Oregon Department of Environmental Quality
Northwest Region

OREGON TITLE V OPERATING PERMIT REVIEW REPORT

Intel Corporation - Aloha Campus
5200 NE Elam Young Parkway
Hillsboro, Oregon 97124-6497

PSEL CRED	SOURCE TEST	COMS	CEMS	AMB MON	COMPL SCHED	SPEC COND	REPORT A S Q M	EXCESS R N	NSPS	NSR	PSD	NESH APS	SIZE A1 A2
	X					X	X	X	X				X

This permit review report is formatted to accommodate the permit conditions and thus it is recommended to be reviewed simultaneously and in direct reference to the permit line items. This review report intends to convey all pertinent emission data, rules, policies, theories and engineering assumptions used to construct the Oregon Title-V Operating Permit 34-2681. The primary source of information used to construct this permit is the referenced application (No. 016312).

Oregon Title-V Operating Permit 34-2681 focuses on numerous permitting issues which include a source specific RACT determination, increase in the boiler PSELs, and the pre-approved changes and pollution prevention protocols. Applicable regulatory standards and associated monitoring, recordkeeping, reporting requirements, along with the applicable conditions from the existing Air Contaminant Discharge Permit (ACDP) are incorporated into the Oregon Title-V Operating Permit 34-2681 as outlined below:

The review report and permit have been revised and reissued to incorporate a significant modification, a Department reopening to correct typographical errors, and an administrative amendment.

This modification focuses on the following issues:

1. A change of VOC PSEL from 190 tpy to 160 tpy (condition 12);
2. Justification for deleting periodic monitoring and recordkeeping for insignificant activities (conditions 13, 22, and 27);
3. Revising language in the permit requiring Intel to implement the approved pollution prevention program (condition 16);
4. Revising the aggregate hazardous air pollutant (HAP) monitoring condition (24) so that monitoring will be conducted every month;
5. Providing explanation of how monthly non-VOC HAPs compliance will be conducted;
6. Change the name of the facility contact person; and
7. Updating of language in the permit (inserting new dates, additional information since the

issuance of the 10/5/95 permit, removing the word “proposed,” etc.), and making changes to the document for clarity sake.

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BACKGROUND INFORMATION

The Oregon Title-V Operating Permit, issued 10/5/95, replaced an existing Air Contaminant Discharge Permit (ACDP) which was issued on 4/19/93 and was scheduled to expire on 11/01/96. The Title V Permit as been revised to include several modifications. The revised permit applies to all existing and planned activities at the Intel Aloha Campus occupying 54.5 acres of properties located at 3585 Southwest 198th Avenue, Aloha, Oregon, 97007. Mr. Steve C. Cox, Fab 15 Plant Manager, is newly identified as the primary responsible official for the Aloha Campus operations. Audrey Holes (503) 591-3038), Environmental Engineer, is the facility contact for environmental matters.

Intel submitted a Land Use Compatibility Statement (LUCS) to Washington County Department of Land Use & Transportation (WCDLUT), and Washington County signed and approved the LUCS on 9/20/91. Other permits issued or required by the Department for this source include NPDES permit 100917 for non-process wastewater discharge. The process wastewater is discharged to one of the Unified Sewerage Agency's (USA) wastewater treatment plants of Washington County. This source is also a registered large quantity hazardous waste generator; ORD 060591963. The VOC emission calculations include monitoring of the hazardous waste streams.

On October 5, 1995, Oregon Title V Operating Permit No. 34-2681 was issued to Intel Corporation in Aloha, Oregon.

On May 12, 1997, the permittee submitted an application requesting modifications to: the VOC Plant Site Emission Limit in condition 12, the pollution prevention program condition 16, the hazardous air pollutant monitoring condition 24, and a change in the name of the facility contact person.

Condition 12 is being changed to reflect the Voluntary Plant Site Emission Limit Reduction Agreement. The VOC PSEL is reduced, in this revised permit, from 190 tpy to 160 tpy. See paragraph 12 of this review report.

On 9/13/96, Intel and DEQ came to an agreement whereby Intel voluntarily reduced plant wide VOC emissions by 30 tons per year. In exchange, DEQ commits to:

- Priority processing for any air quality permitting, and
- Priority access to the Portland Industrial Growth Allowance under the Portland Area Ozone Maintenance Plan.

On 10/16/97, DEQ put on public notice a DRAFT Addendum 1 to the permit to include the requested modifications, and Department initiated changes to Conditions 13, 22, and 27 as well as the VOC PSEL.

EPA provided the following written response to DEQ during the public comment period in a letter of 9/12/97.

	EPA Comment	DEQ Response
1	EPA stated that the proposed addendum was not the correct procedure for those changes described as "administrative amendments" and directed DEQ to use formal reopening procedures in OAR 340—28-2280.	DEQ followed recommended procedures and resubmitted changes in this revised permit format.
2	EPA states that the final permit modification must be issued in the form of a revised permit.	DEQ resubmitted changes in this revised permit.
3	Conditions 13, 22, 27 are proposed to be revised by deleting all of the periodic monitoring and record keeping for insignificant activities. While deletions of this kind are allowed, there was insufficient justification in the review report.	The review report has been expanded to include case-by-case findings to justify deleting monitoring and reporting requirements in Conditions 22 and 27. See paragraph 13. of the review report.
4	While most of the changes to Condition 16 are acceptable, this Condition now fails to require Intel to implement the approved pollution prevention plan.	The Department agrees and has added implementation requirements to Condition 16.
5	Condition 24.d.ii. proposed monitoring aggregate HAP emissions every 2 months. This is not acceptable, they must be monitored every month.	The Department has changed this condition to reflect monthly monitoring. See paragraph 24 below.
6	It is not clear how the monthly non-VOC HAPs compliance demonstration will be made.	See discussion of inorganic HAP monitoring in paragraph 24 below.

FACILITY DESCRIPTION

Intel Corporation operates one of its semiconductor manufacturing plants in Aloha, Oregon, herein occasionally referred to as the Aloha campus. There are five main buildings at the Aloha campus; AL3, AL4, FAB4, FAB5, and D1. Buildings AL3 and AL4 are primarily office buildings. Buildings FAB4 and FAB5 are the main manufacturing facilities. The D1 currently serves as a technology development facility, for newer generation of semiconductors, which would gradually be converted to a manufacturing facility. Besides these five main buildings, there are several other (relatively small) buildings located on the west side of the Aloha campus which are currently used by contractors and consultants working for Intel.

The Aloha facility is located in a maintenance area for ozone and Carbon Monoxide (CO). The facility is a major (> 100 tons/yr) source of VOCs (ozone precursor), but is a minor (32 tons/yr) source of CO. Intel is also a minor source of Hazardous Air Pollutants (HAPs).

This source is not subject to federal regulations for Prevention of Significant Deterioration

(PSD), or National Emissions Standards for Hazardous Air Pollutants (NESHAPS).

COMPLIANCE HISTORY

The most recent facility inspections were conducted on 7/29/97, 10/2/96, 9/25/96, 9/21/95, 9/07/94, and 9/21/93; and the source was found to be in compliance with all existing ACDP and Title V permit conditions. A file review also indicates, since the beginning of operation, no public complaints were received by the Department. The permittee's unblemished compliance history is one of the factors influencing the level of compliance demonstration requirements established in this permit. Item 20.a. of this review report provides a good example.

INTEL'S OPERATING SCENARIO

Intel has identified one operating scenario covering a broad spectrum of semiconductor manufacturing operations. The production steps traditionally include application of photoresist, UV light exposure, developing, etch, deionized water rinse, doping, and acid/solvent rinse steps. Under this one operating scenario, the source operations are divided into three emission units. Each identified emission unit (EU) is grouped with respect to common applicable rule requirements, and this grouping allows each EU to be regulated under uniform compliance monitoring requirements.

The semiconductor manufacturing processes emit VOCs from chemicals/materials that they use. In terms of specific processes, VOCs are emitted from the photoresist applications (mainly spin coaters and developers), solvent cleaning stations, and storage/handling operations. Over 90% of the plant site VOC emissions come from the photoresist applications, and the remaining 10% is mostly generated from the solvent cleaning stations. These VOC generating processes located throughout the Aloha campus are grouped under Emission Unit 1 (EU1).
The operating scenario at EU1 covers the plant site VOC emissions, excluding a small amount of VOCs in the boiler flue gases. Regulations pertaining to Intel's (non-fuel burning) process VOC emissions are uniform. Grouping the VOC emission sources as one emission unit (EU1) eliminates any ambiguity associated with the compliance demonstration with respect to the PSEL and RACT, or applicability of New Source Review (NSR) and Prevention of Significant Deterioration (PSD). This would perhaps become increasingly more apparent as this permit document is reviewed further.

The operating schedule is 24 hrs/day x 365 days/yr; meaning this permit does not directly impose a cap on the operating hours or the production rate. Instead the permit focuses on the actual VOC emissions by strict enforcement of the VOC PSEL and RACT conditions. As will be discussed in the PSEL section, the EU1's VOC PSEL essentially represents a cap and it also serves as the starting point from which to determine the NSR/PSD applicability. The RACT standards in this permit are also designed to limit VOC emissions on a unit production basis. A combination of VOC PSEL and RACT standards effectively regulates the permittee's actual VOCs emissions.

Boilers are separated into two emissions units (EU2 & EU3) based on the size (industrial or commercial) category in which the pre-determined fuel usage is the primary limiting factor for each unit. Unlike the EU1 process VOC PSEL, the combustion PSELs established for EU2 and EU3 boilers represent a cap on fuel usage. All boilers are limited to burn natural gas only as identified in the Intel's only operating scenario. The hourly (short-term) emissions from the EU2/EU3 boilers are based on each Emission Unit's maximum capacity, and theoretically this maximum capacity cannot be exceeded, unless the boiler is physically modified. All EU2/EU3 boilers are operated below their operating capacity. As discussed, annual operations of the EU2/EU3 boilers are limited by the allowable natural gas usage, and these limits are further reflected in the boiler PSELs.

PERMITTED ACTIVITIES

1. Condition 1 basically sets the tone that the permittee is allowed to discharge regulated air pollutants only in accordance with the limits and standards established in the Oregon Title-V Operating Permit 34-2681. The effective date of this permit is the date of the permit issuance.

2. Condition 2 makes a clear distinction between the state-only enforceable conditions from those conditions enforceable by both state and the U.S. EPA. All conditions in this permit are enforceable by both the EPA and State, except those conditions and associated monitoring specifically identified in item 2.a. as state-only enforceable.

   The monitoring (plus recordkeeping/reporting) requirements associated with the state-only applicable requirements are cited in item 2.a. by reference only, for reason that some of these monitoring protocols are also used by the federally enforceable conditions. Specific monitoring is extractable by its association to specific applicable requirements.

   A list of non-applicable rules and the summary of reasons are provided in the Non-applicable requirements section, toward the end of this permit.

EMISSION UNIT AND CONTROL DEVICE IDENTIFICATION

3. Existing air contaminant sources at the facility are grouped as follow:

   3.a. Emission Unit #1 (EU1)

   Buildings AL3 and AL4 are primarily office buildings with no measurable emissions (or worth measuring) and they are listed here for identification purpose only. FAB4 and FAB5 are existing manufacturing facilities, and D1 is currently a technology development center which may also (gradually) become a manufacturing facility.

   Emission Unit #1 (EU1) in a physical sense is the entire Aloha campus excluding EU2 and EU3 boilers. It includes all non-fuel burning activities and processes at the Aloha campus that emit VOCs. These activities/processes are grouped as one emission unit since they emit the same regulated air pollutant (VOCs), trigger the same applicable requirements, and share the same compliance monitoring protocols.

As listed in the permit item 3.a. (table), EU1 is divided into three (3) stationary sources; EU1.1, EU1.2, and EU1.3. FAB4 and FAB5 buildings share a common material flow (distribution & waste collection) and they are combined to comprise a stationary source EU1.1. The PSEL of EU1.1 was 190 tons per year in the 10/5/95 permit. The second stationary source EU1.2 is the D1 building. It utilizes its own material flow and employs newer technology. The D1 building (EU1.2) is currently under expansion and its projected emission capacity is rated at 53 tons per year. As discussed, a stationary source EU1.3 consists of AL3 and AL4 office buildings with no rated emission capacity.

3.b./c. Emission Unit #2 (EU2) and Emission Unit #3 (EU3)

Currently there is a total of sixteen (16) boilers, and two (EU3.4 & EU3.5) more are planned to be installed during the 94/95 calendar year. This permit is for the total capacity of 18 boilers. The electric boiler (EU2.8) has been omitted for obvious reason. All (EU3) D1 boilers fall under the industrial boiler category (10 to 100 million Btu/hr) and the rest (EU2) are commercial type (0.5 to 10 million Btu/hr). All EU2 and EU3 boilers are permitted to burn natural gas (and propane backup) only. In addition, all EU3 boilers would be operated with the Low NO_x control.

EU2	Boiler ID	Yr installed	Max. BHP	Fuel
EU2.1	FAB4 - #1	1977	66.7	n.gas
EU2.2	FAB4 - #2	1977	66.7	n.gas
EU2.3	FAB4 - #3	1977	66.7	n.gas
EU2.4	FAB5 - #1	1978	144.4	n.gas
EU2.5	FAB5 - #2	1978	144.4	n.gas
EU2.6	FAB5 - #3	1992	139.5	n.gas
EU2.7	FAB5 - #4	1992	139.5	n.gas
EU2.9	FAB5 - #6	1993	27.9	n.gas
EU2.10	FAB5 - #7	1993	93.0	n.gas
EU2.11	FAB5 - #8	1993	93.0	n.gas
EU2.12	AL4 - #1	1990	65.1	n.gas
EU2.13	AL4 - #2	1990	65.1	n.gas
EU2.14	AL4 - #3	1990	65.1	n.gas

EU3	Boiler ID	Yr installed	Max. BHP	Fuel
EU3.1	D1 - #1	1992	465	n.gas
EU3.2	D1 - #2	1992	465	n.gas
EU3.3	D1 - #3	1993	653	n.gas

EU3.4	D1 - #4	1994	465	n.gas
EU3.5	D1 - #5	1994	465	n.gas

Baseline Boilers	10^6 Btu/hr (gal/hr)
EU2.1 (FAB4 - #1)	3 (22.8)
EU2.2 (FAB4 - #2)	3 (22.8)
EU2.3 (FAB4 - #3)	3 (22.8)
EU2.4 (FAB5 - #1)	6.5 (49.5)
EU2.5 (FAB5 - #2)	6.5 (49.5)
EU2 Baseline Capacity:	22 x 10^6 Btu/hr (167 gal/hr)

Note the boiler capacity and chronological information contained in this section shall be used to track changes in the boilers' emission capacity since the baseline and determine applicability of NSR/PSD when necessary. The baseline capacity of EU2 is based on the fuel oil usage of 1.47 million gallons per year. Attachment A7 contains estimation of emissions from EU2 boilers based on their baseline oil capacity. The EU3 boilers did not exist during baseline and therefore the baseline capacity of EU3 is set equal to zero.

This permit review determined the EU3 boilers to be NSPS boilers, pursuant to 40 CFR (§) Part 60.40c, Subpart Dc, “Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units”. Each of the five (5) EU3 boilers is capable of burning natural gas (or LPG) only. None of the EU3 boilers generate steam, and they do not heat any materials that would be used in the heat transfer operations. However, as noted above (465 BHP » 20.9 X 10^6 Btu/hr & 653 BHP » 29.4 X 10^6 Btu/hr), each EU3 boiler's capacity is greater than the subpart-Dc lower size cut-off (10 X 10^6 Btu/hr). The EU3 boilers are indeed used partially to heat water used throughout the Aloha campus, thus triggering one of the subpart-Dc applicability.

4. VOCs Pollution Control Devices: Intel operates two pieces of VOC emission control equipment. A wet scrubber (PCD1) was installed and went into operation in late 1994. A wet scrubber controls water miscible VOCs emitted from the FAB4 building. The scrubber effluent containing water-soluble chemicals is routed to one of the wastewater treatment plants operated by Unified Sewerage Agency of Washington County. The Department through the pre-treatment program indirectly regulates this wastewater discharge.

The other VOC control device (PCD26) is the Carbon Concentration Condensation Unit (CCCU), and it also has been installed and began operations in 1995. The PCD26 is dedicated to controlling VOC emissions arising from operations conducted in D1 building (EU1.2).

- VOC emission control devices -

Pollution Control Device(PCD)	PCD ID	Emission Unit/Process Controlled	Design Parameters	Design efficiency
Wet Scrubber (Spray Tower)	PCD1	VOC emissions from FAB4 building (EU1.1)	F_{gas} = 6,000 acfm F_{H2O} = 100-150 gpm P_{drop} = 6.0 in. H_2O	**> 90%**
Carbon Concentration Condensation Unit (CCCU)	PCD26	VOC emissions from D1 building (EU1.2)	F_{gas} = 2,000 acfm The VOC removal efficiency is rated at above 90%, but this efficiency rate (%) is not a necessary parameter to complete the VOC CMB, as described in detail below.	

<u>PCD26</u> The CCCU (PCD26) is designed to treat an air stream relatively dilute with low concentration of VOCs. The CCCU utilizes a carbon adsorption/reactivation technology coupled with a condenser to recover VOCs. The VOC condensate recovered from PCD26 is directly piped to the solvent waste storage tank, and this is the reason the PCD26 control efficiency (normally obtained through source testing) is not needed to complete the chemical mass balance (CMB).

The CCCU consists of a carbon adsorption tower, a desorption tower, and a condenser laid out in series. Process air stream from EU1.2 relatively dilute with VOCs is directed to the bottom of the adsorption tower, where the treated air exits through the top. The adsorption tower is constructed with a series of "tilted" sieve trays designed to move (utilizing gravity force) solid Bead Activated Carbon (BAC) from top tray to the next one below and so on down to the bottom. VOC laden air stream moving upwards fluidizes the BACs, which in turn adsorbs VOCs in the air stream.

Carbon beads (BAC) laden with VOCs exit the adsorption tower and enter the desorption tower, where a small (manageable) volume of air laden with the VOC-stripping gas is introduced to reactivate the BAC by desorbing/stripping VOCs from it. Reactivated BACs are returned to the adsorption tower, in which the cycle is continuous. The VOC laden air (with stripping gas) stream exiting the desorption tower contains optimum amount of VOCs and is routed to the condenser for efficient recovery.

There are basically two control options available for (relatively) concentrated solvent laden air exiting the desorption tower: thermal destruction or condensation. The condenser control option (unlike thermal control) eliminates the formation of combustion by-products, and it is the preferred method, and the method chosen by Intel. The condenser option also simplifies the VOC monitoring since the amount of solvent recovered is already an inherent part of the overall chemical mass balance. As reflected in the permit VOC monitoring condition, where PCD1's control efficiency is needed and must be verified through source test, the PCD26 control efficiency is not necessary to complete the CMB. Of minor note, the thermal control traditionally has been subject to additional monitoring requirements such as measuring the capture and destruction efficiency, and monitoring the combustion temperature.

EMISSION LIMITS AND STANDARDS

This section contains all applicable emission limits and standards other than the PSEL and the source-specific standard such as reasonably available control technology (RACT). The applicable limits and standards of this section are further divided into three sub-categories as follow: Table-I contains those limits applicable to the entire facility. Table-II contains the specific limits applicable to the emission units and pollution control devices identified. Table-III summarizes the applicable limits of "insignificant" activities.

Facility-wide Limits and Standards

5. Condition 5.a. reflects OAR 340-21-060(2) and is applicable to all sources located inside Special control areas as defined in OAR 340-21-010, or when ordered by the Department in other areas. Intel is located inside Washington County, within the Special control areas defined in the rules.

   Condition 5.b. as written establishes a basis for regulating odor and other unforeseeable nuisance problems that may arise in the future.

6. Condition 6. includes two state-only enforceable requirements. The (250 micron) particulate fall out standard is applicable to all permitted sources located inside the tri-county area that do not have specific industrial standards, and thus applicable to Intel. The 1000-ppm SO_2 standard is also applicable to all permitted sources located inside the tri-county area. The tri-county consists of Clackamas, Multnomah, and Washington Counties.

7. This condition requires the permittee to implement the appropriate procedures as outlined in their Source Emission Reduction Plan (SERP) in the event an air pollution alert, warning, or emergency episode, due to high formation of ozone, is declared in the Portland area by the Department.

8. Pursuant to 40 CFR Part 82, Subpart E; The Labeling of Products Using Ozone-depleting substances, Condition 8. is established because the permittee currently uses the following ozone depleting chemicals:

Ozone-depleting substance	Class	Replacement Chemical
CFC-12	I	R-123 or R-134A
HCFC-22	II	No plans yet
HCFC-123	II	No plans yet

Halon 1211	II	No plans yet
Halon 1301	II	No plans yet

Emission Unit Specific Limits and Standards

9. The visible and grain loading standards of this condition apply to any single air contaminant discharge point to the atmosphere that originated from the fuel combustion sources. Which means these standards are applicable to each and every stack of the EU2 and EU3 boilers.

10. The "Operation & Maintenance" requirements of condition 10. are applicable only to PCD1, the VOC wet scrubber. This condition effectively replaces the existing Highest and Best condition in ACDP, pursuant to OAR 340-28-600 (2)(e) and 340-28-620. This O&M condition focuses on the source-specific maintenance and work practice requirements for PCD1 that are deemed appropriate for the Intel specific PCD1 operations.

    Operating parameters that influence the (PCD1) scrubber VOC removal efficiency include the air exhaust from FAB4 (air inlet to PCD1), its (PCD inlet) VOCs concentration, and the scrubber water flow rate. The PCD1 inlet air flow and its VOC concentration are basically dictated by the production, and these are not the appropriate control parameters to be regulated as the permit conditions. The water flow rate is the design control parameter suited for the permit O&M requirements. The VOC removal efficiency varies with respect the water flow rate, and the optimum water flow rate is yet to be determined through source test. The PCD1 design predicts the acetone (to be de-listed) removal rate of 90% or greater. The removal rates of other water soluble VOCs would be slightly less.

Emission Limits and Standards Applicable to Insignificant Activities

11. The grain-loading standard established in Condition 11.a. applies to any single (non-fugitive) air contaminant discharge point (stack) to the atmosphere that originated from non-fuel burning sources, which include "categorical" and non-categorical "aggregate" insignificant activities.

    The 20% opacity limit of Condition 11.b. is applicable to fugitive emission sources as well as the stack emission sources identified as the insignificant activities.

    Recently adopted the paint spray and architectural coating rules (11.c.) are applicable to all permitted sources located inside the Portland ozone non-attainment area.

PLANT SITE EMISSION LIMITS

12. 12.a. EU1 (VOC) PSEL

ANNUAL PSEL: The Aloha campus excluding D1 (EU1.2) was constructed during 1976 through 1978, and the facility was retroactively assigned an emission limit (PSEL) equal to the 1978 capacity to emit (190 tons VOC per year) in the first Department issued Air Contaminant Discharge Permit. This baseline emission rate of 190 tons of VOC per year was also the permittee's PSEL under the 10/5/95 Title 5 permit. It also served as the stationary source EU1.1 (FAB4 & FAB5) maximum capacity to emit. A stationary source EU1.2 (D1) currently under (on-going) expansion was recognized under the previously issued ACDP. The D1 building has the maximum emission capacity of 53 tons/yr, and it is the EU1.2's maximum capacity recognized in this permit.

The baseline PSEL of 190 tons/yr has been changed by the voluntary reduction agreement of 9/13/96 to 160 tons/yr. This means that for the purpose of determining applicability of (major) New Source Review (NSR) or Prevention of Significant Deterioration (PSD), OAR 340-28-1900 through 340-28-2000, the baseline capacity of 160 tons of VOCs per year is the starting point. Accumulative VOC emission increases/ decreases which result in a net (actual) emission increase greater than the Significant Emission Rate (40 tons/yr) would trigger the NSR; and the BACT/LAER review would be imposed on the stationary source that causes the increase. Any increases less than SER but above the PSEL of 160 tons/yr, no matter how small, will trigger the permit modification process.

EU1 Baseline Capacity = EU1 Current PSEL = 160 tons/yr.

WEEKLY PSEL: Pursuant to OAR 340-28-1020 (2), the short term PSEL established in this permit is the weekly PSEL. The weekly limit was determined to be most compatible with source operations.

Intel normally operates their production lines continuously for about 5 to 7 days. Chemicals applied at the production lines have uniform solvent content (% VOC) that does not fluctuate during the continuous weekly operations. The level of VOC emission would be proportional to the production rate. The weekly emission closely reflect the sum of their daily emissions which are evenly distributed. In the last ACDP renewal, the weekly VOC PSEL was set at 8.0 tons/wk. The 8.0 tons weekly PSEL reflects the maximum weekly production rate extrapolated from the emission monitoring conducted from 6/28/92 to 8/29/92 (ACDP data); and it is retained in this permit.

HISTORY OF CHANGE TO VOC (EU1) PSEL: There has been no Department approved VOC (EU1) PSEL increases or decreases between the baseline year (1978) and the 10/5/95 permit. The revised (1998) permit sets the VOC PSEL and baseline to 160 tons/yr.

12.b. Boilers (EU2 & EU3) PSELs

BASELINE Emissions for EU2: The baseline boiler emissions were established based on the fuel usage of 399,000 gallons of diesel. For the purpose of assigning diesel fuel usage among the baseline EU2 boilers, the capacity ratio of each boiler was used (see attached detail sheet A6). Note only the total fuel usage affects the emission calculation. The fuel combustion products (criteria pollutants) generated (tons/yr) based on the fuel usage of 399,000 gallons of diesel are summarized below:

PM_{10}	SO_2	NO_x	CO	VOC
0.4	14.2	4.0	1.0	0.1

CURRENT PSEL for EU2: Intel is committed to fueling these boilers with natural gas only. The short-term PSELs are based on EU2's maximum fuel capacity. And based on proposed natural gas usage the estimated annual EU2 emissions (tons/yr) are:

PM_{10}	**SO_2**	**NO_x**	**CO**	**VOC**
1.15	0.25	9.55	2.01	0.36

BASELINE emissions for EU3: All existing and planned EU3 boilers were/would be constructed after 1978, and therefore the baseline emissions for EU3 are set equal to zero.

CURRENT PSEL for EU3: All EU3 boilers are capable of burning natural gas only. The short-term PSELs are based on EU3's maximum fuel capacity. And based on forecast natural gas consumption the estimated annual EU3 emissions (tons/yr) are:

PM_{10}	SO_2	NO_x	CO	VOC
5.21	0.99	11.97	29.94	1.06

History of changes to the EU2/EU3 boilers' annual PSEL

The ACDP addendum 1 issued on 3/7/89 increased the SO_2 PSEL to 16.4 tons/yr from the baseline rate of 14.2 tons/yr. The EPA AP42 emissions factors for boilers have been updated, and this permit reflects updated AP42 boiler emission factors. The EU2 and EU3 boilers' baseline emissions are reconstructed to reflect these new AP42 emission factors.

Thirteen additional boilers (not counting the electric EU2.8 boiler) have been installed since the baseline year. In this permit, Intel forfeited EU2 boilers' capacity to burn oil and all boilers are now committed to burning natural gas only.

Since the baseline year, a combined capacity of all EU2 and EU3 boilers have increased by almost an eight fold from 22 to 166 million Btu/hr. However, using only the natural gas and retrofitting all D1 boilers with Low NO_x burners would minimize the over-all increases, and actually reduces the boiler SO_2 emissions.

Based on the proposed fuel usage (see attachment A6), the EU2 & EU3 boilers' PSELs are estimated below. The increase in emission of each pollutant is less than the Significant Emission Rate (SER) as defined in OAR 340-28-110. All particulates emitted from the boilers are regarded as PM_{10} for the permitting purpose. Also note the SO_2 PSEL has actually decreased since the baseline while the capacity went up by almost an eight fold. All units are expressed in tons per year:

Pollutant	Baseline	PSEL	Increase	SER
PM_{10}	0.4	6.4	6.0	15
SO_2	14.2	1.3	-12.9	40
NO_x	4.0	21.6	17.6	40
CO	1.0	32.0	31.0	100
VOC	0.1	1.5	1.4	40

EU2/EU3 Short-term PSELs

Oregon's PSEL rules indicate the short-term PSEL (averaging period) be consistent with the ambient standards unless such practice is incompatible with source operation. The short-term ambient standards for criteria pollutants are expressed in term of hourly to 24-hour average.

Intel operates a total of 18 boilers on natural gas, in a maintenance area for ozone and carbon monoxide, and the combined annual emissions (PSEL) total 1.5 tons of VOCs and 32 tons of CO; which are considered insignificant.

The EU2/EU3 PSEL is basically a product of natural gas usage and the AP42 emission factor, in which the gas usage is the actual limiting factor. The short-term (monthly) PSEL for the EU2/EU3 boilers is based on the maximum (rated) hourly capacity multiplied by 24 hrs/day and 31 days/month; the short-term PSEL in this permit can be expressed in either monthly or daily form, and they would actually represent the same limit. It would be theoretically not possible for boilers to operate beyond their maximum capacity. In actual practice, each boiler is normally operated well below its rated capacity.

The gas usage is the only varying parameter used to determine compliance with the PSEL, and the monthly natural gas usage is obtained from the natural gas supplier's monthly billings. Given the size of the boiler emissions, and considering the fact that short-term limits reflect the maximum combined capacity of all boilers, the monthly (PSEL) averaging is determined to be most compatible for the EU2/EU3 boilers operations. The monthly PSELs reflecting the EU2/EU3 boilers' maximum capacities are summarized in the emissions detail sheets.

13. The aggregate limits for insignificant activities established in this Condition reflect OAR 340-28-110 (6); which sets the aggregate Particulate limit at 1.0 tons per year and the aggregate HAP limit at 2.5 tons per year, pursuant to OAR 340-28-1060(2). This condition basically parrots the rule requirements (OAR 340-28-110(6)) that a total combined emissions from all “aggregate insignificant activities” cannot exceed the aggregate limits for each of the regulated pollutants (Particulates & HAPs) identified:

Description of Current insignificant activities	Regulated Air Pollutants	Estimated Emissions (tons/yr)
Baghouses PCD3 & PCD4 for wafer grinding operations	Particulates	0.2
Natural gas combustion of EU2 & EU3 boilers	Organic HAPs	< 0.2
Process scrubbers, Implant sources, etc.	Inorganic HAPs	0.6

This condition does not intend to limit “aggregate insignificant activities” to only those currently identified in the permit application. For same reason the permittee is free to add more categorical insignificant activities to their existing list (identified in the permit application). The permittee can add more insignificant activities to their existing list, even after the permit is issued, provided that the aggregate limits established in the permit (or rules) are not exceeded. The monitoring protocol for the aggregate insignificant activities requires the permittee to report semi-annually of the changed status (if any), at which time the status change will undergo further Department scrutiny.

<u>Aggregate Particulate emissions:</u> The only other criteria pollutant, other than VOCs, generated from EU1 is particulate and all particulate emissions from EU1 are included in the “aggregate insignificant emissions”. No silicon crystals are grown at the Aloha campus. Intel purchases thinly sliced wafers (size varies) with one side having a mirror finished surface (chemically etched & polished). The only silicon-particulate generating process performed at the facility is grinding unpolished side of wafer.
There are two baghouses (PCD3 & PCD4, each with 99.9% control efficiency), located on the south side of FAB4 building, controlling the silicon particulate emissions. The particulate emitted to the atmosphere from these baghouses total about 0.02 tons/yr, and these emissions are included in the “aggregate insignificant emissions”.

EU1	PCD ID	Yr installed	Flow (acfm)	Eff. (%)
FAB4	PCD3	1982	2,900	99.9
FAB4	PCD4	1982	2,900	99.9

Section 70.6(a)(3)(i) requires that all monitoring and analysis procedures or test methods required under applicable requirements be contained in Title V permits. It does not require the same level of testing or monitoring to assure compliance for emissions units that do not have significant potential to violate emission limitations as it does for significant emissions units. Where compliance with the underlying applicable requirement for an insignificant emission unit is not threatened by a lack of a regular program of monitoring and where periodic testing or monitoring is not otherwise required by the applicable requirement, then the status quo (i.e. no monitoring) will meet section 70.6(a)(3)(i). The Aloha Campus is an insignificant source of particulate/visible emissions. The wafer grinding operations are controlled by baghouses and the emissions from these baghouses total ~ 0.02 tons/yr. All boilers burn natural gas only. No silicon crystals are grown at the Aloha Campus. Based on the emission factors published in the OAQPS document, organic HAPs emissions due to EU2 and EU3 natural gas combustion are less than 0.2 tons/yr. Most of the inorganic HAPs originate from the acid baths and are already included in the monthly monitoring requirements associated with Condition 19.b. and 24.d. Monitoring and recordkeeping related to Insignificant Activities emission limits and standards will not improve compliance with the applicable requirements.

Aggregate Organic HAP emissions: Organic HAPs emissions from the EU2 and EU3 boilers were estimated using the emission factors published in the OAQPS document; EPA-450/2-90-011, second edition, October 1990.

EF C_6H_6 = 4% of total VOCs (0.04 x 2.8 lbs/10^6 ft^3 ng.)
EF CH_2O = 88.12 lbs per 10^{12} Btu heat input for EU2 boilers
EF CH_2O = 997 lbs per 10^{12} Btu heat input for EU3 boilers

Combined HAPs emissions due to EU2 and EU3 natural gas combustion total less than 0.2 tons/yr.

E, Benzene (C_6H_6) » 0.04 tons/yr
E, Formaldehyde (CH_2O) » 0.09 tons/yr

Aggregate Inorganic HAP emissions: Inorganic HAPs emissions are summarized in the Table below. Inorganic HAPs are emitted to atmosphere through process scrubbers (PCDs), and emissions from these “high efficiency” PCDs are very small as noted below:

HAPs	DESCRIPTION OF ACTIVITIES	ESTIMATE (tons/yr)
Arsenic compounds	Doping, parts cleaning	trace
Chromium compounds	Backside coating, etch	trace
Ethyl benzene	Negative litho process	trace
Ethylene glycol	Various dips, cleans & eq. Cooling	trace
Phosphine	Implant source	0.02
Phosphorus	Implant source	trace
Hydrofluoric acid	PCD2.1/2.2, PCD5, PCD6, PCD7, PCD8, PCD9, PCD11, PCD19/20	0.09
Hydrochloric acid	PCD2.1/2.2, PCD5, PCD6, PCD7, PCD8, PCD9, PCD11, PCD16, PCD17, PCD19/20	0.40
Chlorine	PCD2.1/2.2, PCD7, PCD8, PCD9, PCD19/20	0.09
Total		0.6

As noted above, controlled emissions of inorganic compounds (mostly acids) from numerous high efficiency scrubbers are small. Most of inorganic HAPs originate from the acid baths, and vapors from the acid baths are routed to wet scrubbers (PCDs) as listed in the following Table. Because acids have strong affinity for water, the dilute acid bath would not release significant amount of acids to begin with, and when such emission is further controlled by wet scrubbers, the acid emissions to the atmosphere are virtually eliminated. This partly explains Intel's ability to remain a minor source of (inorganic) HAPs. The following Table lists all existing PCDs for non-VOC HAPs and their key design parameters:

Inorganic HAPs Emission Control Devices

Pollution Control Equipment(s)	PCD ID	Design Parameters			Year Installed
		Gas Flow (acfm)	in. water	Water Flow (gpm)	
Wet Scrubber/ Thermal decomposition units (Delatech 857)	PCD2.1	200 scfm each	0.25	2.5	1993
	PCD2.2		0.25	2.5	1993
Horizontal Wet Scrubbers (FAB4 SCO #1 - #5)	PCD5	19,050	2.5	120	1974
	PCD6	19,050	2.5	120	1974
	PCD7	19,050	2.5	120	1974
	PCD8	20,000	2.5	120	1988
	PCD9	5,000	2.5	50	1988
Vertical Acid Scrubbers (FAB5 SCO #1 - #4)	PCD10	19,000	< 3	20	1974
	PCD11	“	< 3	20	1974
	PCD12	“	< 3	20	1974
	PCD13	“	< 3	20	1974
HPH Horiz. Scrubber (FAB5 SCO #5)	PCD14	34,000	0.5	30	1993
D1 Horizontal Wet Scrubbers	PCD15	60,000 scfm each	2	500	1992
	PCD16		2	586	1993
	PCD17		2	586	1993
	PCD18		2	500	1992
	PCD19/ 20	10,000	1.25	100	1992
	PCD21	85,000	2.6	341	1994
	PCD22	85,000	2.6	341	1994
	PCD23	29,000	2.6	356	1994

SOURCE SPECIFIC CONDITIONS

This "Source-specific Conditions" section of this permit is reserved for special conditions/requirements applicable to the permittee that are reflective of the source uniqueness. This section is further divided into three subsections:

Condition No.	Subsection
14. - 15.	Source-specific RACT Conditions
16. - 18.	Pollution Prevention and Pre-approved changes
19.	(Synthetic Minor) HAP Emission Limits

14. **REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT)**

Applicability: Pursuant to Oregon Administrative Rules (OAR) 340-22-104 (5), this permit contains a source-specific Reasonably Available Control Technology (RACT) standard for affected operations at the Intel Aloha campus. The source-specific RACT standards need not be approved by the Oregon Environmental Quality Commission (EQC) prior to EPA approval since this source-specific requirement itself is inherently a part of the State Implementation Plan (SIP) VOC rules.

Procedure: The RACT portion of this permit issuance followed the procedural requirements of 40 CFR Part 51.102; which included posting of public notice in the newspaper on June 8, 1995, followed by a public hearing on July 13, 1995. In addition, the RACT portion of this permit was posted on the secretary of state notice to conform to the (state) source-specific SIP revision process. On July 18, 1998 Intel's Non-categorical RACT determination was approved as a Source-Specific SIP Revision in the Federal Register (61FR37393). This approval of Intel's RACT determination is cited as 40 CFR 52.1970(c)(114) and became federally effective September 16, 1996. Intel must comply with this provision within one year, i.e. by September 16, 1997. The Department will check for compliance with RACT.

General background information: The Oregon SIP VOC Rules (Division 22) include several categorical RACT standards applicable to specific categorical sources residing inside the designated maintenance area. Division-22 also includes a provision which requires other non-categorical "affected sources" to comply with the case by case (source specific) RACT standard(s) established by the Department. Intel is the only affected semiconductor manufacturer currently operating in Oregon that became subject to a source-specific RACT determination.

Most RACT determinations are based on EPA Control Technology Guidelines (CTG), but there is no CTG developed for semiconductor industry. However, similar source-specific RACT determinations have been made by the other regulatory agencies (outside Oregon), and this permit uses some of their assessments (for comparative purpose only) as a guideline to assess source-specific RACT standard for certain Intel operations. Subsequently, the engineering/ technical evaluation coupled with the cost analysis dictated the RACT standards in this permit.

* "Affected sources" are those stationary sources operating inside nonattainment areas for which no categorical RACT requirements exist and which have the potential emissions before add-on controls over 100 tons of VOC per year.

<u>The Portland area attainment status:</u> The Portland area was designated as a maintenance area for ozone on April 30, 1997.

No emission increase was proposed with the RACT assessment. In fact the RACT standard will (legally) prevent Intel from increasing the level of pollutant emitted per unit (wafer) production. This performance specific RACT standard combined with the emission cap (PSEL) established in this permit represent one of the most effective environmental protective measure available, which can only help maintain the Portland attainment status.

<u>RACT assessment (screening) overview</u>

Semiconductor manufacturing processes performed at the Aloha campus were initially divided into four (4) distinct categories of operations; out of which only two types of operations are determined to be suitable candidates for specific RACT assessment in this permit:

- VOC storage, handling, and distribution
- VOC waste collection and disposal
- Solvent cleaning stations
- Photoresist operations

VOC storage and handling: Drums (< 55 gal.) and smaller carboys are used to deliver organic chemicals to the process area through a closed fill (hard piped) system, during which displaced vapors (VOCs) are fed back to the waste bulk (under-ground) storage tanks. Solvents in drums are pumped through hard piping to a process unit where it is quantitatively dispensed directly to the process equipment.

VOC Waste collection/disposal: Any excess and/or spent materials from the process equipment are immediately captured and drained (piped) to the waste storage tank.

The over-all controls provided in these first two categories of Intel specific operations exceed RACT; A similar solvent distribution/collection system (>95% efficiency) was determined to be BACT by the California Air Resource Board (CARB). This high degree of collection efficiency provided by the <u>enclosed</u> solvent distribution/collection system is one of the contributing factors that over 90% of all plant site VOC emissions come from the photoresist processes. Most of the remaining (10%) portion of VOC emissions is generated from the solvent cleaning stations. By design, VOC emissions from these tightly controlled solvent distribution/collection operations are insignificant. This is one of the deciding factors not to establish a separate individual RACT standard for these solvent distribution/ collection operations: The level of control provided already exceeds what the RACT would require, and a further technical/economical review would become an academic exercises at best. Furthermore, these operations are actually a (supportive) part of the (main) photoresist activities, and it is more appropriate to regulate these operations under the photoresist RACT standard.

It must be noted that omission (on paper) of these solvent/waste distribution/collection operations from the individual RACT assessment does not mean these operations are being exempted from the RACT review. Instead the RACT standard set forth in this permit for the (main) photoresist operation extends to the solvent distribution/collection operations, because they are essentially an auxiliary part of the main photoresist operations. Of related topic, the photoresist RACT standard would also apply to VOC emissions from the solvent cleaning stations, even though a separate RACT work-performance standard (FBR) is established for the solvent cleaning stations.

The RACT review in this permit focuses on the latter two categories of operations where the environment impact would be the greatest. In addition to the (main) photoresist RACT standard, the permittee is required to provide an additional (FBR) performance measure at the solvent cleaning stations.

In summary, the solvent distribution/collection activity support the photoresist operations, and these activities are actually considered a part of the photoresist operations and it will be regulated as such. Instead of a separate RACT standard for these auxiliary activities, a universal RACT standard, applicable to all phase of semiconductor manufacturing, better serves the Department/permittee from the enforcement/practical standpoint. The FBR control required at the solvent cleaning stations serves as an additional layer of environment protection.

RACT Standard for Solvent Cleaning Stations

Solvent cleaning operations at Intel are executed on a small scale with open area (top dimension) ranging from 2 to 4 ft^2. Size-wise, Intel's solvent cleaning/degreasing stations don't even come close to industrial size cold cleaners, open-top vapor degreasers, or conveyorized degreasers. However, the solvent cleaning operations, regardless of their size, are functionally similar. They all use solvents in either vapor or liquid phase to remove impurities from the product surface. The operational goal of any cleaner or degreaser is common, and this is the rationale for applying the CTG developed for “conventional” organic solvent cleaners/degreasers to Intel's “small scale” solvent cleaning operations.

Recommended CTG standards in general consist of proper operating procedures, and/or additional control devices. The CTG document (EPA-450/3-78-120) recommends conveyorized degreasers smaller than 21.5 ft^2 of air/vapor interface; and open-top vapor degreasers smaller than 10.8 ft^2 of open area be exempted from having to add a major control device such as refrigeration/condenser. Pursuant to the guidelines set forth in the referenced CTG, the RACT assessment in this permit is therefore based on proper operational procedures.

The most common and effective operational procedures applied to the cleaning/degreasing operations include controlled Freeboard Ratio (FBR) and covers. FBR is defined as the freeboard height (depth) divided by the width (not length) of the air/solvent interface area. Higher FBR reduces diffusion (VOC) losses by lessening the effect of (ambient) air current on the air/solvent interface zone. Covers obviously discourage natural draft and reduce solvent evaporative losses.

Approximately 90% control efficiency can be achieved with a 0.7 FBR and covers for the sinks. The test results compiled in "Air Pollution Engineering Manual (1992, p. 352-357) further supports the effectiveness of the FBR control.

Table 1 (Attachment A9) lists various control equipment for cleaners and their control efficiencies taken from the CARB report. Intel also furnished historical source test data (Attachments A10 through A13) to characterize VOC evaporative losses from their operational area during parts cleaning operations.

In establishing the RACT standards for Intel's solvent cleaning stations, a further observation (of source uniqueness) is necessary. There are a few solvent cleaning stations at Intel that are not conventional in a sense that these stations resemble a typical laboratory (or kitchen) sink: It consists of a sink and over-head hood with built-in fan, a solvent faucet, and a typical drain system. The parts are cleaned in running solvents (from the faucet) and the waste solvents are immediately drained (piped to the waste storage vault). If there is no solvent left standing in the sink, the FBR/cover control requirements simply do not apply. Therefore the FBR control is applicable only when parts are cleaned by immersion. The following RACT performance standards (permit language) are appropriated for Intel's solvent cleaning operations:

- The freeboard ratio must be equal to or greater than 0.7 if parts are cleaned by immersion.
- A cover must be provided during idle periods if the sink contains any freestanding solvents.
- The cleaners are exempt from these RACT requirements if they use non-VOC solvents as defined in OAR 340-22-100.

<u>RACT Standard for Photoresist Operations</u>

Reiterating, the photoresist operation is the single largest source of VOC emissions at the Aloha campus, generating approximately 90 percent of total plant site VOC emissions. Traditionally the photoresist processes are categorized into two sub-categories termed "positive" and "negative" (terms used throughout this review report). Both the positive and negative photoresist processes use solvents in their spin coater operations, but only the negative photoresist process uses solvents in the development stage. Historical data confirms the negative process emits a significantly greater amount of VOCs then the positive process.

The (California) Bay Area Air Quality Management District (BAAQMD) has designated the positive process as RACT. Because, in terms of VOC emissions, the positive process translates to the equivalent of 90% abatement for the negative process. In other words, the RACT control for the negative process is either providing the 90% equivalent emission control or a conversion of the negative to the positive system.

The existing photoresist machines at the Aloha campus are all based on the positive technology, except for one negative unit. VOC emissions from the negative process are approximately 11 tons/yr (tpy), and the cost of controlling this emissions to the level of the positive technology (1.1 tpy) was shown to be beyond the cost acceptable for a RACT cost increment. The control cost of thermal destruction was also estimated to run well over $10,000/ton/yr.

Following the BAAQMD's RACT determination, the alternative (to thermal control) is conversion. However, a straight conversion from negative to positive was also determined to be not cost effective for Intel. The cost of conversion would run into well over $10,000/ton/yr (based on a direct quote from the equipment vendor). The Department generally acknowledges the control cost greater than $10,000/ton/yr to be excessive for RACT. From the cost stand point, Intel is exempt from having to provide the RACT level (equivalent to their positive process) control to their negative system. And since the positive system itself is considered equivalent to RACT, the source-specific RACT assessment for the photoresist operations could prematurely end at this point. The permit RACT review for Intel went a step beyond the straight conversion, and the other control alternatives are explored on a plant wide basis:
First of all, recognize the positive photoresist process units significantly outnumber "one and only" negative unit at the Aloha campus. This opens up the possibility of over-controlling (tweaking, P2, etc.) each and every positive units (already considered RACT equivalent) to a degree such that it would not be considered cost excessive. Over-controlling "many" positive units even to a small degree; beyond what the RACT would require, to the extent that is equal to or greater than the under-controlled level from "one and only" negative unit; could easily yield the net result being equal to or greater than the RACT equivalent control across the entire plant. For instance, providing numeric value to a given example, over-controlling VOC emissions from each and every 100 positive units by 0.1 tons (total 10 tons) would more than offset the total under-controlled amount of 5 tons from one (1) negative unit by 2 to 1.

This is accomplished by, in lieu of having separate standards for the positive and the negative, establishing a common universal standard for both the positive and negative system. This universal RACT standard, which is based on the (cleaner) positive technology, is also applicable to the negative process performed at the Aloha campus. Theoretically, the permittee can only comply with this universal RACT standard by providing over-control at the positive units. This basically illustrates the Bubble (OAR 340-28-1030) concept.

In addition to the Bubble concept, the universal RACT standard serves another purpose. Consider the dynamic nature of the semiconductor industry. Unlike traditional smokestack industries, the semiconductor technology, and the manufacturing process, which it is based on, rapidly changes with respect to time. The manufacturing processes may no longer be based on so-called the positive/negative photoresist technology. From the enforcement perspective, it is highly desirable to have a definite regulatory control over Intel's future operations, as well as their existing operations.

The universal RACT standard in this permit is applicable to all existing positive and negative systems, as well as all future wafer-manufacturing processes, regardless of the technology a new system may rely on. The RACT standard will encourage Intel to promote the pollution prevention, such as incorporation of necessary process equipment design/changes and chemical substitution, during the research and development stage. Furthermore, this universal RACT standard eliminates the need to separately monitor the chemical usage (emissions) of the positive from the negative. This greatly simplifies the chemical mass balance (enforcement tool) needed to determine permittee's compliance status with respect to the RACT standard.

Intel's historical emission and production data were evaluated and the appropriate time period that accurately represents Intel specific positive photoresist technology was identified. The year selected is 1985 because it was the year the positive process at the Aloha campus incorporated the (source-specific) EBR and cuprinse steps. These unique EBR/cuprinse designs significantly reduced the VOCs emissions from the traditional (those without EBR/cup- rinse) positive photoresist process. The positive process units at the Aloha campus continue to utilize these source-specific EBR/cuprinse technologies.

VOC emissions	Production
59.97 tons	181,300 normalized 8” (inch) wafers

Chemical and production specific information is available at the plant site for Department/EPA inspections. Based on the above emission data from the Intel specific positive system with the EBR/cuprinse design, the universal source-specific RACT standard applicable to Intel's entire spectrum of wafer manufacturing processes is:

2 X 10^{-4} lbs VOC per cm^2 Wafer Processed

- The permittee must achieve real reductions in actual VOC emissions consistent with the RACT level (2X10^{-4} lbs VOC/cm^2) of control. The RACT standard, directly tied to actual production rate, provides an assurance that source cannot utilize non-production or equipment downtime credits in their emission calculations to show compliance with the VOC PSEL. A RACT is essentially a performance standard independent of PSEL and it directly limits the amount (lbs) of VOC emitted per specific amount (cm^2) of wafer production.

- The RACT standard applicable to the current technology employed by Intel extends to all future technologies contemplated and adopted by Intel and utilized at the Aloha campus.

RACT Averaging Time

The short term PSEL in this permit is weekly and it was determined to be most compatible with the source operations, pursuant to OAR 340-28-1020(2). The RACT averaging period needs to be consistent with the VOC PSEL short-term monitoring period and is therefore based on weekly also.

The RACT compliance determination is essentially based on the wafer start (processed; not the final number of finished product) and CMB. The ratio of the amount (lbs) of VOC emitted in a week period is taken against the amount (cm^2) of wafer start in that same week period. The result is measured against the permitted RACT standard to determine the permittee's compliance status.
The wafer production lines continuously operate for about 5 to 7 days. Raw chemicals/solvents used in wafer production have uniform VOC content (%), and the production rate (and thus VOC emission rate) remains consistent throughout a given weekly production cycle. This means weekly emission is essentially the sum of daily (hourly) emissions, if such (hourly/daily) measurement is viable. A weekly period is determined to be the shortest practical period most compatible with the source operations, and thus the averaging period selected in this permit.

Summary: The RACT standard established in this permit (#14.a.) for the photoresist operations is actually the universal (plant-wide) standard applicable to the entire spectrum of semi-conductor manufacturing performed at the Intel Aloha campus. The Free Board Ratio (FBR) established in this permit (#14.b.) is applicable only to the solvent cleaning stations, and it essentially serves as a built-in performance standard that further encourages (additional layer of) emission control from the permittee. Condition 14.c. is to be used as a vehicle to trigger the RACT standards in Conditions 14.a. and 14.b. once the Department receives an approval from EPA.

POLLUTION PREVENTION AND PRE-APPROVED CHANGES

Permit conditions 16. through 18. represent an attempt to incorporate pollution prevention conditions in the Title-V operating permit and provide the permittee operating flexibility to meet pollution prevention goals and objectives by pre-approving a narrowly defined set of changes. The Department views this as a trial project and an opportunity for the Department to gain a wealth of information on the viability and effectiveness of including pollution prevention requirements in a Title-V operating permit.

15. This condition placed requirements on Intel in the event that EPA disapproved the RACT standards identified in Condition 14. In fact, EPA has since approved these standards, therefore, Condition 15. Is no longer applicable.

16. Pollution Prevention

The pollution prevention condition requires the permittee to implement a pollution prevention program and submit reports on implementation of the program.

16.a. Implementation of the program, as established in item 16.a., is fairly short and designed to implement the pollution prevention quickly upon issuance of this permit.

16.b. The program consists of at minimum the following program elements:

16.b.i. A description of the process the permittee will use to introduce pollution prevention into their decision-making procedures;

16.b.ii. a partnership/agreement the permittee will establish with its material suppliers to minimize hazardous air pollutants and volatile organic compounds from the raw materials and products;

16.b.iii. a partnership/agreement the permittee will establish with its equipment vendors to minimize hazardous air pollutants and volatile organic compounds using pollution prevention in equipment design;

16.b.iv. development of a data collection system appropriate for evaluating pollution prevention effectiveness;

16.b.v. development of an employee training program to promote pollution prevention at the permitted facility; and

16.b.vi. a statement of commitment to pollution prevention at the permitted facility.

16.c. Item c. is a provision for changing elements in the pollution prevention program, differentiating between minor changes that can be made immediately and reported in the annual report and major changes which require 30 day notification prior to change and a demonstration of need for the change. A major change is eliminating a program element, such as the employee-training program. Modification of a program element, such as a change to the training program, is considered a minor modification.

16.d. The permittee is required to develop a detailed annual report that outlines progress made during the preceding calendar year. As this detailed report will contain market-sensitive information, it will be kept at the site and made available to Department representatives for inspection at the facility. The permittee shall also submit an executive summary of the detailed annual report. The annual report during the last year of this permit shall contain a summary of the project and a self-evaluation of the effectiveness of the program.

17. Pre-approved Changes

Through pre-approval of a narrowly defined set of changes, Intel and Oregon DEQ will expedite the administrative procedural requirements of minor new source review (OAR 340-28-2270). These pre-approvals do not involve increase in emissions or major modifications, and definitely do not represent an exemption to any applicable requirement. These conditions are drafted to be fully protective of environment and to promote pollution prevention.

17.a. Item a. states the approved changes only extends to VOC emitting activities at stationary sources EU1.1 and EU1.2. The only other remaining stationary source (EU1.3) at EU1 consists of two office buildings which are listed in the permit for identification purpose only.

17.b. Item b. strictly prohibits the permittee from adding a new stationary source.

17.c. Item c. states all new or modified activities must continue to comply with the VOC PSEL. This condition also binds the permittee to do the pollution prevention as specified in Condition 16.

17.d. Item d. prohibits addition of a new Pollution Control Device, and it also prohibits the permittee from making changes to existing VOC control devices (PCD1 & PCD26) such that the performance (control efficiency) would be degraded.

17.e. Item e. states all new or modified activities must continue to comply with the source-specific RACT standard.

17.f. Item f. states the permittee cannot deviate from the existing compliance monitoring requirements established for the VOC PSEL and RACT Conditions.

17.g. On top of all the restrictive criteria specified in items a. through f., item g. is established to further insure that no new applicable requirement is triggered.

17.h. Item h. directs the permittee to the appropriate monitoring and reporting that they must abide by.

18. This condition is a sunset provision which conveys that the pollution prevention (16.) and pre-approval (17.) conditions will expire at the expiration date of this permit unless there is a mutual agreement between the permittee and the Department to continue.

19. AGGREGATE HAP EMISSION LIMIT

The aggregate combined Hazardous Air Pollutants (HAPs) limit of 10 tons/yr for each organic and inorganic HAPs set forth in this section comprises a cap on the permittee's total HAPs emissions. It limits the permittee's potential to emit and categorizes the permittee as a minor HAP source. As long as the permittee operates within the HAP limits set forth in this section, the permittee retains the minor HAP source status and the provisions set forth in OAR 340-32-300 through 340-32-4500 remain not applicable.

The minor HAP source status was initially determined from the permit application (specific chemical usage is confidential and all records are kept at the plant site and are made available to the Department/EPA representative). A review indicates the HAP minor source status was determined (conservatively) by using the HAP usage data and not the emission data for certain chemicals. Toxic substance usage data are provided in Attachment 14 (A14).

The emission cap set forth in this section is actually more stringent than what the applicable rule requires: OAR 340-32-120 defines a major source as one that has the potential to emit, considering control, in the aggregate, 10 tons/yr or more of any individual HAP or 25 tons/yr or more of any combination of HAPs. The 10 tons/yr emission cap in this permit applies to emissions of a total combined organic HAPs, and similarly a separate 10 tons/yr emission cap applies to inorganic HAPs emissions.

The individual organic or inorganic HAP emission can never exceed 10 tons/yr since the combined emissions of either organic or inorganic HAPs must remain below the 10 tons/yr cap. Therefore the permit compliance demonstration requirements do not require monitoring of individual HAPs. (This is an excellent trade-off, more stringent limit for easy of monitoring) Only the aggregate amount is needed to determine the permittee's compliance status with respect to the 10 tons/yr aggregate limits set forth in this permit.

MONITORING REQUIREMENTS

Monitoring requirements provided in this section are the primary tools used by the permittee and the Department to assess the permittee's compliance status. Monitoring requirements in this section are divided into six (6) parts: Condition 20. specifies the monitoring related to the facility-wide applicable requirements. Condition 21. specifies the monitoring related to those applicable requirements targeted at specific emission unit(s). Condition 22. deals with the monitoring associated with the limits applicable to "insignificant" activities. Condition 23. outlines the compliance determination for the (EU2 & EU3) boiler PSELs. Condition 24. is reserved for the monitoring associated with the VOCs and HAPs PSELs and the source-specific RACT requirements. And lastly Condition 25. identifies monitoring related to the pre-approval condition.

20. <u>"Facility-wide" Monitoring</u>

Before individual monitoring protocol associated with the applicable standard(s) in this section is judged solely by its content, a thorough understanding of what is actually being regulated is necessary, as this influences the level of monitoring related to such activities. Intel is a major source of VOCs emissions. Emissions of other criteria pollutants are generated from natural gas burning boilers. Intel is an insignificant source of particulate/visible emissions. Besides natural gas combustion, the only potential particulate generating processes performed at the Aloha campus is the wafer grinding operations. As discussed extensively (considering the subject of discussion was "insignificant") in item 13. of this review report, the wafer grinding operations are controlled by PCD3 and PCD4 baghouses, and the emissions from these baghouses total about 0.02 tons/yr.

20.a. This Condition establishes the monitoring protocols necessary to determine compliance with respect to the process fugitive dust control requirements set forth in Condition 5.a and the odor/nuisance control requirements set forth in Condition 5.b. Solid materials (mostly wafers) that Intel use in their processes have minimal chance of becoming air borne. The source also has an excellent compliance history (no permit violation or public complaints to this date).

Monitoring requirements consist of complaint investigations as they occur and the subsequent reporting in the semi-annual report. For example, the Department may request Intel to investigate upon receiving complaints from the public; or Intel may initiate the investigation themselves upon receiving complaints related to referenced permit conditions. The permittee is also subject to the Department and/or EPA inspection, which is another vehicle used to determine the permittee's compliance status with respect to the permit nuisance conditions.

20.b. Reiterating, Intel is an insignificant source of particulate emissions; the only notable particulate emissions come from PCD3 and PCD4 and these baghouses are incapable of emitting particulate matters larger than 250 micron. In addition, natural gas burning boilers are the only potential source of SO_2 emissions. Natural gas burning boilers are simply not capable of emitting SO_2 at a level greater than 1000 ppm. Reflecting such, the permit monitoring basically consists of self-evaluation every six months to ensure that no such equipment have been added.

20.c. This Condition requires the permittee to keep a summary of actions taken during an air emergency episode declared in the Portland area by the Department for ozone.

20.d. This Condition references the monitoring associated with the Labeling of Products Using Ozone-depleting chemicals.

21. <u>"Emission Unit Specific" Monitoring</u>

21.a. The 0.1 gr./scf grain loading and the 20% opacity standards are federally and state enforceable conditions that apply to all fuel burning equipments. These standards therefore apply to all EU2 and EU3 natural gas burning boilers.

Again, the nature and characteristics of an affected emission source must be considered and then reviewed with respect to the intent and (occasionally) history of applicable standards in order to develop a meaningful monitoring requirement. The grain loading and opacity standards cited above were developed in the early seventies in order to regulate the boilers fueled by wood wastes, coal, and heavy residual oils, that are generally operated without any control.

Natural gas is one of the cleanest fuels available, and visible/particulate emissions from natural gas combustion are insignificant when compared to combustion of oil, coal, or wood wastes. Visible emissions, other then heat wave (or condensed water) during cold weather, from natural gas combustion are virtually non-detectable to the human eye. It is safe and reasonable to conclude (assume) that the 20% opacity standard would not be exceeded during natural gas combustion.

Grain loading from natural gas combustion would generate particulates (all considered to be PM_{10}) at a level below the grain loading standard of 0.1 gr./scf, corrected to 12% CO_2 (stoichiometric feed of air). EPA AP42 indicates 12 lbs of particulate is generated from million (10^6) ft^3 of natural gas combustion. In reference to 40 CFR, Part 60, Appendix-A, Method 19; a million ft^3 of natural gas combustion based on stoichiometric feed of air would yield 9.15 x 10^6 ft^3 of dry flue gases:

$$10^6 \text{ ft}^3 \times (1050 \text{ btu/ft}^3) \times F_d = 9.15 \times 10^6 \text{ dscf}$$

$$\text{where } F_d = 8{,}710 \text{ dscf}/10^6 \text{ Btu}$$

Twelve pounds (12 lbs) of particulates in 9.15 x 10^6 dscf of flue gases are equivalent to grain loading of about 0.01 gr./scf.

$$\frac{12 \text{ lbs} \times 7000 \text{ gr./lb}}{9.15 \times 10^6 \text{ dscf}} \approx 0.009 \text{ gr./scf} < 0.1 \text{ gr./scf.}$$

Even a conservative EPA AP42 figure of 12 lbs/10^6 ft^3 indicates the average grain loading from natural gas combustion is less than 10% of the rule standard of 0.1 gr./scf.

In conclusion, as long as the permittee uses natural gas only, the 20% opacity and 0.1 g/scf grain loading standards would be met. The compliance demonstration requirements include necessary monitoring and reporting of type(s) of fuel used and its consumption rate(s). In the event the permittee elect to use fuels other then natural gas (oil for instance), the permit must be opened to incorporate necessary applicable requirements, such as OAR 340-22-010 to 340-22-0250, and to modify compliance demonstration requirements, pursuant to item 21.a.iii.

21.b. Periodic monitoring requirements established in this condition adequately demonstrate the compliance status with respect to the O&M requirements set forth for PCD1. The water pressure drop across the scrubber packing is directly influenced by the water flow rate, and therefore the pressure drop in place of actual water flow rate is an acceptable substitute monitoring parameter. The water flow rate can also be obtained from the pump curve. The key parameter to monitor and record, per this condition, is the changed status of the water flow rates. However, it is expected that once the optimum water flow is determined through a source test, the water flow rate would be kept constant at or above the optimum level.

22. <u>"Insignificant Activities" Monitoring</u>

22.a. [reserved] Based on discussions in paragraph 13 above.

22.b. A written certification can be in the form of Material and Safety Data Sheet (MSDS).

22.c. [reserved] Based on discussions in paragraph 13 above.

23. <u>"EU2/EU3 Boilers PSEL" Monitoring</u>

The boiler emissions are calculated based on natural gas usage and the appropriate emission factors. The EU3 boilers are equipped with Low NO_x control, and comparatively EU3 boilers' NOx emissions are much less than EU2 boilers. See emission detail sheets; attachments A1 through A6.

23.a. The annual emission is determined by multiplying annual fuel usage to appropriate EF listed in the Table. All EFs are the AP42 data, except EU3 boiler's NO_x and CO EFs which are based on manufacturer data, verified by source test.

23.b. The monthly emission is determined by multiplying monthly fuel usage to appropriate EF listed in the Table. The EU2/EU3 boilers' monthly PSELs are based on the sum of each boiler's maximum capacity, and theoretically this maximum capacity can never be exceeded. As long as no physical modification is made to the boilers, the capacity remains the same. In actual practice, all boilers are operated well below their maximum capacity.

23.c. The permittee obtains the natural gas usage from the natural gas supplier's monthly billing. The billing documents the actual natural gas usage between two dates approximately a month apart. For example, Intel receives an invoice on 4/15 for actual usage from 3/3 to 4/5. From this data, the permittee can approximate the amount of natural gas used from the beginning (1st) to the end of the month. For the sole purpose of assessing compliance with respect to the combustion PSELs established in Condition 12.b., this is an acceptable method for calculating the monthly emissions from the EU2/EU3 boilers.

23.d. Pursuant to 40 CFR (§), Subpart Dc, "Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units", this condition establishes the daily monitoring (per § 60.48.c (g)) of natural gas usage on EU3 boilers. The sole purpose of the daily monitoring of the EU3 natural gas usage is to meet the NSPS (§ 60.48.c (g)) monitoring requirement.

The permit minimum recordkeeping requirement of 5 years, as specified in Condition 29., more than satisfies the NSPS (per § 60.48.c (i)) recordkeeping requirement of 2 years. This is the reason the less stringent 2-year NSPS recordkeeping requirement is omitted.

24. <u>Monitoring related to "source specific" Applicable Requirements</u>

This condition determines the permittee's compliance status with respect to the VOC PSEL and RACT conditions, and the aggregate HAP limits. They are combined here because certain parameters monitored are shared by the VOC and (organic) HAP PSELs and RACT conditions. The monitoring requirements in this section are specifically written to accommodate the source-specific types of conditions and to reflect source's unique parametric monitoring needs.

Items a., b., and c. determine the annual VOC emissions through chemical mass balance. However, the nature and complexity of Intel's manufacturing processes interfere with the direct monitoring of VOC emissions in a short-term (weekly) basis. The weekly VOC emission monitoring is best accomplished by a combination of direct and indirect measurements.

This permit utilizes the bi-monthly VOC emission factor (EF) calculated based on the actual solvent usage and the actual production figures from the previous two month. The bi-monthly EF will be updated every two month to reflect the most recent process changes. This is needed to compensate for the on-going process changes. Weekly emission is then estimated by multiplying EF to weekly production output. The VOC weekly emission monitoring, although indirectly measured, is proven to produce consistent and accurate emission data. As shown in Figure-1 (attachment A8), the EF dependent monitoring closely reflect the actual emissions. Furthermore, the actual emission monitoring is not omitted in this permit, but rather it is delayed for a short period (two month) of time.

The VOC monitoring also contains a built-in quality assurance measure. The accuracy of each EF is verified at the end of each monitoring period (2 months) by comparing the EF dependent emissions (2 month sum of item g.) to the actual emissions obtained from the actual bi-monthly solvent monitoring as specified in items a, b, and c.

Item d. establishes the monitoring requirements necessary to verify the permittee's (synthetic) minor HAP source status. Item d. requires a separation of organic HAPs from the inorganic HAPs. Emissions of organic HAPs are estimated through chemical mass balance, the same method used to determine VOC emissions. Estimating emissions of inorganic HAPs is a different matter, however, and there are several factors to consider.

As documented in item 13 of this review report, inorganic HAP emissions are well controlled, and the current inorganic HAPs emissions total less than one fourth (2.5 tons/yr) the permitted level of 10 tons/yr. On a related topic, emissions from the aggregate insignificant activities must be included in the HAP emissions calculations, but the permittee needs to quantify emissions from aggregate insignificant activities only once per permit period, as specified in the permit condition 22.b.i.

No simple calculation or emission factor are available for inorganic HAP emissions. The emissions of inorganic HAPs are best estimated through the usage data and the efficiency of control device. The monthly inorganic HAP emissions can be extrapolated from the 1994 (application) emissions/usage data, provided the type(s) and quantity of inorganic HAPs are not significantly changed from the current (1994 application) level, and the existing inorganic HAP control equipment are not altered.

As an insurance, when the inorganic HAP usage starts to depart significantly from the current level, and the total annual inorganic HAP emissions (verified monthly) start to exceed the level beyond three fourth (3/4) the permit 10 ton limit, the Department may request the permittee to perform emission testing at PCDs/activities causing the significant increase to confirm actual emissions.

As stated before, the 10 tons/yr annual cap set forth in this permit is based on a monthly rolling average, continuously averaged over previous 12 month period. This means the permittee must be able to demonstrate each month that their aggregate annual HAPs emissions during the previous 12 month period was below the 10 tons/yr cap.

Items e. through h. depend an empirical equation (bi-monthly EF) formulated from a combination of (weekly) production monitoring and chemical mass balance to determine compliance status with respect to the RACT standard of $2X10^{-4}$ lbs VOC/cm^2 and the weekly PSEL of 8 tons. Item i. specifies the monitoring related to the RACT FBR, and item j. indicates the trigger date for the RACT monitoring.

The last item (k.) of Condition 24. establishes source testing requirements for PCD1. Unlike PCD26, source testing is required on PCD1 to determine its control efficiency. No source testing is required on PCD26 (as discussed in #4.) because the amount of solvent recovered is already measured (as waste) to complete the mass balance.

25. <u>Monitoring related to Pre-approval</u>

This condition requires the permittee to verify whether new VOC emitting activities and/or changes made to the existing VOC emitting activities at the stationary sources EU1.1 and/or EU1.2 comply with the criteria set forth in Condition 17. Verification with respect to the criteria set forth in Conditions 17.a., 17.b., and 17.d. through 17.g. must be done on a six-month basis, and these should be straight forward. The permittee needs to include in the semi-annual report a summary of these inspection results.

As specified in Conditions 25.a. and 25.c., verification with respect to the criterion set forth in Condition 17.c. is more involved. The permittee must determine whether or not the maximum combined capacity to emit of each stationary source at EU1 has been increased beyond the weekly PSEL. The permittee must also monitor the changes in the maximum capacity to emit of stationary sources at EU1 on a six month basis. If no increase is noted from the previous level, no further action is necessary. If any increase has occurred, the permittee shall submit Notice of Completion containing the required information as specified in item 25.c.i. through 25.c.iv.

TEST METHODS AND PROCEDURES

26. This section, titled "Test Methods and Procedures", is provided so that the permittee and Department will know what test methods should be used to measure pollutant emissions in the event that testing is conducted for any reason. This section does not by itself require the permittee to conduct any more testing than was previously included in the permit. Although the permit may not require testing because other routine monitoring is used to determine compliance, the Department and EPA always have the authority to require testing if deemed necessary to determine compliance with an emission limit or standard. In addition, the permittee may elect to voluntary conduct testing to confirm the compliance status. In either case, the methods to be used for testing in the event that testing is conducted are included in the permit. This is true for SIP as well as NSPS emission limits and standards.

RECORDKEEPING REQUIREMENTS

Recordkeeping requirements, Condition 27. through 29., of this permit are drafted pursuant to OAR 340-28-2130(3)(b). As was the case with the ACDP records, all records related to the Oregon Title-V Operating Permit 34-2681 compliance monitoring must be kept at the plant site for at least 5 years.

REPORTING REQUIREMENTS

Reporting requirements, conditions 30. through 32, of this permit are drafted pursuant to OAR 340-28-2130(3)(c). Under the Source-specific Reporting Requirements of Condition 32., the fuel usage data obtained per item 32.e. is used to estimate the annual emissions from the EU2/EU3 boilers. Items 32.f. through 32.j. report the compliance status with respect to the VOC PSEL and RACT conditions; and item 32.k. provides a summary of compliance status with respect to the rolling HAP limits.

The annual (PSEL) emissions reported for criteria pollutants are based on calendar year, and the compliance status is determined at the end of the year. However, the annual aggregate emissions reported for (HAPs) per item 32.k. are based on rolling monthly average. The compliance status with respect to the annual (synthetic minor) HAP limit is determined at the end of each month; and this means a total of 12 compliance determination per year will be made with respect to the annual HAP limits set forth in Condition 19.

NON-APPLICABLE REQUIREMENTS

33. Pursuant to OAR 340-28-2190, the permit shield rule, non-applicable rules are grouped in this section according to the reasons (summary) as provided in the permit. Note that a particular rule that is already mentioned elsewhere in the permit, conditional type of rule in the general conditions section for example, regardless of its current applicability, is not mentioned in this section.

GENERAL CONDITIONS

The "General Conditions" section lists additional applicable rule requirements that permittee must adhere to, as with any other permit conditions; and with a few minor exceptions, the requirements of general conditions are common among all Title-5 sources.

As specified in the General condition G6., the permittee is subject to the immediate reporting of excess emissions.

As specified in the General condition G21., the permittee is subject to the modification procedural requirements applicable to non-major HAP source.

SUMMARY/PUBLIC NOTICE

The Title V permit issued for the Intel Aloha facility on 10/5/95 is revised with this permit to make the following changes: The modifications to the Title V permit were noticed to the public from 10/16/97 until 11/16/97. No comments were received from the public. Comments were received from EPA. In response to EPA's comments the following changes were made:

> Language was added to the review report to address EPA concerns about changes to conditions 13, 22, and 27. The revised permit removes monitoring and recordkeeping requirements for insignificant activities. EPA requested more justification for this change in the review report.

In addition to making EPA's suggested changes, the Department also included the PSEL reduction from 190 tpy to 160 tpy.

The proposed revised permit will be submitted to EPA for their 45-day review and then issued.

Table 1

Control Equipment and Control Efficiencies

VOC Control Equipment	**Control Efficiencies (%)**
Cold Cleaner (low volatility)	
• cover	55 - 80
• mechanically assisted cover and spray and agitation control	50 - 90
Cold Cleaner (high volatility)	
• cover	55
• mechanically assisted covers and spray and agitation controls	70
Batch-loaded Vapor Cleaner	
• cover	45 - 60
• mechanically assisted covers and spray and agitation controls	60 - 75
Conveyorized Vapor Cleaner	
• cover	25
• mechanically assisted covers and spray and agitation controls	60
Carbon Absorbers	40 - 95[a/]
Refrigerated Chillers	10 - 40[b/]
Higher Freeboard Ratio	25 - 50[c/]
Use of Non-VOC Solvents	100

a/ A typical value is about 40 percent.

b/ For a batch-loaded vapor cleaner.

c/ Based on a baseline freeboard ratio of 0.5 for batch-loaded vapor cleaners. Increasing the ratio from 0.5 to 0.75 and 1.0 results in about 25 and 50 percent emission reduction, respectively.

ATTACHMENT A
STACK TEST SUMMARY

N/A = Not Applicable

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
FAB 4:					
1	Degreaser	IPA	0.83	0.0762	9.18
	Hood Fan	TCA	0.46	0	0
		Acetone	0.27	0.0038	1.43
		Freon N/A		0.0050	0
		HMDS	N/A	0.0009	0
		Cyclohex	N/A	0.0001	0
		Cel Acet	N/A	0.0004	0
		Xylene	N/A	0.0005	0

The hood was used for 15 minutes to clean D&W parts.

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
2	Degreaser	IPA	1.37	0.1384	10.10
	Hood Fan	Freon	0.55	0.0016	0.30
		Acetone	N/A	0.0013	0
		MethylCel	N/A	0.0003	0
		TCA	N/A	0.0053	0
		CTC	N/A	0.0002	0
		Cyclohex	N/A	0.0001	0
		Cel Acet	N/A	0.0012	0
		Xylene	N/A	0.0003	0

The hood was used for 1 hour to degrease 30 parts.

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
1	Solvent Hood	Cel Acet	18.8	0.0342	0.18
	Fan	NBA	2.16	0.0008	0.4
		Xylene	3.38	0.0178	0.53
		Acetone	N/A	0.0003	0
		IPA	N/A	0.0038	0
		Freon	N/A	0.0004	0
		MethylCel	N/A	1.5775	0
		TCA	N/A	0.0003	0
		Cyclohex	N/A	0.0001	0
		Chloroben	N/A	0.0010	0

Sink was used for 5 hours. Poured 43 gallons of waste resist.

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
2	Solvent Hood Fan	Cel Acet	20.11	0.3484	1.74
		NBA	2.31	0.0026	31.32
		Xylene	3.53	1.1055	0.11
		Acetone	N/A	0.1837	0
		IPA	N/A	0.0053	0
		Methyl Cel	N/A	0.0030	0
		TCA	N/A	0.0003	0
		Cyclohex	N/A	0.0001	0
		Chloroben	N/A	0.0010	0

Sink was used for 6 hours. Poured 46 gallons of waste resist.

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
1	Small Solvent Hood	Acetone	1.10	0.6341	57.65
		IPA	N/A	0.0009	0
		Freon	N/A	0.0001	0
		HMDS	N/A	0.0016	0
		NBA	N/A	0.0036	0
		Chloroben	N/A	0.0108	0
		Cel Acet	N/A	0.1099	0
		Xylene	N/A	0.0607	0

Used for 2 hours.

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
2	Small Solvent Hood	Acetone	1.10	0.4235	38.51
		IPA	N/A	0.0013	0
		NBA	N/A	0.0005	0
		Cel Acet	N/A	0.0178	0
		Xylene	N/A	0.0635	0

Used for 2 hours.

FAB 5:

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
1	Degreaser Hood	IPA	1.86	0.0824	4.43
		Freon	0.27	0	0
		TCA	0.23	0.0223	9.72
		Acetone	0.14	0.0884	63.21
		HMDS	0.03	0	0
		NBA	N/A	0.0001	0
		Cel Acet	N/A	0.0027	0
		Xylene	N/A	0.0011	0

Hood used 7 separate occasions.

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
2	Degreaser Hood	HMDS	0.53	0.0027	0.51
		Acetone	N/A	0.0443	0
		IPA	N/A	0.0734	0
		MethylCel	N/A	0.0025	0
		TCA	N/A	0.0183	0
		Cyclohex	N/A	0.0029	0
		NBA	N/A	0.0001	0
		Chloroben	N/A	0.0001	0
		Cel Acet	N/A	0.0016	0
		Xylene	N/A	0.0009	0

Hood used once.

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
1	Solvent Hood	Acetone	12.48	0.2037	1.63
		Cel Acet	0.01	0.0226	226.89
		Xylene	0.001	0.0087	871.69
		NBA	0.001	0.0002	23.54
		M-pyrrol	0.40	Not Tested	
		IPA	N/A	0.0020	0
		Freon	N/A	0.0001	0
		TCA	N/A	0.0043	0

Hood used 8 times.

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
2	Solvent Hood	Acetone	0.93	0.2606	28.03
		Cel Acet	0.02	0.0177	88.96
		Xylene	0.003	0.0103	344.08
		NBA	0.003	0.0001	3.49
		M-pyrrol	0.40	Not Tested	
		IPA	N/A	0.0013	0
		TCA	N/A	0.0159	0
		Chloroben	N/A	0.0004	0
1	Degreaser Hood Downstairs	TCA	0.92	0.117	12.71
		IPA	0.55	0.065	11.82
		Acetone	0.55	0.072	13.09
		NBA	N/A	0.002	0
		Cel Acet	N/A	0.001	0

Hood used once to degrease parts.

TEST	SOURCE/STACK	CHEMICAL	USAGE (LB/HR)	EMISSIONS (LB/HR)	%EVAP
2	Degreaser Hood Downstairs	TCA	0.92	0.0349	3.79
		IPA	0.55	0.0097	1.76
		Acetone	0.55	0.0069	1.25
		Freon	N/A	0.0007	0
		NBA	N/A	0.0036	0
		Cel Acet	N/A	0.0010	0
		Xylene	N/A	0.0005	0
		Trimethyl	N/A	0.0020	0

Hood was used once to degrease parts.

CHEMICAL NAME INDEX

IPA	Isopropyl Alcohol
TCA	1,1,1, Trichloroethane
NBA	N Butyl Acetate
M-pyrrol	1-Methyl-2-Pyrrolidone
Cel Acet	Cellosolve Acetate
Freon	Freon 113
Cyclohex	Cyclohexanone
Chloroben	Chlorobenzene
Methyl Cel	Methyl Cellosolve
HMDS	Hexamethyldisilazane
CTC	Carbon Tetrachloride
Trimethyl	Trimethylbenzene

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