipment 120B, 122B, 124B, 126B.

Referring now to Figure 6, an apparatus which provides clean air to a bay and a chase according to one embodiment of the present invention is shown. The apparatus of Figure 6 operates similarly to that of Figure 4, with the addition of 25 conventional IBM-compatible 586 personal computer 146 coupled to contamination sensors 141B, 143B, 145B and conventional motorized air duct shutoff valves 140B, 142B, 144B mounted on duct or conduit 147B (connections to the computer 146 are not shown to avoid cluttering the Figure). In one embodiment, 30 conventional contamination sensors 141B, 143B, 145B commercially available as model CM4 Continuous Gas Monitor from Zellweger Analytics of Lincolnshire, Illinois detect the presence of hydrochloric acid contaminants and are used along with conventional motorized air duct valves, commercially 35 available from Pace Company of Portland Oregon, or York

International Corporation of York, Pennsylvania. Software in computer 146 monitors the signals sensors 141B, 143B, 145B which indicate the level of contaminants detected by sensors 141B, 143B, 145B and sends a signal to open motorized air duct valve or valves 140B, 142B, 144B corresponding to the one or more sensors 141B, 143B, 145B that are detecting the lowest levels of contaminants in the air in the bay 100B to feed duct 112 with air from the bay, with the other valves 140B, 142B, 144B being closed, or receiving signals from computer to close.

In the event that the air supplied via duct 112 cannot supply an adequately pure resource, it may be further filtered. Referring now to Figure 7, one embodiment of an apparatus which supplies clean air to a bay and a chase is shown. The apparatus is the same as that of Figure 4, with the addition of recirculation air handler unit 106C, similar to recirculation air handler unit 102C, coupled between duct 112 and inlet 132C to further remove contaminants from the air supplied via duct 112. Such an embodiment may be useful to slightly reduce contaminants where the amount supplied via duct 112 are unacceptably high. Also, where the air supplied from duct 112 is free of some types of contaminant but not others, recirculation air handler unit 106C can provide further filtration of only the contaminants at an unacceptably high level, without having to filter the remainder of the contaminants that are already filtered by make up air handler units 104B and 104C as well as recirculation air handler unit 102B.

Referring now to Figure 8, one embodiment of a method of providing substantially pure air to a bay and a chase is shown. The resource may be optionally purified of substantially all of its contaminants 710 in the event that it is not supplied clean using conventional water wash, chemical filtration such as using a carbon filter, moisture condensation or HEPA air filtration techniques 99.9995

percent efficient at 0.12 micron to 0.2 micron size contaminants. Purification or cleansing of substantially all of the contaminants means cleansing to an acceptably low level of contaminants. What is an acceptably low level of contaminants will vary depending on the manufacturing process used, but should provide a failure rate not higher than the one desired. In the fabrication of semiconductors, a supply of air having particulate matter of no more than 3.5 particles per cubic meter greater than 0.1 micron and chemical composition of no more than 1 microgram of ionic contaminants per cubic meter, 0.1 microgram of sodium contaminants per cubic meter, 10 parts per billion of hydrocarbon content and 100 micrograms of volatile organic compounds per cubic meter is presently considered having an acceptably low level of contamination. A resource with such acceptably low level of contamination is considered "clean." The resource such as air is received at the bay 720 and impurities are imparted or allowed to be imparted to the resource in the bay 730. Optionally, a source resource with low contamination is identified in the bay 740. A source of resource with low contamination is an area of the bay in which the contaminant levels measured using the contaminant measurement techniques described above result in a measurement of one or more contaminants that are lower than the average level in the bay. The impurified resource is collected 750 either from the source identified in step 740 or elsewhere in the bay, and delivered to a chase 760. Additional impurities are imparted at the chase 770, and at least a portion of the additionally impurified resource may be exhausted from the chase. Optionally, the resource may be cleaned by the removal of some or all contaminants at some or all of steps 735, 755, or 765 using conventional water wash, chemical filtration such as using a carbon filter, moisture condensation or HEPA air filtration techniques.

Exhibit A

Recirculation Air Handling Unit Specifications

Equipment name	Recirculation air-handling unit
Tag	RAH-2-1
Location Fan deck	
Prefilter	
Type	30 percent, disposable
Face velocity, maximum	500 fpm
Clean pressure drop	0.25 inch WC
Dirty pressure drop	0.5 inch WC
VOC filter (option)	
Type	Activated carbon disposable
Face velocity, maximum	500 fpm
Clean pressure drop	0.5 inch WC
Materials of construction	
Casing 16-gauge steel	
Acoustic Liner	Multidensity fiberglass, totally scrim reinforced, Mylar encapsulated
Coil	Aluminum fin, copper tube
Drain Pan	Stainless steel
Finish Baked-on power-coat polyester	
Fan	Aluminum
Frame Structural steel	
Dampers	16-gauge galvanized steel
Cooling coil	
Type	2-row
Fins 0.008-inch aluminum 12 fins per inch max	
Tubes 0.02 minimum wall copper	
Face velocity, maximum	500 fpm

Entering air temperature	72°F
Leaving air temperature	67°F
Air pressure drop	0.13 inch WG
Entering water temperature	60°F
Leaving water temperature	65°F
Water pressure drop max	10 feet head
Fluid Water Leak test	200 psi air
Fan	
Type	Centrifugal plug or Vain Axial
Total static pressure	2.25 inches WC
External static pressure (clean filters)	1.25 inches WC
Pressure class	AMCA Class I
Motor	
Type	TEAO high-efficiency extended shaft
Air volume modulation	AFD
Cabinet	
Inlet location	Rear (bottom)
Inlet size	(See drawing RAHU)
Makeup air location	(Top) (Side) (Rear)
Outlet location	Bottom
Outlet size	Sized for 1,000 fpm velocity
Dampers	
Smoke damper	Low leakage downstream of coil same size as coil
Makeup air damper	Opposed blade with locking quadrant sized for 10 percent makeup

Support (Base mount)

(Suspended)

Access door location

Size (TBD), fan (return plenum)
wrap around (view windows),
(bulb seals)

Note: All recirculation units should not have anything protruding from maximum cabinet dimensions, with the exception of the AFDs and disconnect switch.

Exhibit B

Make Up Air Handling Unit Specifications

Equipment name	Fab makeup air handler
Tag number	MAH-1-1 through MAH-1-4
Reference drawing	MAH
Location	Makeup air fan deck
Piping connection	Right side
Materials of construction	
Casing	16-gauge steel
Acoustic liner	Multidensity fiberglass, totally scrim reinforced, Mylar encapsulated
Coil	Aluminum fin, copper tube
Drain pan	Stainless steel
Finish	Baked-on enamel
Fan	Aluminum
Frame	Structural Steel
Dampers	16-gauge galvanized (blade and jamb seals for isolation)
Prefilter	
Type	30 percent deep pleated 4-inch disposable cartridge
Face velocity, maximum	500 fpm
Pressure drop, maximum	
Clean	0.25
Dirty	0.5

Preheat coil

Type	2 row
Fins	0.008-inch aluminum 8 fpi
Tubes	0.02-inch wall copper
Face velocity, maximum	500 fpm
Entering air	
Temperature, db	0 to 20°F
Leaving air	
temperature, db	40° to 50°F
Air pressure drop,	
maximum	0.2 to 0.4 inch
Entering water	
temperature	100° to 180°F
Leaving water	
temperature	70° to 150°F
Water pressure drop,	
maximum	10 feet WC

VOC filter (alternative)

Type	Activated carbon disposable cartridge
Face velocity, maximum	500 fpm
Clean pressure drop	0.5 inch WC
Dirty pressure drop	0.51 inch WC

Main filter section

Type	12 inches, rigid
Face velocity, maximum	500 fpm
Pressure drop, maximum	
Clean	0.5
Dirty	1

Cooling coil section

Type	
Precool	8 row, 10 fpi
Cooling	6 row 8 fpi
Face velocity, maximum	500 fpm

Entering air temperature, db	100° to 90°F
Entering air temperature, wb	80° to 70°F
Leaving air temperature, db	55° to 49°F
Leaving air temperature, wb	54° to 48°F
Air pressure drop, maximum	2.3 inches
Entering water temperature	42°F
Water pressure drop, maximum	25 feet WC
Glycol coil section	
Type	12 row, 8 fpi
Face velocity, maximum	500 fpm
Entering air temperature, db	48° to 50°F
Entering air temperature, wb	47° to 49°F
Leaving air temperature, db	40°F
Leaving air temperature, wb	39.5°F
Air pressure drop, maximum	0.9 inch WC
Entering glycol temperature	32°F
Glycol pressure drop, maximum	20 feet WC
Percent glycol	15
Fan	
Type	Centrifugal plug
Total static pressure	8.5 inches WC

External static pressure (Clean filters) Pressure class Motor type	0.5 inch WC 6 inches WC AMCA Class II TEAO high-efficiency extended shaft
Air volume modulation	AFD
Vibration/Isolation	Internal springs 2-inch deflection with leveling bolts and snubbers
Humidifier type	Clean fog injection
Reheat coil section	
Type	2 row
Fins	0.008-inch aluminum 12 fins per inch maximum
Tubes	0.02 minimum wall copper
Face velocity, maximum	700 fpm
Entering air temperature	51°F
Leaving air temperature	56°F
Air pressure drop	0.2 inch WG
Entering water temperature	90°F
Leaving air temperature	85°F
Water pressure drop maximum	10 feet head
Fluid	Water
Leak test	200 psi air
Final filter section	
Type	HEPA 12 inches deep, high capacity
Face velocity, maximum	500 fpm
Pressure drop, maximum	
Clean	1.4

Dirty
Discharge plenum

Options

2

Minimum 6 feet long

Spare parts

- Fan wheel
- Motor
- Complete fan assembly
- AFD
- HEPA filters (one set)
- Prefilters (one set)

Alternatives:

- Mechanical modulation
- VOC carbon filters, 12 inch
- Incandescent service lighting
- Quick removal fan assembly and wiring for 15-minute replacement
- Cooling coil air pressure drop gauge and adjustable flag
- Evaporative type humidifier (DI water)
- Clean steam injection humidifier
- Standard preheat coil with circulation pump
- Vane axial fan with inlet and outlet cones
- Units not shipped with an AFD have combination magnetic starters with the following:
 - NEMA 12 enclosure.

- NEMA ABI circuit breakers with instantaneous magnetic trip in each pole. Provide safety disconnect with lockable off position.
- NEMA ICS 2 auxiliary contacts, one set N.O./NC.
- NEMA ICS 2 hand-off-auto switch.
- NEMA ICS 2 push-to-test indicating lights, red (run), green (stop).
- 120-volt control transformer 100 VA minimum.
- NEMA ICS 2 overload relays, melting alloy type, rated at motor nameplate rating.
- Spray water wash with impingment fins



What is claimed is:

1. An apparatus for providing a resource to a chase having an inlet for receiving a contaminated resource comprising:

a bay having:

5 an inlet coupled to receive a clean resource;
a contamination source for contaminating the resource; and

an outlet for exhausting at least a portion of the contaminated resource from the bay; and

10 a passage coupled between the outlet of the bay and the inlet of the chase to carry the resource contaminated in the bay to the chase.

2. The apparatus of claim 1 additionally comprising a resource source comprising:

an input coupled to receive the resource with an unacceptable level of contaminants;

5 a filter for filtering at least some of the contaminants from the resource; and

an output coupled to the bay inlet for providing a clean resource.

3. The apparatus of claim 2 wherein the resource is air.

4. The apparatus of claim 3 wherein the contamination source in the bay is at least one piece of manufacturing equipment.

5. The apparatus of claim 4 wherein the at least one of the pieces of manufacturing equipment is semiconductor manufacturing equipment.

6. A method for affecting the manufacture of at least one product using a resource, comprising:

receiving a clean resource;

affecting the manufacture of at least one of the
5 products with the resource received;
contaminating the clean resource;





providing at least a portion of the contaminated resource to a chase; and

10 affecting the manufacture of at least one of the products using the resource provided;

7. The method of claim 6 wherein the resource is contaminated in a bay.

8. The method of claim 7 comprising the additional step of further contaminating the resource in the chase substantially more than it was contaminated in the bay.

This Sheet Has Been Replaced

