NOTE: Attachments are not available

MEMORANDUM

DATE: April 23, 1999

SUBJECT: MACT Floors for Batch and Continuous Chemical Manufacturing Processes at Existing Sources Covered by the MON

FROM: Chuck Zukor and Reese Howle
Alpha-Gamma Technologies, Inc.

To: Miscellaneous Organic NESHAP Project File

The purpose of this memorandum is to summarize the maximum achievable control technology (MACT) floor determinations for batch and continuous chemical manufacturing processes at existing sources which are covered by the Miscellaneous Organic NESHAP (MON). Material discussed in this memorandum includes:

1) Regulatory background including standard applicability, available information for MACT analyses, and MACT definitions;

2) Determination of the process vents MACT floor;

3) Determination of the storage tanks MACT floor;

4) Determination of the wastewater MACT floor; and

5) Determination of the equipment components MACT floor.

1.0 BACKGROUND

This section presents some background on the development of MACT floors for the MON. Section 1.1 summarizes the facility applicability criteria for the MON. Section 1.2 describes the available information used in the MACT floor determinations. Section 1.3 summarizes the required guidelines for determining MACT floors and a summary of the resulting MON MACT floor determinations.

1.1 MON Applicability Criteria

The MON will apply to facilities meeting all of the following criteria:

- **!** Manufacture of organic chemicals in batch or continuous processes;
- **!** Emit a hazardous air pollutant (HAP) and considered a major source;
- **!** Are covered by one of the following Standard Industrial Classification (SIC) codes: 282, 284, 286, 287, 289, or 386; and
- **!** Are not covered by any other MACT standard.

Additional details regarding applicability of the MON were published in the Federal Register on November 7, 1996 (61 FR 57602).

1.2 Available Information

The MACT floor analyses are based on information that was readily available to the EPA. The information was obtained from two general sources: (1) responses to Section 114 surveys, and (2) permit and emissions inventory data maintained by state and local regulatory agencies. A more detailed description of the type of data available for batch and continuous chemical processes is provided below.

1.2.1 Batch Processes

The Environmental Protection Agency (EPA), under the authority of Section 114 of the 1990 Clean Air Act Amendment, requested information from facilities which are subject to the MON and which have batch chemical manufacturing processes. The Section 114 requests were sent to 194 facilities in a letter from the EPA on January 28, 1997 with a clarification letter sent on March 10, 1997. The facilities which received the Section 114 questionnaires were identified from EPA's 1993 Toxic Release Inventory (TRI) database. First, facilities which had a SIC code of 282, 284, 286, 287, or 386 were identified. Then, facilities which had total actual HAP emissions greater than 12.5 tons/yr or actual emissions of one HAP greater than 5 tons/yr were identified. From this set, all facilities which may produce a MON product were identified using the list of chemical products produced in SRI International's "1996 Directory of Chemical Producers."

Data from the facilities for the 1995 calendar year were provided to the EPA on a computer disk or on paper (hard copy). Alpha-Gamma entered the data received from the facilities into a MS Access database. The MON batch processes database contains data from 160 facilities. Some of the data provided were not in the format requested in

the Section 114 questionnaire. Alpha-Gamma made the necessary conversions before the MACT floor analyses were performed. The memorandum “Quality Assurance and Quality Control of MON Batch Chemical Processes Database”, October 7, 1997 describes the quality control procedures performed by Alpha-Gamma.

1.2.2 Continuous Process

Information contained in the MON continuous database primarily consists of electronic emission databases maintained by individual states. Alpha-Gamma obtained electronic emission databases from the following seven states: Texas, Louisiana, North Carolina, Illinois, Missouri, California, and New Jersey. For Texas, information contained in the database was supplemented by hard copies of air permits for facilities with at least one miscellaneous organic process. For Louisiana, additional information was obtained through hard copies of compliance plans, permit applications, and emissions inventory documentation. In the case of North Carolina, annual air emissions inventories were used as sources of additional information.

1.3 MACT Floor Determinations

According to the Clean Air Act, the MACT floor for existing sources is defined as "the average emission limitation achieved by the best performing 12 percent of sources (for which the Administrator has emissions information)." The EPA has interpreted the word "average" in 59 FR 29196 as a measure of the "central tendency of a data set." The central tendency may be represented by the arithmetic mean, median, or some other measure that is reasonable. The MACT floors for the MON are based on the central tendency for each emission type, using the available data. Table 1 provides a summary of the MACT floor determinations for batch and continuous chemical processes at existing sources. The MACT floors and the methodology used to determine these floors are described in the following sections.

Table 1. MACT Floor Determinations for Chemical Processes at Existing Sources

Source Type	Required Control	Performance Level	
Process Vents	98 percent reduction	Each continuous vent within a facility with a TRE $\leq$ 2.8	All batch vents within a product process with total product process HAP emissions $\geq$ 10,000 lb/yr
Storage Tanks	IFR/EFR or 95 percent reduction	Tank with capacity $\geq$ 10,000 gal and HAP partial pressure $\geq$ 1.0 psia	
Wastewater	None	None	

Equipment Components	HON equivalent LDAR program	All affected product processes.

2.0 PROCESS VENT MACT FLOOR DETERMINATION

A “process vent” is defined as the gaseous discharge from an individual unit operation (i.e., emission source) such as reactor or dryer. A process vent may discharge directly to the atmosphere, to another unit operation, or to an emission control device. A “product process” is defined as a group of unit operations and associated equipment required to manufacture a specific organic chemical product.

A class distinction was established between process vents associated with continuous and batch chemical processes. Therefore, separate MACT floors were determined for continuous and batch chemical processes:

- The MACT floor for continuous process vents is a control device with a HAP reduction efficiency of 98 percent or greater for an individual vent with a total resource effectiveness (TRE) value of 2.8 or less.

- The MACT floor for batch process vents is a control device capable of reducing product process HAP emissions by 98 percent or greater for batch product processes with total HAP emissions of 10,000 lb/yr or more.

The affected process vent population used in the MACT floor determination is described in Section 2.1. In Section 2.2, the class distinction between continuous and batch vents is discussed. Section 2.3 describes the MACT floor level of performance. Section 2.4 discusses the performance criteria which defines the affected source. While, Section 2.5 describes the MACT floor determinations.

2.1 Affected Vent Population

All process vents associated with continuous and batch (dedicated and non-dedicated) product processes were considered. Vents releasing inorganic materials such as cobalt compounds, cyanide compounds, hydrogen chloride, hydrogen fluoride, chlorine, and manganese compounds were eliminated from the MACT floor determination. Typically, vents releasing inorganic materials require different control technologies than organic materials (e.g., filters versus flares). In addition, vents with dilute HAP concentrations were eliminated from the MACT floor analyses. A total HAP de minimis concentration of 50 ppmv was selected because it is consistent with de minimis concentrations used in other EPA standards, such as the Hazardous Organic NESHAP (HON).

The process vent population that results from the above exclusions is 3,599 vents located in 685 product processes. Where, batch (dedicated and non-dedicated) operations account for approximately 84 percent (3,009) of the process vent population and 87 percent (597) of the product processes.

2.2 Class Distinctions

A class distinction was established between vents associated with continuous and batch chemical processes. Factors considered in establishing the continuous-batch class distinction included the following:

- Hours of operation (hr/yr) for continuous vents are longer than batch vents (average of 8,100 vs 3,500 hr/yr),

- Volumetric flow rates (scfm) for continuous vents are higher than batch vents (average of 6,450 vs 415 scfm), and

- Annual emissions (lb/yr) for continuous vents are higher than batch vents.

The EPA already has several regulatory standards which have set a precedent for establishing a class distinction between continuous and batch chemical processes. Examples of these precedents include: the HON, Polymers & Resins (Group I & IV) NESHAP, and New Source Performance Standards for Distillation Units (Subpart NNN) and Reactor Processes (Subpart RRR).

2.3 MACT Floor Level of Performance

The selected MACT floor level of performance is a control device achieving a HAP emission reduction efficiency of 98 percent or more. Approximately, 14 percent of the continuous vents and 13 percent of the batch vents reported a control device achieving a HAP emission reduction efficiency of 98 percent or more, excluding scrubbers. Therefore, a MACT floor level of performance exists for the continuous and batch vents.

The MACT floor level of performance established for continuous and batch vents is consistent with the HON and other chemical industry MACT standards. Process vents equipped with scrubbers were not considered in the MACT floor determination. A review of responses to the Section 114 industry questionnaire indicated that scrubbers are typically used to remove water-soluble pollutants such as methanol from process vents. However, the pollutants may only be transferred from one media to another (i.e., absorbed from the process vent into the scrubbing media), rather than being destroyed or recovered. Due to a concern that these water-soluble pollutants may not be recovered or destroyed, scrubber controls were not considered.

2.4 Affected Source

2.4.1 Continuous Vents

The TRE for each continuous process vent was selected as the measure of performance to rank order vents controlled at a MACT floor level. Vents with MACT floor equivalent controls and a high TRE value are considered more stringent than similar vents with a lower TRE value.

All vents associated with continuous product processes at a facility are considered the affected source. All continuous vents within each facility were ranked by the corresponding TRE in ascending order (low-to-high) to determine the TRE "threshold" below which all vents are controlled at a MACT floor level of performance. Starting from the vent with the lowest TRE value, it was confirmed whether this vent is controlled at the MACT floor level. If the answer was "no," then there is no applicable threshold value for the facility. If the answer was "yes," the same procedure was applied to the vent with the next-to-lowest TRE value. The process was repeated until a vent was identified as not meeting the MACT floor performance level. At this point, the threshold value (or TRE performance level) for the facility was defined as the TRE value below which all vents are controlled at a MACT floor level.

2.4.2 Batch Vents

Total uncontrolled HAP emissions for a batch product process was selected as the measure of performance to rank order batch vents which are collectively controlled within a product process at the MACT floor level. This collective vent approach was selected because information in the MON database indicated that batch vents were commonly manifolded within a product process prior to control. Typically, the volumetric flow rates associated with batch vents are small. Thus, it is more cost effective to manifold like vent exhausts for destruction in a common control device.

Batch product processes with MACT floor equivalent controls and low total uncontrolled HAP emissions are considered more stringent than similar vents with higher uncontrolled HAP emissions. All batch product processes with MACT equivalent controls were ranked by the corresponding uncontrolled HAP emissions in ascending order (low-to-high) to determine the top performing 12 percent of batch product processes. All vents associated within a batch product process are considered the affected source.

2.5 MACT Floor Determinations

For continuous vents, the top performing 12 percent of sources were determined by rank ordering the respective facilities by the determined TRE performance level in descending order (high-to-low). Facilities with the highest TRE performance level are considered the best performing facilities. The top 12 percent of the 48 continuous facilities corresponds to the top 6 facilities. The median TRE performance level for the top facilities is a TRE of 2.2. The average TRE performance level for the top facilities is a TRE of 2.8. It was determined that the average TRE performance level of 2.8 represented the "central tendency" of the top facilities. Since the TRE values for the top performing facilities represented an even distribution over a limited value range, it was determined that the average TRE value best represented the central tendency of the data set. Attachment A provides a complete MACT floor ranking with corresponding TRE performance levels for continuous vents.

For batch vents, the top performing 12 percent of sources were determined by rank ordering the respective product processes by the total uncontrolled HAP emissions in ascending order (low-to-high). Product processes with the lowest total uncontrolled HAP emissions are considered the best performing facilities. The top 12 percent of the 731 batch product processes corresponds to the top 44 product processes. The median performance level for the top product processes is total uncontrolled HAP emissions from the product process of 10,000 lb/yr (rounded up from 9,860 lb/yr). The average performance level for the top product processes is a total uncontrolled HAP emissions from the product process of 15,200 lb/yr. It was determined that the median performance level of 10,000 lb/yr of uncontrolled HAP emissions represented the "central tendency" of the top product processes. Since the HAP emission values for the top performing facilities represented a skewed distribution over a large value range, it was determined that the median value best represented the central tendency of the data set. Attachment B provides the batch vents MACT floor ranking including the corresponding HAP emission performance levels for batch product processes with an overall control efficiency of 98 percent or more.

3.0 STORAGE TANK MACT FLOOR DETERMINATION

The MACT floor for storage tanks was determined to be an internal or external floating roof (IFR or EFR), or a control device with a HAP reduction efficiency of 95 percent or greater for all tanks 10,000 gallons or greater and storing a material with a HAP partial pressure of 0.90 psia or greater.

The affected storage tank population used in the MACT floor determination is described in Section 3.1. In Section 3.2, the MACT floor level of performance is described. Section 3.3 discusses the performance criteria which defines the affected source. While, Section 3.4 describes the MACT floor determinations.

3.1 Affected Tank Population

All storage tanks associated with continuous and batch (dedicated and non-dedicated) product processes were considered. Tanks storing inorganic materials such as hydrogen chloride, hydrogen fluoride, chlorine, and potassium compounds were eliminated from the MACT floor determination. Typically, tanks storing inorganic materials require different control technologies than organic materials (e.g., filters versus condensers). Although maleic and phthalic anhydrides are organic materials they sublime at ambient temperatures. Thus, tanks storing these compounds were also eliminated from the floor analysis.

The EPA did not request data on tanks with capacities less than 10,000 gal or tanks storing materials with a HAP content less than 5 percent by weight to be consistent with the classes of tanks covered by the HON.

The tank population that results after these exclusions is 1,458 tanks located in 150 facilities. Where, batch (dedicated and non-dedicated) account for approximately 86 percent (1,259) of the tank population.

3.2 MACT Floor Level of Performance

The selected MACT floor level of performance is a tank equipped with an internal or external floating roof (IFR or EFR), or another control device with a HAP emission reduction efficiency of 95 percent or more. Approximately 16 percent of storage tanks are reported as equipped with an IFR/EFR or a control device achieving a HAP emission reduction efficiency of 95 percent or more, excluding scrubbers. Therefore, a MACT floor level of performance exists for storage tanks.

This level of performance is consistent with the HON and other chemical industry MACT standards. Tanks equipped with scrubbers were not considered a MACT floor level of performance. A review of responses to the Section 114 industry questionnaire indicated that scrubbers are typically used to remove water-soluble pollutants such as methanol from storage tank vents. However, the pollutants may only be transferred from one media to another (i.e., absorbed from the storage tank vent into the scrubbing media), rather than being destroyed or recovered.

3.3 Affected Source

The HAP partial pressure (psia) of the stored material was selected as the measure of performance to rank order tanks controlled at a MACT floor level. Tanks with MACT floor equivalent controls and storing materials with a low HAP partial pressure are considered more stringent than similar tanks storing materials with a higher HAP partial pressure.

All tanks located in each facility operating continuous and/or batch product processes are considered the affected source. All tanks at each facility were ranked by the corresponding HAP partial pressure in descending order (high-to-low) to determine the partial pressure "threshold" above which all tanks are controlled at a MACT floor level of performance. Starting from the tank with the highest HAP partial pressure, it was confirmed whether this tank is controlled at the MACT floor level. If the answer was "no," then there is no applicable threshold value for the facility. If the answer was "yes," the same procedure was applied to the tank with the next-to-highest HAP partial pressure. The process was repeated until a tank was identified as not meeting the MACT floor performance level. At this point, the threshold value for the facility was defined as the HAP partial pressure above which all tanks are controlled at a MACT floor level.

A de minimis limit of 0.05 psia was selected for the HAP partial pressure. Many tanks in the affected tank population store ethylene glycol and/or glycol ethers (EG/GE) and have HAP partial pressures less than 0.05 psia. The Polymer and Resin II rule has excluded tanks storing EG/GE because the emission potential from these tanks is very low. For the MON, all tanks storing materials with a HAP partial pressure equal to or less than 0.05 psia account for approximately 0.5 percent of the total baseline emissions for storage tanks. For these reasons, the HAP partial pressure of 0.05 psia is considered de minimis.

3.4 MACT Floor Determinations

The top performing 12 percent of facilities were determined by rank ordering all facilities by the determined threshold value in ascending order (low-to-high). Facilities with the lowest threshold values are considered the best performing facilities. The top 12 percent of the 128 facilities corresponds to the top 16 facilities. The median threshold value for the top 12 percent of facilities is a HAP partial pressure of 0.14 psia. The average threshold value for the top 12 percent of facilities is a HAP partial pressure of 1.0 psia (rounded up from 0.88 psia). It was determined that the average performance level of 1.0 psia represented the "central tendency" of the top facilities. The HAP partial pressure values for the top performing facilities represented a skewed distribution towards the low value range. It was determined that the average HAP partial pressure value best represented the central tendency of the data set. Although the median HAP partial pressure value represents a more stringent option, a large number of facilities controlling tanks with extremely low HAP partial pressures (e.g. less than 0.1 psia) skewed the data set. A HAP partial pressure performance level of 0.14 psia is clearly not representative of the industry. Attachment C provides a complete MACT floor ranking with corresponding HAP partial pressure performance levels for all storage tanks.

4.0 WASTEWATER MACT FLOOR DETERMINATION

The MACT floor for MON batch and continuous wastewater streams was determined to be no control. Wastewater streams generated from batch and continuous chemical processes were considered together to determine the MACT floor. The MON continuous and batch wastewater data are summarized in Table 2.

There are a total of 519 wastewater streams in the MON continuous and batch data. Only 9 wastewater streams (less than 2 percent) are controlled with a steam stripper or an air stripper vented to a control device. Thus, the MACT floor for MON continuous and batch wastewater streams was determined to be no control.

Table 2. Summary of MON Batch and Continuous Wastewater Data

MON Database	Total Number of Wastewater Streams	Number of Wastewater Streams with Control[a]	Percent of Wastewater Streams with Control[a]
Continuous	19	1	5.3%
Batch	500	8	1.6%
TOTAL	519	9	1.7%

[a] Wastewater streams were considered controlled if they were controlled with a steam stripper or an air stripper (air from air stripper vented to a combustion control device)

5.0 EQUIPMENT COMPONENT FLOOR DETERMINATION

The MACT floor for equipment components was determined to be a HON equivalent leak detection and repair (LDAR) program for facilities with continuous and batch chemical operations. The affected source population used in the MACT floor determination is described in Section 5.1. In Section 5.2, the MACT floor level of performance is described. Section 5.3 discusses the performance criteria which defines the affected source. While, Section 5.4 describes the MACT floor determinations.

5.1 Affected Source Population

Equipment components associated with facilities operating continuous and batch chemical operations were considered as the affected source. Facilities with equipment components in contact with inorganic materials such as hydrogen chloride, hydrogen fluoride, and chlorine were eliminated from the MACT floor determination. Typically,

equipment components in inorganic service require different leak detection technologies than organic materials. Thus, product processes with equipment components in contact with inorganic materials were eliminated from the floor analysis.

The affected source population that results from the above exclusions is 229 facilities. Where, batch processes (dedicated and non-dedicated) account for approximately 73 percent (168) of the facilities.

5.2 MACT Floor Level of Performance

The selected MACT floor level of performance is a leak detection and repair (LDAR) program for equipment components equivalent to the HON LDAR program. Alpha-Gamma evaluated the effectiveness of various LDAR programs using a set of model plants. The HON LDAR program is estimated to reduce HAP emissions by 63 to 75 percent for continuous chemical processes and 70 to 73 percent for batch chemical processes. Several LDAR programs implemented by Louisiana and Texas regulatory agencies were determined roughly equivalent to the HON LDAR program when applied to continuous chemical processes. The HON equivalent LDAR programs for continuous chemical processes include:

- State of Louisiana's non-HON LDAR program which is estimated to reduce HAP emissions up to 70 percent; and

- State of Texas' LDAR programs: TX28VHP, TX28MID, and TX28RCT which are all estimated to reduce HAP emissions up to 73 percent.

Approximately, 33 percent of facilities with continuous and batch chemical processes were reported as implementing some type of a structured LDAR program for equipment components. Therefore, a MACT floor level of performance exists for equipment components. The MON LDAR program data for continuous and batch facilities are summarized in Table 3.

5.3 Affected Source

The overall effectiveness of an LDAR program in reducing HAP emissions from a facility was selected as the measure of performance to rank order facilities controlled at a MACT floor level. Facilities implementing LDAR programs with the highest overall effectiveness in reducing HAP emissions are considered the best performing sources.

5.4 MACT Floor Determinations

The top performing 12 percent of facilities were determined by rank ordering all facilities by the LDAR program and overall effectiveness in descending order (high-to-

low). Facilities implementing LDAR programs with the highest overall effectiveness are considered the best performing sources. The top 12 percent of the 229 facilities corresponds to the top 28 facilities. The LDAR program implemented at 30 facilities is the HON LDAR program or a program equivalent to the HON. A total of 16 batch facilities specifically use a HON LDAR program. While, a total of 14 continuous facilities use the HON or equivalent LDAR program. Therefore, the “central tendency” of the top facilities is the HON LDAR program for both batch and continuous chemical operations.

Table 3. Summary of MON Batch and Continuous LDAR Program Data

LDAR Program	LDAR Emission Reduction Ranges[a] (Percent)		Number of Facilities		
	Cont.	Batch	Cont.	Batch	Total
HON Subpart H	63-75	70-73	1	16	17
LA Non-HON	61-70	33-50	2	4	6
TX28VHP	48-73	25-53	2	1	3
TX28MID	48-73	25-53	7	1	8
TX28RCT	48-73	24-53	2	0	2
SOCMI NSPS Subpart VV	38-48	16-25	0	26	26
SOCMI CTG, Subpart V	41-46	16-24	0	4	4
TX28M	24	1-2	5	2	7
TX Reg 5	NA	NA	0	1	1
LA2122	NA	NA	1	0	1
None or AVO	0	0	41	113	154
TOTAL			61	168	229

[a] Range of anticipated emission reductions for aggregate LDAR programs based on vinyl acetate and cumene.

ATTACHMENT A

MACT FLOOR RANK FOR CONTINUOUS PROCESS VENTS

ATTACHMENT B

MACT FLOOR RANK FOR BATCH PROCESS VENTS

ATTACHMENT C

MACT FLOOR RANK FOR STORAGE TANKS

ATTACHMENT D

MACT FLOOR RANK FOR WASTEWATER STREAMS