OSHA DIRECTION

U.S. DEPARTMENT OF LABOR

Occupational Safety and Health Administration

DIRECTION NUMBER: CPL 03-00-005	EFFECTIVE DATE: 7/27/07

SUBJECT: National Emphasis Program – Microwave Popcorn Processing Plants

ABSTRACT

Purpose: This Direction describes policies and procedures for implementing a National Emphasis Program to identify and reduce or eliminate exposures to butter-flavoring chemicals used in microwave popcorn manufacturing facilities.

Scope: This Direction applies OSHA-wide.

References:

A. OSHA Instruction CPL 02-00-103 (CPL 2.103), September 26, 1994, Field Inspection Reference Manual (FIRM).

B. OSHA Notice 07-03 (CPL 02) - Site-Specific Targeting 2007 (SST-07) Effective, May 14, 2007.

C. Instruction CPL 02-00-140, June 23, 2006, Complaint Policies and Procedures.

D. OSHA Instruction CPL 02-02-038 (CPL 2-2.38D), March 20, 1998, Inspection Procedures for the Hazard Communication Standard.

E. OSHA Instruction CPL 02-00-120 (CPL 2-0.120), September 25, 1998, Inspection Procedures for the Respiratory Protection Standard.

F. Memorandum for Regional Administrators, Area Directors, State Plan Designees, Consultation Program Managers, October 12, 2004, Subject: Popcorn/flavoring Establishment Assistance.

G. NIOSH Health Hazard Evaluation Report: Gilster-Mary Lee Corporation. Publication # 2000-0401-2991.

Cancellations: None.

State Impact: This Direction describes a Federal program change which establishes a National Emphasis Program (NEP) to identify and reduce or eliminate employee exposures to butter-flavoring chemicals used in microwave popcorn manufacturing facilities. States with establishments where significant exposures to these flavoring chemicals exist are encouraged to participate in this national emphasis effort. State notice of intent regarding this direction is required. (See Paragraph VI.)

Action Offices: OSHA National, Regional and Area Offices, State Plan and State Consultation Offices

Originating Office: Office of Health Enforcement

Contact: Directorate of Enforcement Programs
Office of Health Enforcement
200 Constitution Avenue, NW
Washington, DC 20210
202-693-2190

By and Under the Authority of

Edwin G. Foulke, Jr.
Assistant Secretary

Executive Summary

In January 2006, the National Institute for Occupational Safety and Health (NIOSH) released a Health Hazard Evaluation Report on its investigation at a microwave popcorn production facility. Several former employees from this facility were diagnosed with bronchiolitis obliterans, a severe obstructive lung disease. Following this investigation and the evaluation of lung function tests and air sampling results, NIOSH determined that inhalation exposure to butter-flavoring chemicals presents a risk for occupational lung disease. This instruction establishes a National Emphasis Program (NEP), which will provide guidance on targeting, inspection procedures, engineering controls, work practice controls and compliance assistance.

Significant Changes

None. This Direction describes a new initiative by the Occupational Safety and Health Administration.

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II. Scope. This Direction applies OSHA-wide.

III. References.

A. OSHA Instruction CPL 02-00-103 (CPL 2.103), September 26, 1994, Field Inspection Reference Manual (FIRM).

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G. NIOSH Health Hazard Evaluation Report: Gilster-Mary Lee Corporation. Publication # 2000-0401-2991.

H. OSHA Publication, Hazard Communication Guidance for Diacetyl and Certain Food Flavorings Containing Diacetyl (soon to be released).

I. OSHA Safety and Health Information Bulletin (SHIB), Respiratory Disease Among Employees in Microwave Popcorn Processing Plants (soon to be released).

IV. Cancellations. None.

V. Action Offices.

A. Responsible Office Directorate of Enforcement Programs, Office of Health Enforcement.

B. Action Offices National, Regional and Area Offices; Consultation Project Managers.

C. Information Offices OSHA National Offices.

VI. Federal Program Change/Notice of Intent Required. This Direction describes a Federal program change which establishes a National Emphasis Program (NEP) to identify and reduce or eliminate employee exposures to flavoring chemicals used in microwave popcorn manufacturing facilities. States where employees have significant exposures to these flavoring chemicals are encouraged to participate in this national emphasis effort. State notice of intent regarding this directive is required.

The State's notice of intent must indicate whether the State will initiate an emphasis program and if so, whether the State's program will be identical to or different from the Federal program. The State's implementing policies and procedures are expected to be at least as effective as those in this instruction and must be available for review. If the State's program differs from the Federal one, the State may either post its different emphasis program on its State plan Web site and provide the link to OSHA or provide information on how a copy may be obtained. OSHA will provide summary information on the State responses to this instruction on its Web site. The assignment of appropriate IMIS identifier codes for State Emphasis Programs should be coordinated with the Directorate of Information Technology and the Regional Administrator.

VII. Expiration. This Direction will expire one (1) year from the date of issuance.

VIII. Significant Changes. There are no significant changes. This is a new program.

IX. Application. This Direction applies to all establishments that manufacture and process microwave popcorn, and in which butter-flavoring chemicals are used.

X. Background.

In May 2000, the Missouri Department of Health and Senior Services (MDHSS) received information concerning eight individuals who had worked at the same microwave popcorn processing facility and appeared to have developed bronchiolitis obliterans, a rare, fixed obstructive disease of lung airways that impairs breathing. A ninth case was discovered later in the same Jasper, Mo., plant. The nine individuals had been employed at this microwave popcorn production facility for eight months to 17 years. They first noticed breathing problems five months to nine years (median, 1.5 years) after starting work at this facility. Five of the former employees had worked in the mixing room where butter flavorings and oil are mixed. The other four had worked on the packaging lines where popcorn and the oil/flavorings mixture are added to microwaveable bags and packaged for shipment. The employees reported similar symptoms, including progressive shortness of breath, persistent cough, and unusual fatigue. Five of the nine employees were placed on a lung transplant candidate list [1]. One of the employees died in April 2006 without receiving a lung transplant. She had worked for 18 months at the plant during the mid-1990s.

Using information supplied by the employer relating to the eight original cases, the initial

incidence of disease for the microwave popcorn mixing and packaging areas was determined. The four ill employees who worked in the mixing area represented 31 percent of the estimated 13 employees who worked in that area between 1992 and 2000. The other four ill employees who worked on the packaging line never worked in the mixing area and represented 1.4 percent of the estimated 272 employees who worked in this area between 1992 and 2000.

Since the incidence of bronchiolitis obliterans raised concern, MDHSS continued to investigate the illnesses and the conditions at the facility, and requested technical assistance from the National Institute for Occupational Safety and Health (NIOSH) in August 2000.

Based on the results of their initial investigation, NIOSH researchers concluded that the bronchiolitis obliterans identified in the eight former employees was most likely caused by occupational exposure to volatile butter-flavoring ingredients including diacetyl [2]. NIOSH used diacetyl as a marker of exposure to volatile flavorings in other working areas of the plant. Area sample results indicated that diacetyl concentrations ranged from below the limit of detection (</= 0.25 ppm) to 97.9 ppm. To protect employees during the initial and subsequent phases of the investigation, NIOSH and MDHSS recommended the installation and use of exposure controls in the facility. These controls included general dilution ventilation, local exhaust ventilation of tanks that contained butter flavorings, process isolation, and personal protective equipment (respiratory, skin and eye protection). NIOSH evaluated data from several follow-up medical and environmental surveys at this facility to assess the effects of these exposure controls on employee health. NIOSH published an Alert on flavorings-related lung disease [3] and has a Safety and Health Topics page on this subject on its Web site [4].

Additional cases of lung disease characterized by fixed airways obstruction, including bronchiolitis obliterans, have been recognized among employees at other microwave popcorn plants as well as among those who manufacture flavorings for foods outside the microwave popcorn manufacturing industry [3, 5]. A survey by NIOSH at five other microwave popcorn plants with five to 206 employees identified six additional employees with clinical findings consistent with bronchiolitis obliterans. These involved one mixer at each of three plants and three packaging line employees at a fourth plant [5]. Analysis of air samples for diacetyl at the plants where these six employees worked indicated much lower mean concentrations than those found in comparable areas of the Jasper, Mo., plant – 0.6 ppm (1.6 percent of the mean in Jasper) or less in the mixing areas for the three mixers and 0.3 ppm (16 percent of the mean in Jasper) in the packaging area for the three packagers [5]. Since these cases occurred at much lower levels of diacetyl than those initially measured in the Jasper, Mo., plant, NIOSH concluded that employee exposure to butter-flavoring chemicals should be limited as much as possible [5].

The lung disease identified in the NIOSH investigations is characterized by spirometry (lung or pulmonary function tests, PFT) findings of fixed airways obstruction. Airways obstruction is diagnosed when the person tested has difficulty blowing air out of the

lungs. A fixed obstruction means that there is no improvement in lung function even after administration of asthma medication (i.e., bronchodilators). Symptoms of fixed airways obstruction include cough, fatigue, and shortness of breath with exertion. Symptoms usually have a gradual onset, but in some cases severe symptoms have occurred suddenly with rapid progression of lung disease. Symptoms generally do not improve when employees go home for the weekend or go on vacation. In some instances, lung function tests have indicated that employees had fixed airways obstruction even in the absence of respiratory symptoms [3].

According to the Centers for Disease Control and Prevention (CDC), bronchiolitis obliterans is "a rare, severe lung disease characterized by cough, dyspnea (shortness of breath) on exertion, and airways obstruction that does not respond to bronchodilators" [6]. Established occupational risk factors for this chronic lung disease include inhalation of toxic fumes, grain dusts, mineral dusts, welding fumes, and irritant gases [7]. Bronchiolitis obliterans also has been associated with other types of inhalational injuries, infectious agents (viruses and atypical bacteria), allergic reactions, drugs, and a variety of medical conditions such as connective tissue disorders [7, 8]. In a number of cases, the disease is idiopathic, i.e., there is no known cause. The symptoms of bronchiolitis obliterans can occur in some cases as quickly as 4-6 hours after exposure to certain kinds of toxic substances, resulting in acute respiratory distress [8]. Weeks later, the employee may develop irreversible respiratory obstruction [8]. The original eight cases from the plant in Jasper, Mo., did not have a history of acute toxic exposure and likely developed lung disease over a longer period of time. They failed to show improvement in pulmonary function following oral corticosteroid treatment [1].

Currently, OSHA does not have a specific standard or a permissible exposure limit (PEL) for diacetyl nor has NIOSH recommended an exposure level. OSHA does, however, have permissible exposure limits for a number of other popcorn flavoring chemicals such as methyl ethyl ketone, acetaldehyde, furfural and acetic acid. These and other flavoring chemicals have been identified in analysis of butter-flavorings and some were found in butter-flavorings used in the popcorn manufacturing facilities investigated by NIOSH [10].

This NEP is being implemented to direct OSHA's field staff efforts to address the hazards and control measures associated with working in the microwave popcorn manufacturing industry where butter-flavoring chemicals including diacetyl are used in powder, liquid or paste forms, especially when the chemicals have the potential of becoming volatile.

XI. National Emphasis Program Goals.

A. To minimize and/or eliminate employee exposure to the hazards associated with microwave popcorn manufacturing. Reduction and/or elimination of chemical exposures will help to reduce and prevent the occurrence of skin and eye injuries as well as occupational lung injury and illness, including fixed airways obstruction and bronchiolitis obliterans, lung dysfunction, and restrictive airways

obstruction.

B. To accomplish this goal, OSHA will implement a combined effort that includes inspection targeting, direction on methods of controlling chemical hazards, and extensive compliance assistance.

C. Inspections will be directed to those facilities within the targeted SIC/NAICS codes listed on the website described in XII.A.1.b. below, and other establishments known to manufacture microwaveable popcorn.

D. The National Office will provide NIOSH with the names and locations of inspection sites that receive OSHA citations and Hazard Alert Letters. This information will give NIOSH the opportunity to offer its services to employers and employees when this is deemed necessary.

XII. Program Procedures.

A. Site Selection.

1. Targeting Sources.

a. Inspections conducted under this NEP will focus on facilities where employees are manufacturing or processing microwave popcorn.

b. A listing of facilities identified as manufacturing microwave popcorn is included on the Directorate of Enforcement Programs (DEP) Intranet Web site. **All** such establishments within the Area Office's (A.O.) jurisdiction will be scheduled for inspection.

NOTE: This list is for internal scheduling purposes **only** and shall not be released to the public.

c. Sites not included on the DEP Intranet listing of known establishments, but known to the A.O. to be manufacturers of microwaveable popcorn, shall be added to the inspection targeting list for that A.O. and scheduled for inspection.

NOTE: **All** establishments identified by the A.O. must be added to the list.

d. Appendix A contains a list of NAICS and SIC codes for establishments which may be using butter-flavoring chemicals in the manufacture of microwave popcorn.

2. Inspection Scheduling.

a. All establishments on DEP's Intranet or known by the A.O. shall be scheduled.

b. Whenever an office becomes aware of a previously unknown popcorn manufacturing establishment within any of the identified NAICS/SIC codes, the establishment shall be added to the list. For reporting purposes, all enforcement inspections under this NEP will be reported as "Health" inspections on the IMIS.

3. Deletions.

a. Any facility that has received a comprehensive inspection where employee exposures to butter-flavoring chemicals have been specifically evaluated within the last two (2) years by OSHA, shall be deleted from the list if the case file documents that the employer has instituted feasible engineering and work practice controls, provided respirators (where necessary) and appropriate personal protective equipment, and such protections have been found to be effective.

B. Complaints and Referrals.

Complaint or referral inspections alleging employee exposure to any other hazards at microwave popcorn processing facilities shall be expanded to address the issues covered under this NEP. For further guidance, CSHOs should refer to CPL-00-140, Complaint Policies and Procedures.

C. Programmed Inspections.

Some establishments may be selected for inspection under the SST-07 plan or also under one or more other OSHA initiatives (National Emphasis (NEP) or Local Emphasis (LEP) Programs). This NEP, which is based on microwave popcorn butter-flavoring hazards, shall be run **concurrently** with the SST-07 plan**;** however, the NEP inspections have priority.

Whenever an establishment is scheduled for inspection on the current cycles of both the NEP plan and the SST-07 program plan, the inspections may be scheduled at the same time. CSHOs shall use all IMIS codes applicable for the inspection. The employer's DUNS number must also be recorded for each inspection.

In cases of an establishment scheduled for inspection under both the SST-07 and this NEP, an inspection limited in scope to the safety and health issues targeted by the NEP program must be conducted even if all CSHO-calculated DART rates for

the establishment are found to be below the SST-07 inspection thresholds.

D. Expanding Scope of Inspection.

Inspections under this NEP shall normally be limited to the butter-flavoring chemicals hazards described in this Direction, but the Compliance Safety and Health Officer (CSHO) may expand the scope of the inspection if other safety and health hazards or violations are observed. If the facility also has potential exposures to flavoring chemicals containing diacetyl, other than butter-flavorings (e.g., cheddar cheese, jalapeno, almond, etc.) the CSHO shall expand the scope of the inspection to address the related exposures as well.

XIII. OSHA's Response Efforts and Outreach.

A. OSHA has already responded to NIOSH's findings by conducting the following outreach activities:

1. In response to NIOSH's August 2001 Interim Report on its investigation of Gilster Mary-Lee Corporation, in February 2002, OSHA's Directorate of Enforcement Programs issued a memorandum to Regional Administrators and Area Directors alerting them to NIOSH's findings at the Missouri facility. The memorandum advised the field to investigate these types of exposures whenever they encountered employees working around popcorn butter-flavoring chemicals. In addition, the agency mailed hazard alert letters to locations where microwave popcorn manufacturing was occurring.

2. In September 2002, OSHA's Region VII established an Alliance with the Popcorn Board to use their collective expertise to help foster a culture of prevention, best practices and technical knowledge.

3. In October 2002, OSHA's Region VII-Kansas City published a brochure entitled "Recommended Preventative and Control Measures to Reduce the Risk of Obstructive Lung Disease Among Workers in the Microwave Popcorn Packaging Industry".

4. In October 2003, OSHA posted to its Web site an update of its Safety and Health Topics: Chemical Sampling Information File on Diacetyl, which included information on toxicology and health effects of this chemical.

5. In October 2004, OSHA's Directors of Enforcement Programs, and Cooperative and State Programs, issued a memorandum to Regional Administrators, Area Directors, State Plan Designees, and Consultation Program Managers encouraging them to contact employers that may have employees exposed to the potential hazards in this industry. The field was provided with copies of the NIOSH alert titled "Preventing Lung Disease

in Workers Who Use or Make Flavorings". Letters were mailed to locations where microwave popcorn manufacturing was occurring.

6. OSHA has prepared a safety and health information bulletin (SHIB) entitled, *Respiratory Disease Among Employees in Microwave Popcorn Processing Plants*, which will be released shortly.

7. OSHA has prepared a guidance document entitled: *Hazard Communication Guidance for Diacetyl and Certain Food Flavorings Containing Diacetyl*, which will be released shortly.

B. Additional Outreach Activities.

1. Compliance Assistance Specialists (CAS) may undertake the following:

a. Contact local hospitals, occupational health clinics, and local occupational physicians and alert them via mail about this NEP and also provide them with a copy of NIOSH's final report and the OSHA SHIB. See Appendix B for a form letter developed specifically for the health care industry.

b. Contact Temporary Employment Agencies, alerting them to this NEP so that they can inform their employees and clients who use or may be exposed to butter-flavoring chemicals while on assignments.

XIV. Inspection Procedures.

This section outlines procedures for conducting inspections and preparing citations for hazards related to employee exposures to butter-flavoring chemicals. For further guidance, CSHOs should consult the OSHA directives, appendices, and other references provided below.

Appendix E provides a description of hazardous conditions that may be encountered at a popcorn processing facility.

A. Opening Conference.

1. During the opening conference, the CSHO shall initially confirm that the employer uses butter-flavoring chemicals in the manufacture of microwave popcorn.

2. CSHOs must explain the goals of this NEP to the employer and provide, when they become available, copies of the Popcorn SHIB, the Hazard Communication Guidance Document for Diacetyl and Food Flavorings, and NIOSH's Gilster-Mary Lee HHE report to the employer.

Note: CSHOs may choose to provide a copy of NIOSH's report to the employer for copying or inform the employer that a copy can be accessed at http://www.cdc.gov/niosh/hhe/reports.

3. CSHOs must request copies of MSDSs for all butter-flavoring chemicals used at the facility.

4. CSHOs must request information on any hazard analyses performed at the facility for the following:

   a. 29 CFR 1910.132(d): Hazard assessment and equipment selection: OSHA's Personal Protective Equipment (PPE) standards require employers to assess their workplaces to determine if hazards are present, or are likely to be present, which necessitate the use of PPE (29 CFR §1910.132). If such hazards are present or are likely to be present, employers must ensure that employees use the appropriate PPE to protect their eyes, face, hands and extremities, depending on the nature of the hazard (29 CFR §§1910.132, .133, .138). The employer is responsible for both the quality of the hazard assessment and the adequacy of the PPE selected.

   b. 29 CFR 1910.134(d): Selection of Respirators**:** The NIOSH finding of severe lung disease in employees at several microwave popcorn manufacturing plants demonstrates that "inhalation exposure to butter-flavoring chemicals is a risk for occupational lung disease" (9). Accordingly, employers in the microwave popcorn manufacturing industries that use butter flavoring ingredients **must conduct** the evaluation required by §1910.134(d)(1)(iii) of the Respiratory Protection standard.

      The hazard evaluation requirement is performance-oriented, and a variety of estimation techniques may be used to characterize employee exposures, depending upon the nature of the chemical products, processes, operating environment, and other factors.

      Where a substance is used that may pose a respiratory hazard, the employer **must** assess the nature and magnitude of the hazard relative to the conditions of use in its workplace, considering both normal operating conditions and reasonably foreseeable emergencies.

   c. 29 CFR 1910.1200(d): Hazard determination**:** OSHA's Hazard Communication standard requires that employers who choose not to rely on the evaluation of a hazardous chemical performed by a chemical manufacturer or importer, must conduct their own

evaluation in accord with §1910.1200(d)(2) and (d)(3), and consider the available scientific evidence concerning that chemical.

B. Walk-Around and Records Review.

1. MSDS. CSHOs must thoroughly review the MSDSs for flavoring chemicals used in the microwave popcorn production process to ensure they are in compliance with the requirements of 29 CFR 1910.1200(g). If any deficiency is found, referrals **shall** be made to the appropriate Area Offices pursuant to OSHA Instruction CPL 02-02-038 (CPL 2-2.38D)- Inspection Procedures for the Hazard Communication Standard.

   a. CSHOs should be aware that some MSDSs for diacetyl and other butter-flavoring chemicals may be inadequate. Review the health effects and personal protective equipment sections to determine whether hazard information adequately addresses respiratory, eye, and dermal hazards associated with flavorings containing diacetyl.

   b. For additional information, CSHOs should refer to OSHA's "Hazard Communication Guidance for Diacetyl and Food Flavorings Containing Diacetyl."

2. Injury/Illness Records. CSHOs must review the employer's injury and illness records to identify any employees with recorded illnesses or symptoms associated with exposure to diacetyl and or other butter-flavoring chemicals.

   a. CSHOs shall investigate log entries for any type of respiratory issues such as: chronic bronchitis, asthma, emphysema, pneumonia, toxic effects, fume/vapor respiratory inflammation and other similar entries that could potentially be misdiagnosed as not related to exposure to butter-flavorings. Skin or eye injuries involving chemicals should also be investigated.

      NOTE: When reviewing the OSHA 300 logs, CSHOs should investigate and follow-up on entries such as asthma, respiratory abnormality, toxic effects and other similar notations. Most often, physicians unfamiliar with bronchiolitis obliterans – a rare disease – may incorrectly diagnose the employee's illness. Consult with the Office of Occupational Medicine (OOM) for further guidance.

   b. CSHOs shall follow-up (review additional information) on entries that may be recorded with any of those symptoms and may consult with the Office of Occupational Medicine (OOM) to evaluate whether these symptoms could be associated with exposure to butter-flavorings.

c. CSHOs shall interview **all** employees whose names are recorded on the logs. To identify other cases of respiratory illness which may not have been recorded, CSHOs shall also interview employees working in areas where employees are, or may be, exposed to flavoring chemicals.

Appendix F contains an employee questionnaire to assist with these interviews.

d. CSHOs should attempt to obtain contact information for employees whose names appear on the log but are no longer working at the facility, and interview them if possible.

3. Medical Access Orders. Based on information obtained from illness/injury records and interviews, CSHOs may need to review additional employee medical information. When accessing employee medical information, CSHOs should follow the procedures in 29 CFR 1913.10 and obtain a written medical access order. CSHOs may also consider obtaining specific written consent from an employee pursuant to 29 CFR 1910.1020(e)(2)(ii), and should ensure that the agency or agency employee is listed on the consent form as the designated representative to receive the information.

4. Production Process Evaluation: CSHOs must request and review the employer's production and processing records.

a. Document the types and quantities of flavoring chemicals used to formulate the various batches of flavors, and how often the batches are made.

b. Determine whether the employer uses any ingredients that are heated and if so, to what temperature. The primary means for controlling exposures are local exhaust ventilation to remove contaminants at their source, enclosing production processes or exposure sources, isolation of the processes or exposure sources, substitution of less hazardous materials and general dilution ventilation. Areas of particular concern include mixing areas where butter-flavoring chemicals are mixed, poured, heated and added to heated oil, production areas where ingredients are mixed, packaging lines where popcorn and oil/flavorings are added to microwaveable bags and packaged for shipping and quality assurance or control areas where multiple bags are popped and tested.

c. Evaluate and document how frequently butter-flavorings are

directly handled (e.g., measuring, pouring, mixing, transferring, etc.) and the extent to which engineering controls, work practices, and protective equipment are implemented during these operations.

d. Evaluate employees' respirator usage, if any, and request a copy of the employer's respiratory protection program.

NOTE: NIOSH has used **diacetyl,** a ketone with butter-flavoring characteristics as a marker of exposure to volatile butter-flavorings at microwave popcorn manufacturing facilities. CSHOs should be aware that diacetyl is used in varying percentage amounts depending on the flavor and batch. Therefore, monitoring should particularly include those batches containing the greatest percentage of diacetyl. Also, powdered flavoring chemicals and flavoring pastes may represent potential respiratory hazards via inhalation of volatile chemicals or respirable particles.

5**.** Exposure Monitoring. CSHOs must conduct full-shift personal air monitoring and short-term personal air monitoring for diacetyl (when applicable) during operations that involve direct handling of butter-flavorings and other hazardous substances as appropriate. For some butter-flavoring chemicals, monitoring to assess short-term exposure limits (STELs), ceiling (C) or OSHA PELs may be necessary. Area sampling should also be done. NIOSH has found the following chemicals with OSHA PELs to be present at facilities it investigated.

- Acetaldehyde - PEL 200 ppm
- Furfural-PEL- Skin 5 ppm
- Acetic Acid - PEL10 ppm

a. CSHOs are to use the available MSDSs, production and process information, as well as the listing of other flavoring chemicals provided in Appendix G, in determining whether additional monitoring for other butter-flavoring chemicals should be performed. CSHOs should consult with the Regional Offices to determine whether to conduct additional monitoring.

b. NIOSH has identified the mixing room as an area associated with exposure to butter-flavoring ingredients and an increased potential for lung disease in employees. Air monitoring should also be conducted in the mixing rooms, as well as in the following areas of the worksite, where applicable.

- Rooms where flavoring tanks are located
- Production line(s)

- Quality assurance laboratory (ies)
- Packaging area(s) and
- During cleaning and maintenance activities

c. Appendix D provides more sampling information.

C. Citation Guidance.

1. The General Duty Clause:

a. Where all the elements for a General Duty Clause violation can be established, the A.D., in consultation with RSOL, shall consider issuing a citation.

Elements of a General Duty Clause violation are:

- The employer failed to keep the workplace free of a hazard to which employees of that employer were exposed;
- The hazard is recognized by the employer or its industry;
- The hazard was causing or was likely to cause death or serious physical harm; and
- There were feasible and useful means to correct the hazard.

The CSHO must initially determine whether employees have experienced, or are experiencing, respiratory symptoms consistent with exposures to butter-flavoring chemicals similar to those documented in the NIOSH study, and that there was exposure to those chemicals. The following types of evidence will be necessary to establish a General Duty Clause violation:

- Documented instances of obstruction of airways, lung disease or lung-function abnormalities in current employees,
- Documented employee exposure to diacetyl,
- Evidence of feasible and effective measures that the employer could have implemented to reduce or eliminate exposures to diacetyl and other butter flavoring chemicals, and
- Expert opinion evidence.

b. When workplace conditions/operations are similar to those

observed by NIOSH during its evaluation of the industry (See Appendix E) and the employer has provided no protective measures, (such as installing engineering controls, instituting work practices or providing adequate respiratory protection), but there are no identifiable employee respiratory illnesses present, Area Offices may consider issuing 5(a)(1) citations only after consulting with the National Office.

NOTE: When the criteria for a 5(a)(1) citation are not met, then a Hazard Alert Letter (HAL) may be issued (see Appendix C).

c. Sample Alleged Violation Description (AVD) for citing employee exposures to butter-flavoring ingredients containing diacetyl

Note: Sample AVD language is presented as a model to assist CSHOs in developing citations. Care should be taken to tailor citations to reflect the conditions found at particular facilities and to give notice to cited establishments of the violative conduct.

Section 5(a)(1) of the Occupational Safety and Health Act: The employer did not furnish employment and a place of employment which were free from recognized hazards that were causing or likely to cause death or serious physical harm to employees, in that employees were required to perform tasks that exposed them to an inhalation hazard from diacetyl and/or butter-flavoring ingredients containing diacetyl. NIOSH studies have established that there is a statistically significant and positive relationship between cumulative exposures to diacetyl in microwave popcorn processing plants and the development of severe occupational lung disease.

(a) (LOCATION)(DATE)(IDENTIFY SPECIFIC OPERATION/TASK(S) AND DEPARTMENTS, DESCRIBE CONDITIONS, INCLUDING EXPOSURE LEVELS) An evaluation of this operation/task(s) indicated that employees required to perform this task were exposed to a hazard which caused, or was likely to cause, severe lung disease and obstruction of lung airways.

Abatement

Feasible and useful abatement methods for reducing this hazard include, but are not limited to, the implementation and use of engineering and work practice controls such as: (List all recommended controls and practices not used by the employer). See Appendix H for a list of recommended engineering and work practice controls. Selection and use of appropriate respiratory protection. Employee illnesses may also be reduced by

identifying exposed employees, using medical questionnaires to identify employees with respiratory symptoms of lung dysfunction and airway obstruction and referring symptomatic employees to physicians who specialize in occupational or pulmonary medicine for appropriate medical treatment.

NOTE: CSHOs may consult NIOSH's Gilster-Mary Lee Corporation HHE exposures for additional information. That report shows that, when certain controls were in place, both the exposure levels and the incidence of employee symptoms decreased

2. OSHA PELs

Where exposures are in excess of the permissible exposure limits (PELs), ceiling limits (C) or STELs, for substances listed in Table Z-1, cite the applicable sections of 29 CFR 1910.1000.

3. Respirator Standard

a. Where employers fail to conduct the initial respiratory hazard evaluation, cite 29 CFR 1910.134(d)(1)(iii).

b. Where the employer uses respirators, but fails to comply with a requirement in the respirator standard, cite the applicable sections of 29 CFR 1910.134.

- No overexposure is required to issue citations under this standard but when overexposures are found, this standard may be cited in conjunction with the General Duty Clause or 29 CFR 1910.1000 as appropriate.

4. PPE Standards

Where flavoring chemicals having irritant properties are present, and employees' eyes and or skin are potentially exposed to such chemicals, cite the applicable PPE standard (29 CFR §§1910.132, .133, 138).

a. Chemical goggles or other appropriate eye protection must be used when there is a potential for splash or vapor exposure to a substance that is likely to cause injury to the eye.

b. Chemical-resistant gloves, or sleeves or other appropriate protection for exposed skin must be used when handling liquid, paste, or powdered flavoring ingredients that could cause dermal injury. CSHOs should consult the MSDS for the appropriate gloves.

Note: Since butter-flavorings vary among manufacturers, CSHOs should recommend that employers communicate with their flavoring manufacturer and their protective equipment vendor to select the appropriate glove material.

c. The employer must also provide training for exposed employees as indicated in 29 CFR 1910.132. This training must include information on when and how to use appropriate PPE.

d. In addition, employers must provide information on the value, limitations and maintenance of this equipment in accordance with 29 CFR §§1910.132 and .134.

D. Other Applicable Requirements.

1. Hazard Communication.

a. Employees who may be exposed to popcorn butter-flavoring chemicals and flavoring ingredients, including diacetyl, are required to be trained on the hazards of the chemicals in the workplace pursuant to 29 CFR §1910.1200(h)(3).

b. Employees must be informed of the signs and symptoms of any respiratory, skin or eye conditions associated with exposures to butter-flavoring chemicals, as identified by NIOSH.

c. Employers must ensure that all Material Safety Data Sheets (MSDS) are readily accessible to employees.

NOTE: CSHOs should be aware there are over 2,000 chemically-defined flavoring substances which are used to formulate flavors and employers may use varying combinations. However, existing MSDSs and labels may not include the newer information regarding the health effects of diacetyl and other popcorn food flavoring chemicals. Therefore, CSHOs should ensure that all containers, including those used for mixing process chemicals, are labeled with the appropriate hazard warnings. Some chemicals may be exempt due to coverage under the Federal Food, Drug and Cosmetic Act (21 U.S.C. 301 *et seq*.) However, even if a chemical is covered by the FDA, it must be labeled pursuant to the HCS once it is transferred into in-house containers.

Citation Guidance: Detailed inspection and citation guidance, including guidance on how to address inadequate MSDSs, is

contained in OSHA Instruction CPL02-02-038 (CPL 2-2.38D)-Inspection Procedures for the Hazard Communication Standard.

2. Exposure and Medical Records.

a. Interview the employees to determine whether they understand their rights to review their medical and exposure records, as well as their rights regarding the confidentiality of such records.

b. CSHOs must review the employer's recordkeeping program to ensure that the required information is collected and recorded as required by 29 CFR 1904.

c. When reviewing the employee medical records, ensure that the confidentiality of these records is protected, in accordance with 29 CFR 1913.10.

d. Evaluate the employer's method of ensuring the confidentiality of employee medical records.

Citation Guidance: Where there are violations, CSHOs should cite the applicable sections of 29 CFR 1904 or 1910.1020.

3. Flammable and combustible liquids.

a. Diacetyl is a highly flammable liquid and vapor. Other popcorn butter-flavoring chemicals may also be flammable. Therefore, during the course of an investigation attention should be paid to the handling and storage of these chemicals. Flammables are to be kept in closed containers, and during transfers, the containers should be bonded and grounded.

Citation Guidance: The requirements of 1910.106 (e) should be cited when appropriate.

4. Confined Space.

a. Popcorn processing facilities and facilities using flavoring substances generally use large containers and tanks for storage and mixing. CSHOs should determine whether any confined spaces exist at a facility and the employer's procedures for cleaning this equipment.

Citation Guidance: All applicable requirements of 29 CFR 1910.146 shall be cited when employees are required to enter containers that may be considered confined spaces. Compressed air

may not be used for cleaning. If the employer is using compressed air for cleaning confined spaces, 29 CFR 1910.242(b) should be cited.

E. Hazard Alert Letters:

1. Where a determination is made not to issue a 5(a)(1) citation but cases of illnesses related to exposures to popcorn flavoring chemicals, including diacetyl, can be documented, or other evidence of a hazard exists, a hazard alert letter (HAL) should be sent to the employer. The HAL should recommend specific actions that would assist in the reduction of illnesses and include a notification that a follow-up inspection may be conducted. A sample Hazard Alert Letter is included in Appendix C.

F. Follow-up Inspections:

1. Where citations are issued for overexposure to regulated popcorn flavoring chemicals, or exposure to unregulated flavoring chemicals such as diacetyl, follow-up site visits must be conducted to determine whether the employer has implemented appropriate abatement measures, including engineering controls or work practices and providing respirators and other appropriate PPE where necessary.

2. After abatement verification the Area Office will send all relevant information to the Regional Office. Information includes:
    - Area Office
    - Inspection Number
    - Follow-up Inspection Number(s)
    - Inspection Dates
    - Company Name
    - Initial Sampling Results
    - Follow-up Sampling results
    - Abatement Measures

G. Program Evaluation:

1. This NEP will be evaluated using data collected from case files and follow-up site visit reports submitted by each Area Office to the Regional Offices. Each Region shall designate an individual as the Popcorn Flavoring Chemical Coordinator, who will work with the Office of Health Enforcement.

H. Coordination.

1. National Office: This NEP will be coordinated by the Directorate of Enforcement Programs (DEP) - Office of Health Enforcement (OHE). All questions and comments should be directed to the Office of Health Enforcement. OHE will coordinate with the Directorate of Science Technology and Medicine (DSTM), Office of Occupational Medicine and other offices for assistance as needed.

2. Regional Office: Each Regional Administrator will identify a coordinator for this NEP. The coordinator will be responsible for collecting the data required under Section F2.

I. Federal Agencies. Executive Order 12196, Section 1-201, and 29 CFR 1960.16 require Federal Agencies to follow the enforcement policy and procedures contained in this Direction.

J. IMIS Coding Instructions. The instruction below is for recording popcorn butter-flavoring chemicals inspections under this popcorn NEP. The majority of inspections conducted under this NEP will be "Health" inspections and should be coded as such. When this NEP is conducted in conjunction with an SST inspection, the OSHA-1 Forms must be marked as "programmed planned" in item 24, and in item 21, Inspection Category must be recorded as "H". In addition, the "NEP" value of "SSTARG07" will be recorded in Item 25d along with the NEP code "POPCORN."

If during an SST inspection (or other safety-related inspections) popcorn butter-flavoring chemical hazards are observed, the NEP code for "POPCORN" will be recorded.

This new "POPCORN" code applies to the following enforcement forms: OSHA-1, OSHA-7, OSHA-36, OSHA-90 and OSHA-55.

Consultation: Whenever a visit is made in response to this NEP, Consultation request/visit forms are to be completed with the NEP code "POPCORN" in item 25 on Form-20, and in item 28 on Form-30.

XV. Consultation. When appropriate, 21(d) Consultation Projects are encouraged to develop their own outreach activities and plan to address exposures to popcorn flavoring chemicals.

APPENDIX A
Establishment List of NAICS and SIC Codes

This appendix contains a list of SIC and NAICS Codes which may be involved in microwaveable popcorn butter-flavoring production and/or the use of popcorn flavors containing diacetyl to manufacture foods, beverages and other consumer products. This should not be considered an exhaustive listing; instead, it is a list of those facilities codes NIOSH has identified as using popcorn butter-flavoring chemicals, as well as facilities codes reported by Dun & Bradstreet as butter-flavored microwave popcorn manufacturers.

SIC Code	Industry Title	NAICS Code
2099	**Popcorn packaged except popped, as well as manufacturing of prepared foods**	**311340**
2087	**Flavoring extracts, and flavoring syrups**	**311942**
2096	**Popcorn balls, candy covered popcorn**	**311919**
2064	**Candy and other candy covered popcorn products**	**311330**
2043	**Breakfast foods/non chocolate Confectionary Manufacturing (1)**	**311340**
	Post-harvest Crop Activities (except cotton Ginning) (1)	**115114**
2099	**Other miscellaneous food Manufacturing (13)**	**311999**
2068	**Confectionary and Nut Stores (1)**	**445292**

APPENDIX B
Health Care Form Letter

Area Office Header
Date

Name of Health Care Provider
Address of Health Care Provider

Dear _____:

Subject: Occupational Lung Disease Among Employees in the Microwave Popcorn Manufacturing Industry

The Occupational Safety and Health Administration Region/Area office is alerting health care professionals to the occurrence of occupational lung disease among employees who are exposed to butter flavoring ingredients in the microwave popcorn manufacturing industry. In 2000, the National Institute for Occupational Safety and Health (NIOSH) investigated a microwave popcorn manufacturing facility in Missouri where nine employees developed bronchiolitis obliterans, a severe, potentially fatal, pulmonary disease. The investigation concluded that there was an increased risk for occupational lung disease among employees with inhalational exposure to butter flavorings. Since this initial investigation, additional cases of occupational lung disease including bronchiolitis obliterans have been recognized among employees at other microwave popcorn manufacturing plants. Diacetyl, a butter-flavoring chemical, has been detected in NIOSH investigations where cases of fixed obstructive lung disease, including bronchiolitis obliterans, have been diagnosed in microwave popcorn manufacturing facilities.

Occupational History:
The occupational history should include a description of current and past jobs, as well as information about workplace exposures to chemicals (including flavoring ingredients). It is important to ask if any other employees are experiencing respiratory symptoms or are known to have developed lung disease. Additional information about workplace exposures to flavoring chemicals can be found in Material Safety Data Sheets (MSDS) or by contacting manufacturers. Diacetyl is listed by the CAS number 431-03-8.

Symptoms:

Symptoms experienced by employees include cough (usually non-productive) and dyspnea, particularly with exertion. These symptoms may not improve when employees are away from work (e.g., nights, weekends, vacations). Additional signs

and symptoms related to exposure to butter flavorings may include eye, nose, throat and skin irritation, fever, night sweats and weight loss. Symptoms are usually gradual in onset but severe symptoms may occur suddenly. Bronchiolitis obliterans is a rare disease and employees may be misdiagnosed as having asthma, chronic bronchitis, emphysema, and other lung diseases.

Medical Evaluation:
The occupational lung disease identified in the NIOSH investigations is characterized by fixed airways obstruction on spirometry after challenge with bronchodilators. Spirometry findings may also include evidence of restriction. Spirometry should follow criteria established by the American Thoracic Society (ATS) guidelines for standardization of spirometry which can be obtained through the ATS website: http://www.thoracic.org/sections/publications/statements/index.html.

Additional studies such as diffusing capacity are usually normal, but lung volumes may show hyperinflation. Chest radiographs are also usually normal. If fixed airways obstruction is present and bronchiolitis obliterans is suspected, referral to pulmonary and radiographic specialty care is optimal to ensure correct diagnosis and follow-up of this rare and severe lung disease. Bronchiolitis obliterans is usually diagnosed by findings on paired inspiratory and expiratory high resolution computerized tomography scans (CT or CAT scans).

More information about occupational lung disease related to flavoring exposure is available at:

http://www.osha.gov/SLTC/flavoringlung/index.html
http://www.cdc.gov/niosh/docs/2004-110/

OSHA is dedicated to saving lives, preventing injuries and illnesses and protecting America's working men and women. Safety and health add value to business, the workplace and life. For more information about OSHA programs, visit our website at www.osha.gov.

Sincerely,

Area Director

Enclosure(s)

Appendix C
Sample Hazard Alert Letter

Note: This letter must be adapted to the specific circumstances noted in each inspection. The letter below is an example of the type of letter that may be appropriate in some circumstances. If the employer has implemented, or is in the process of implementing efforts to address hazardous conditions, those efforts should be recognized and encouraged, if appropriate.

Italicized comments are for OSHA compliance use only and should not be included in the letter.

Dear Employer:

An inspection of your workplace and evaluation of your OSHA recordkeeping logs at (location) on (date) disclosed the following workplace condition(s) which have been associated with the development of occupational lung disease in employees and are consistent with employee illnesses that can be caused by conditions related to exposure to butter-flavoring chemicals.

[Include a general description of working conditions for each task/job associated with respiratory disease or fixed airway obstruction, such as lack of ventilation, lack of PPE, inappropriate PPE, etc.]

The results of sampling showed exposure(s) above the detection limit(s) for the unregulated butter-flavoring chemical(s) or the permissible exposure limit for OSHA regulated chemical(s) (*name chemicals)*. In the interest of workplace safety and health, I recommend that you voluntarily take the necessary steps to materially reduce or eliminate your employees' exposure to the conditions listed above.

Based on the results of its own studies, NIOSH has found that the following recommended engineering and work practice controls can help reduce employee exposures to popcorn butter-flavoring chemicals as well as other food flavoring chemicals.

1. Engineering Controls

   Engineering controls are the first line of defense in employee protection. Therefore, employers should provide appropriate engineering controls and should train their employees in the use of those controls and in work practices to ensure that employee exposures to popcorn butter flavoring chemicals are minimized. The following engineering controls are recommended:

   - Isolation of the mixing room from the rest of the plant using walls, doors, or other appropriate barriers.
   - Equipping the mixing room with a separate ventilation system or ensuring that negative air pressure (relative to the rest of the plant) is maintained in the mixing room to avoid the outward migration of contaminated air to adjacent areas of the plant.
   - Reducing the operating temperature of the holding and mixing tanks to that

necessary to prevent solidification of the flavoring mixture (normally <120˚ F). This aids in reducing the volatilization of components not limited to the butter flavoring and their release into the workroom air.

- Equipping the head space of the mixing and holding tanks where flavorings are added to oil or held in pure form with local exhaust ventilation directed out of the plant.
- Automation of the mixing process.
- Covering the flavoring and finished oil tanks and ventilating the headspace to reduce emissions into the room.
- Eliminating spillage from overfilling tanks, leaks in seals and fittings, and manual transfer of materials, all of which have been identified as sources of emissions.
- Establishing standard procedures for cleaning workplace tanks and containers, and spills.
- Reducing dust exposure during bag dumping by installing commercially available bag dumping stations equipped with local exhaust ventilation (three-sided canopy hood) and bag disposal.
- Putting lids on transfer buckets to avoid residual vapor release and/or placing buckets in a ventilated area following transfer; or pumping flavoring from smaller to larger tanks to avoid manual transfer altogether.
- Adding flavorings at room temperature.
- If flavoring must be heated prior to adding it to the flavoring tank or mixing tank, transfer the flavoring to the tank via a pumping system rather than manual transfer.
- Providing additional general dilution ventilation using axial flow wall fans.
- Storing volatile flavoring substances in cooled storage areas, with their own air handler that has minimum circulation.
- Isolation of cleaning areas, and ensuring that vessels used for powdered butter-flavoring chemicals are not cleaned with compressed air. When vessel entry is necessary, ensuring compliance with the confined space entry requirements.
- Maintaining good housekeeping in any areas where flavorings substances or their ingredients are handled.

2. Personal Protective Clothing and Equipment

a. Skin and Eye Protection

To minimize skin contact, ensure that appropriate protective clothing is worn in areas where popcorn butter flavoring and other food flavoring chemicals are being mixed or processed. Protective clothing includes garments worn over the employee's skin. To be effective, personal protective equipment must be appropriate to the hazard it is meant to protect against; individually selected; properly fitted and periodically refitted; conscientiously and properly worn; regularly maintained; and replaced as necessary. In addition, employers must:

- Perform a workplace hazard assessment in accordance with 29 CFR 1910.132(d)

to determine if hazards are present, or are likely to be present which necessitate the use of personal protective equipment (PPE);

- Provide and ensure the use of chemical-resistant gloves or sleeves or other appropriate protection when there is potential for dermal injury, chemical goggles or appropriate eye protection, and protective clothing when a potential eye or skin exposure exits, and
- Train employees on the limitations and use of PPE required during the handling of microwave popcorn processing operations.

b. Respiratory Protection

The following requirements and recommendations will assist microwave popcorn employers utilizing respiratory protection:

- Employers requiring the use of respiratory protection must establish, implement, and maintain a written respiratory protection program in accordance with 29 CFR 1910.134(c);
- Employees must be trained annually and medically evaluated prior to using respiratory protection;
- Employees must be fit tested prior to being required to use respirators;
- Employers must provide employees with clean respirators and ensure that respirators are being stored in a manner to protect them from damage or contamination;
- A NIOSH certified half-facepiece negative-pressure respirator with organic vapor cartridges and particulate filters is the minimum level of respiratory protection recommended for entry into mixing areas;
- Powered air-purifying respirators or supplied-air respirators are also appropriate and will provide a higher level of protection.

3. Training and Information

Employers must comply with the OSHA Hazard Communication standard, 29 CFR 1910.1200. In particular, employers must ensure that employees exposed to hazardous chemicals, including diacetyl, are trained in and have access to the following information:

- The specific nature of the operations in their workplace where exposure to diacetyl and other butter-flavoring chemicals may occur;
- Material Safety Data Sheets (MSDSs) for flavoring chemicals containing diacetyl and other butter-flavoring chemicals;
- The signs and symptoms of butter-flavoring chemical exposure;
- The importance of avoiding skin contact when working with chemicals that can cause dermal effects.
- The engineering controls the employer is using to reduce employee exposures to diacetyl and other flavoring chemicals;
- Specific work practices that should be used to reduce exposure to these chemicals;

- The use of appropriate protective equipment, including respirators and skin protection;
- Methods that may be used to detect the presence of diacetyl or other butter-flavoring chemicals in the workplace, such as workplace monitoring; and
- The results of any industrial hygiene sampling the employer or others have conducted for levels of diacetyl or other butter-flavoring chemicals used in microwave popcorn processing.

4. Medical Surveillance

A medical screening program can help employers to identify employees experiencing adverse health effects from exposure to butter flavorings. Spirometry, or pulmonary function testing (PFT), measure the breathing capacity of the lungs and is the best available test for early detection of decreasing or abnormal lung function among exposed employees. It is recommended that employers:

- Perform a baseline spirometry test for all newly-hired employees and ask each employee to complete a health questionnaire before starting work in areas where butter flavorings are used.
- At a minimum, perform an annual evaluation for symptoms (i.e., health questionnaire) and an annual spirometry for all employees exposed to volatile butter flavorings and food flavorings containing diacetyl.

[Please refer to the OSHA SHIB, Respiratory Disease Among Employees in Microwave Popcorn Processing Plants, for more information on medical screening.]

Using the above components, together with information gathered during the inspection, describe the specific conditions or weaknesses and suggest methods of abatement.

You may voluntarily provide this Area Office with progress reports on your efforts to address these conditions. OSHA may return to your worksite to further examine the conditions noted above.

Enclosed is a list of available resources that may be of assistance to you in preventing work-related injuries and illnesses in your workplace.

If you have any questions, please feel free to call [name and phone number] at [address].

Sincerely,
Area Director

Enclosure

APPENDIX D
Guidelines for Air Sampling

This appendix summarizes the procedures for obtaining air samples for diacetyl and other butter-flavoring chemicals used in the mixing process. Diacetyl air concentrations were the highest in the mixing rooms of several (6) facilities NIOSH investigated. Most often the facilities have an open process with large tanks of heated mixture of soybean oil, butter flavorings, coloring and salt. Flavorings can be supplied as powders, liquids or pastes. The flavorings are often measured in open containers and poured into open tanks of heated soybean oil.

CSHOs should ensure that both full-shift personal monitoring and area monitoring are conducted in rooms where flavoring tanks are located, as well as, on the production line, and in the quality assurance and packaging areas. When applicable, short-term (STELs, Ceilings, etc.) exposure monitoring is conducted. CSHOs should be aware that some employers may substitute powdered flavorings, which are not as volatile when mixed. However, this powdered flavoring form does become airborne and CSHOs should be prepared to conduct total and respirable dust sampling depending on particle size.

1. DIACETYL:

Synonyms: Biacetyl; 2,3-Butanedione; 2,3-Butadione; 2,3-Diketobutane; Dimethyldiketone; Dimethylglyoxal; Glyoxal, dimethy².

OSHA IMIS Code Number: D740

Chemical Abstracts Service (CAS) Registry Number: 431-03-8

NIOSH, Registry of Toxic Effects (RTECS) Identification Number: EK2625000

Chemical Description and Physical Properties: Green-yellow liquid
molecular formula: $C_4H_6O_2$
molecular weight: 86.09
boiling point: 88°C
vapor pressure: 178 mm
melting point: -3°C
Potentially hazardous incompatibilities: strong oxidizers, bases, reducing agents, metals
Laboratory Sampling/Analytical Method: sampling media:
Two Silica Gel Tubes in series (150/75mg sect., 20/40 mesh)
Analytical solvent: 95:5 ethanol:water
Maximum volume: 3 Liters
Maximum flow rate: 0.05 L/min

Current analytical method: Gas Chromatography; GC/FID
Method reference: OSHA Manual of Analytical Methods (OSHA PV2118)
Method classification: Partially Validated

2. POWDERED FLAVORINGS: use methods for PNOR (Particulates not otherwise regulated(Respirable Fraction).

(a) Synonym(s): Dust (**Respirable Nuisance**) prior to 9/1/89; PNO

OSHA IMIS Code Number: 9130

MEDIA: Tared Low Ash Polyvinyl Chloride (LAPVC) filter 5 microns preceded by a 10 mm Nylon cyclone
MAX V: 816 Liters MAX F: 1.7 L/min
ANL 1: Gravimetric
REF: 11, 12
SAE: 0.10
CLASS: Fully Validated

(b) Synonyms: Dust, (Total); "Inert" dusts; Nuisance dusts; PNOR [Note: Includes all inert or nuisance dusts, whether mineral, inorganic, not listed specifically in 1910.1000.]

OSHA IMIS Code Number: 9135
IMIS Name History: Dust, (**Total**) prior to 9/1/89

Media: Tared 37-mm diameter low-ash polyvinyl chloride filter
M**aximum volume:** 960 Liters
Maximum flow rate: 2.0 L/min--DO NOT USE A CYCLONE--
Current analytical method: Gravimetric
Method reference: OSHA Analytical Method (OSHA PV2121)
Method classification: Partially Validated

Note: CSHOs should contact the SLCTC for further guidance.

Below is a table showing other flavoring chemicals, PELs, and analytical methods.

APPENDIX D
FLAVORING SUBSTANCES

FEMA No. and Priority[1]	CAS No. and OSHA IMIS [2] No.	Substance	Synonyms	PEL	IDLH [3]	Respiratory Acute [3,4]	Analytical Method [2]	Sampling Medium [2]	Air Volume and Sampling Rate [2]
1231 Low	78-92-2 0461	*sec*-Butyl alcohol	2-Butanol; Butylene hydrate; 2-Hydroxybutane; Methyl ethyl carbinol [3]	TWA 150 ppm (450 mg/m^3)	2000 ppm	Irritating to respiratory tract	NIOSH 1401	Charcoal tube (100/50 mg)	10 L 0.2 L/min
2003 High	75-07-0 0010	Acetaldehyde	Acetic aldehyde; ethanal; ethyl aldehyde [3]	TWA 200 ppm (360 mg/m^3)	2000 ppm	Mildly irritating to respiratory tract	OSHA 68	HMP-coated XAD-2 tube (450/225 mg)	3 L 0.05 L/min
2006 High	64-19-7 0020	Acetic acid	Acetic acid (aqueous); glacial acetic acid (pure compound); ethanoic acid; methane-carboxylic acid [3]	TWA 10 ppm (25 mg/m^3)	50 ppm	Pulmonary edema	OSHA PV2119	Charcoal tube (400/200 mg)	48 L 0.2 L/min
2008 High	513-86-0 A624	Acetoin	Acetyl methyl carbinol; 1-hydroxyethyl methyl ketone; gamma-hydroxy-beta oxybutane; 3-hydroxy-2,3-butanone; 2,3-butanolone; dimethylketol [2]	None	No Data in NPG		NIOSH 2558	Anasorb CMS tube (150/75 mg)	10L 0.2 L/min
2035 High	870-23-5	Allyl mercaptan	2-Propene-1-thiol [5]	None	No Data in NPG				
2053 High	12124-99-1	Ammonium sulfide	Ammonium sulfide; ammonium sulphide; ammonium hydrogen sulfide; ammonium hydrosulfide; ammonium mercaptan; ammonium sulfhydrate; monoammonium sulfide [6]	None	No Data in NPG	Strong irritant to skin and mucous membranes[5]			
2055 Low	123-92-2 1530	Isoamyl acetate	Banana oil; isopentyl acetate; 3-methyl-1-butanol acetate; 3-methylbutyl ester of acetic acid; 3-methyl-butyl ethanoate [3]	TWA 100 ppm (525 mg/m^3)	1000 ppm	Irritating to respiratory tract	OSHA PV2142	Charcoal tube (100/50 mg)	10 L 0.2 L/min
2057	123-51-3 1532	Isoamyl alcohol	Primary isoamyl alcohol; fermentation amyl alcohol; fusel oil; isobutyl carbinol; isopentyl alcohol; 3-methyl-1-butanol [3]	TWA 100 ppm (360 mg/m^3)	500 ppm	Irritating to respiratory tract	NIOSH 1402	Charcoal tube (100/50 mg)	10 L 0.2 L/min

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FLAVORING SUBSTANCES

FEMA No. and Priority[1]	CAS No. and OSHA IMIS [2] No.	Substance	Synonyms	PEL	IDLH [3]	Respiratory Acute [3,4]	Analytical Method [2]	Sampling Medium [2]	Air Volume and Sampling Rate [2]
2127 High	100-52-7 B105	Benzaldehyde	Benzoic aldehyde; benzenecarbonyl; benzene carbaldehyde [3]	None	No Data in NPG				
2147 Low	100-53-8	Benzyl mercaptan	α-Toluenethiol; benzylthiol [5]	None	No Data in NPG	Toxic by inhalation and ingestion; irritant to tissue [5]			
2170 Low	78-93-3 0430	2-Butanone	Ethyl methyl ketone; MEK; methyl acetone; methyl ethyl ketone [3]	TWA 200 ppm (590 mg/m^3)	3000 ppm	Irritating to respiratory tract	OSHA 1004	Anasorb CMS (150/75 mg) SKC 575-002 Passive Sampler 3M 3520 Organic Vapor Monitor	12 L 0.05 L/min 5 to 240 min 5 to 240 min
2174 Low	123-86-4 0440	Butyl acetate	n-Butyl acetate; n-butyl ester of acetic acid; butyl ethanoate [3]	TWA 150 ppm (710 mg/m^3)	1700 ppm [10%LEL]	Irritating to respiratory tract	OSHA 1009	Charcoal tube (100/50 mg)	10 L 0.2 L/min
2175 Low	110-19-0 1534	Isobutyl acetate	Isobutyl ester of acetic acid; 2-methylpropyl acetate; 2-methylpropyl ester of acetic acid; b-methylpropyl ethanoate [3]	TWA 150 ppm (700 mg/m^3)	1300 ppm [10%LEL]	Irritating to respiratory tract	OSHA 1009	Charcoal tube (100/50 mg)	10 L 0.2 L/min
2178 Low	71-36-3 0460	Butyl alcohol	n-Butyl alcohol; 1-butanol; n-butanol; 1-hydroxy-butane; n-propyl carbinol [3]	TWA 100 ppm (300 mg/m^3)	1400 ppm [10%LEL]	Irritating to respiratory tract	NIOSH 1401	Charcoal tube (100/50 mg)	10 L 0.2 L/min
2179 Low	78-83-1 1536	Isobutyl alcohol	IBA; isobutanol; isopropylcarbinol; 2-methyl-1-propanol [3]	TWA 100 ppm (300 mg/m^3)	1600 ppm	Irritating to respiratory tract	NIOSH 1401	Charcoal tube (100/50 mg)	10 L 0.2 L/min
2219 Low	123-72-8	Butyraldehyde	Butaldehyde; *n*-butanal; *n*-butylaldehyde; butyric aldehyde [5]	None	No Data in NPG				

APPENDIX D
FLAVORING SUBSTANCES

FEMA No. and Priority[1]	CAS No. and OSHA IMIS [2] No.	Substance	Synonyms	PEL	IDLH [3]	Respiratory Acute [3,4]	Analytical Method [2]	Sampling Medium [2]	Air Volume and Sampling Rate [2]
2220 High	78-84-2 R237	Isobutyraldehyde	2-Methylpropanal; isobutyric aldehyde; isopropylformaldehyde; isobutnal; methyl propanal; valine aldehyde; isobutaldehyde; 2-methylpropionaldehyde [3]	None	No Data in NPG		NIOSH 2539 (OSHA modified)	HMP-coated XAD-2 tube (150/75 mg)	5 L 0.05 L/min
2221 High	107-92-6 B709	Butyric acid	Butanoic acid; ethylacetic acid; propylformic acid [3]	None	No Data in NPG		SLTC in-house literature file	Silica Gel tube (520/260 mg)	18 L 0.1 L/min
2222 High	79-31-2	Isobutyric acid	2-Methylpropanoic acid [3]	None	No Data in NPG				
2230 Low	76-22-2 0522	Camphor	2-Camphonone; Synthetic camphor; Gum camphor; Laurel camphor [3]	2 mg/m^3	200 mg/m^3	Irritating to respiratory tract, skin, and eyes	NIOSH 1301	Charcoal tube (100/50 mg)	24 L 0.2 L/min
2286 Low	104-55-2	Cinnamaldehyde	3-Phenylpropenal; cinnamyl aldehyde; cinnamic aldehyde [5]	None	No Data in NPG				
2370 High	431-03-8 D740	Diacetyl	Biacetyl; 2,3-butanedione; 2,3-diketobutane; dimethyldiketone; dimethylglyoxal; glyoxal, dimethyl [2]	No PEL	No Data in NPG		OSHA PV2118	Two silica gel tubes in-series (150/75 mg each)	3 L 0.05 L/min
2414 Low	141-78-6 1040	Ethyl acetate	Acetic ester; acetic ether; ethyl ester of acetic acid; ethyl ethanoate [3]	TWA 400 ppm (1400 mg/m^3)	2000 ppm [10%LEL]	Irritating to respiratory tract	NIOSH 1457	Charcoal tube (100/50 mg); ship cold to lab	6 L 0.2 L/min
2418 High	140-88-5 1050	Ethyl acrylate	Ethyl acrylate (inhibited); ethyl ester of acrylic acid; ethyl propenoate [3]	TWA 25 ppm (100 mg/m^3) [skin]	Ca [300 ppm]	Irritating to respiratory tract	OSHA 92	TBC coated Charcoal tube (110/55 mg)	12 L 0.05 L/min
2419 Low	64-17-5 1060	Ethyl alcohol	Alcohol; ethanol; EtOH; grain alcohol; cologne spirit [3]	TWA 1000 ppm (1900 mg/m^3)	3300 ppm [10%LEL]	Irritating to respiratory tract	OSHA 100	Two Anasorb 747 tubes in-series (400/200 mg); separate tubes after sampling	12L 0.05 L/min

APPENDIX D
FLAVORING SUBSTANCES

FEMA No. and Priority[1]	CAS No. and OSHA IMIS [2] No.	Substance	Synonyms	PEL	IDLH [3]	Respiratory Acute [3,4]	Analytical Method [2]	Sampling Medium [2]	Air Volume and Sampling Rate [2]
2434 Low	109-94-4 1155	Ethyl formate	Ethyl ester of formic acid; ethyl methanoate [3]	TWA 100 ppm (300 mg/m^3)	1500 ppm	Irritating to respiratory tract	NIOSH 1452	Charcoal tube (100/50 mg)	10 L 0.2 L/min
2487 High	64-18-6 1310	Formic acid	Formic acid (85%–95% in aqueous solution); hydrogen carboxylic acid; methanoic acid [3]	TWA 5 ppm (9 mg/m^3)	30 ppm	Corrosive, Pulmonary edema	OSHA ID 186SG	Charcoal tube (400/200 mg) ship cold to lab	48 L 0.2 L/min
2489 High	98-01-1 1325	Furfural	Fural; 2-furancarboxaldehyde; furfuraldehyde; 2-furfuraldehyde [3]	TWA 5 ppm (20 mg/m^3) [skin]	100 ppm	Irritating to respiratory tract	OSHA 72	Petroleum-base Charcoal tube (100/50)	180 L 1.0 L/min
2491 Low	98-00-0 1330	Furfuryl alcohol	2-Furylmethanol; 2-hydroxymethylfuran [3]	TWA 50 ppm (200 mg/m^3)	75 ppm	Irritating to respiratory tract	NIOSH 2505	Porapak Q tube (150/75 mg)	25 L 0.05 L/min
2525	56-81-5 1363	Glycerol	Glycerin (anhydrous); glycyl alcohol; 1,2,3-propanetriol; trihydroxypropane [3]	TWA 15 mg/m^3 (total) TWA 5 mg/m^3 (resp)	No Data in NPG	Irritating to respiratory tract	OSHA PV2121	Tared 37-mm low-ash PCV filter	960 L 2.0 L/min (Total Dust) 10-mm Nylon Clyclone; 816 L 1.7 L/min (Respirable Fraction)
2544	110-43-0 1675	2-Heptanone	Amyl methyl ketone; n-amyl methyl ketone; methyl (n-amyl) ketone [3]	TWA 100 ppm (465 mg/m^3)	800 ppm	Irritating to respiratory tract	NIOSH 1301	Charcoal tube (100/50 mg)	25 L 0.2 L/min
2676 Low	79-20-9 1650	Methyl acetate	Methyl ester of acetic acid; methyl ethanoate [3]	TWA 200 ppm (610 mg/m^3)	3100 ppm [10%LEL]	Irritating to respiratory tract	NIOSH 1458	Charcoal tube (100/50 mg)	7 L 0.2 L/min
2691 Low	96-17-3	2-Methylbutr-aldehyde	2-Methylbutanal [5]	None	No Data in NPG				

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FEMA No. and Priority[1]	CAS No. and OSHA IMIS [2] No.	Substance	Synonyms	PEL	IDLH [3]	Respiratory Acute [3,4]	Analytical Method [2]	Sampling Medium [2]	Air Volume and Sampling Rate [2]
2692 Low	590-86-3 I201	3-Methylbutyr-aldehyde	Isovaleral; isovaleral; isovaleric aldehyde; 3-methylbutyraldehyde [5]	None	No Data in NPG		SLTC in-house literature file	Three DNPH-coated filters; two stacked, one separated by a cassette ring; store collected samples in dark	3 L 0.05 L/min
2716 High	74-93-1 1643	Methyl mercaptan	Mercaptomethane; methanethiol; methyl sulfhydrate [3]	C 10 ppm (20 mg/m^3)	150 ppm	Irritating to respiratory tract	OSHA 26	Mercuric acetate-coated 37-mm glass fiber filter	20 L 0.2 L/min
2731 Low	108-10-1 1385	4-Methyl-2-pentanone	Isobutyl methyl ketone; methyl isobutyl ketone; MIBK; hexone [3]	TWA 100 ppm (410 mg/m^3)	500 ppm	Irritating to respiratory tract	OSHA 1004	Anasorb CMS (150/75 mg) SKC 575-002 Passive Sampler 3M 3520 Organic Vapor Monitor	12 L 0.05 L/min 5 to 240 min 5 to 240 min
2742 Low	554-12-1	Methyl propionate	Propionic acid, methyl ester; methyl propanoate; methyl propylate; propanoic acid, methyl ester [6]	None	No Data in NPG				
2746 High	75-18-3 D650	Methyl sulfide	Dimethyl sulfide; dimethyl sulphide; thiobismethane; DMS; methylthiomethane; 2-thiopropane; 2-thiapropane [3]	None	No Data in NPG		SLTC in-house literature file	Charcoal tube (100/50 mg)	5 L 0.1 L/min
2842 Low	107-87-9 2010	2-Pentanone	Ethyl acetone; methyl propyl ketone; MPK [3]	TWA 200 ppm (700 mg/m^3)	1500 ppm	Irritating to respiratory tract	NIOSH 1300	Charcoal tube (100/50 mg)	10 L 0.2 L/min
2908 High	110-89-4 R269	Piperidine	Cyclopentimine; azacyclohexane; cypentil; hexahydropyridine; hexazane; pentamethyleneimine; pentaethyleneimine;pyridine, hexahydro [3]	None	No Data in NPG				

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FEMA No. and Priority[1]	CAS No. and OSHA IMIS [2] No.	Substance	Synonyms	PEL	IDLH [3]	Respiratory Acute [3,4]	Analytical Method [2]	Sampling Medium [2]	Air Volume and Sampling Rate [2]
2923 High	123-38-6 P129	Propionaldehyde	Propanal; propyl aldehyde; propionic aldehyde [5]	None	No Data in NPG	suffocating odor [5]			
2925 Low	109-60-4 2180	Propyl acetate	n-Propyl acetate; n-propyl ester of acetic acid [3]	TWA 200 ppm (840 mg/m^3)	1700 ppm	Irritating to respiratory tract	NIOSH 1450	Charcoal tube (100/50 mg)	10 L 0.2 L/min
2926 Low	108-21-4 1540	Isopropyl acetate	Isopropyl ester of acetic acid; 1-methylethyl ester of acetic acid; 2-propyl acetate [3]	TWA 250 ppm (950 mg/m^3)	1800 ppm	Irritating to respiratory tract	NIOSH 1454	Charcoal tube (100/50 mg)	9 L 0.2 L/min
2928 Low	71-23-8 2170	Propyl alcohol	n-Propyl alcohol; ethyl carbinol; 1-propanol; n-propanol [3]	TWA 200 ppm (500 mg/m^3)	800 ppm	Irritating to respiratory tract	NIOSH 1401	Charcoal tube (100/50 mg)	10 L 0.2 L/min
2929 Low	67-63-0 1560	Isopropyl alcohol	Dimethyl carbinol; IPA; isopropanol; 2-propanol; sec-propyl alcohol; rubbing alcohol [3]	TWA 400 ppm (980 mg/m^3)	2000 ppm [10%LEL]	Irritating to respiratory tract	OSHA 109	Two Anasorb 747 tubes in-series (400/200 mg); separate tubes after sampling; ship cold to lab	18 L 0.2 L/min
2943 Low	110-74-7	Propyl formate	Pormic acid, propyl ester; propyl methanoate; propylformate [6]	None	No Data in NPG				
2944 Low	625-55-8	Isopropyl formate	Formic acid, isopropyl ester; isopropyl formate; isopropyl methanoate; isopropylformate [6]	None	No Data in NPG				
2966 High	110-86-1 2220	Pyridine	Azabenzene; azine [3]	TWA 5 ppm (15 mg/m^3)	1000 ppm	Irritating to respiratory tract	SLTC in-house file	Two XAD-7 tubes in-series (100/50 mg); separate tubes after sampling	10 L 0.1 L/min

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FEMA No. and Priority[1]	CAS No. and OSHA IMIS [2] No.	Substance	Synonyms	PEL	IDLH [3]	Respiratory Acute [3,4]	Analytical Method [2]	Sampling Medium [2]	Air Volume and Sampling Rate [2]
3039 High	7446-09-5 2290	Sulfur dioxide	Sulfurous acid anhydride; sulfurous oxide; sulfur oxide [3]	TWA 5 ppm (13 mg/m^3)	100 ppm	Irritating to respiratory tract	NIOSH 6004	MCEF filter followed by Na_2CO_3 - coated cellulose filter	200 L 1.5 L/min
3173 Low	5077-67-8	1-Hydroxy-2-butanone		None	No Data in NPG				
3217 High	764-40-9	2,4 Pentadienal		None	No Data in NPG				
3218 High	764-39-6	2-Pentenal		None	No Data in NPG				
3219 High	107-85-7	Isopentylamine	1-Amino-3-methylbutane [6]	None	No Data in NPG				
3223 High	108-95-2 2040	Phenol	Carbolic acid; hydroxybenzene; monohydroxy-benzene; phenyl alcohol; phenyl hydroxide [3]	TWA 5 ppm (19 mg/m^3) [skin]	250 ppm	Corrosive, Pulmonary edema	OSHA 32	XAD-7 tube (100/50 mg)	24 L 0.1 L/min
3233 Low	100-42-5 2280	Styrene	Ethenyl benzene; phenylethylene; styrene monomer; styrol; vinyl benzene [3]	TWA 100 ppm C 200 ppm 600 ppm (5-minute maximum peak in any 3 hours)	700 ppm	Irritating to respiratory tract	OSHA 89	TBC-coated Charcoal tube (100/50 mg)	12 L 0.05 L/min
3326 Low	67-64-1 0040	Acetone	Dimethyl ketone; ketone propane; 2-propanone [3]	TWA 1000 ppm (2400 mg/m^3)	2500 ppm [10%LEL]	Irritating to respiratory tract	OSHA 69	Carbosieve S-III tube (130/65 mg)	3 L0.05 L/min
3368 Low	141-79-7 1635	4-Methyl-3-penten-2-one	Isobutenyl methyl ketone; isopropylideneacetone; methyl isobutenyl ketone; mesityl oxide [3]	TWA 25 ppm (100 mg/m^3)	1400 ppm [10%LEL]	Irritating to respiratory tract	NIOSH 1301	Charcoal tube (100/50 mg)	10 L 0.2 L/min

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FEMA No. and Priority[1]	CAS No. and OSHA IMIS [2] No.	Substance	Synonyms	PEL	IDLH [3]	Respiratory Acute [3,4]	Analytical Method [2]	Sampling Medium [2]	Air Volume and Sampling Rate [2]
3382 Low	1629-58-9	1-Penten-3-one	Ethyl vinyl ketone [6]	None	No Data in NPG				
3407 Low	497-70-0	2-Methyl-2-butenal		None	No Data in NPG				
3417 Low	625-33-2	3-Penten-2-one	Ethylidene acetone; methyl propenyl keto [6]	None	No Data in NPG				
3478 Low	109-79-5 0480	1-Butanethiol	Butanethiol; n-butanethiol; 1-mercaptobutane; n-butyl mercaptan [3]	TWA 10 ppm (35 mg/m^3)	500 ppm	Irritating to respiratory tract	SLTC in-house literature file	Mercuric acetate-coated 37-mm glass fiber filter	20 L 0.2 L/min
3521 High	107-03-9	Propanethiol	3-Mercapto-propane;propane-1-thio;propyl mercaptan; n-propyl mercaptan [3]	None	No Data in NPG				
3523 High	123-75-1	Pyrrolidine	Azacyclopentane, prolamine, pyrrole, tetrahydro-; tetrahydropyrrole, tetramethyleneimi [6]	None	No Data in NPG				
3536 Low	624-92-0	Dimethyl disulfide	Methyl disulfide; dimethyl disulfide; dimethyldisulphide, dimethyldisulfide, disulphide, dimethyl; disulfide, dimethyl; 2, 3-dithiabutane; DMDS Evolution [6]	None	No Data in NPG		SLTC in-house literature file	Charcoal tube (100/50 mg)	10 L 0.1 L/min
3537	108-83-8 0924	2,6-Dimethyl-4-heptanone	Diisobutyl ketone; DIBK; sym-diisopropyl acetone; isovalerone; valerone [3]	TWA 50 ppm (290 mg/m^3)	500 ppm	Irritating to respiratory tract	NIOSH 1300	Charcoal tube (100/50 mg)	25 L 0.2 L/min
3553 Low	78-59-1 1538	Isophorone	Isoacetophorone; 3,5,5-trimethyl-2-cyclohexenone; 3,5,5-trimethyl-2-cyclohexen-1-one [3]	TWA 25 ppm (140 mg/m^3)	200 ppm	Irritating to respiratory tract	NIOSH 2508	Petroleum-based Charcoal tube (100/50 mg)	12 L 0.2 L/min
3584 Low	616-25-1	1-Penten-3-ol	Ethyl vinyl carbinol; 1-pentenol-3 [6]	None	No Data in NPG				

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FEMA No. and Priority[1]	CAS No. and OSHA IMIS [2] No.	Substance	Synonyms	PEL	IDLH [3]	Respiratory Acute [3,4]	Analytical Method [2]	Sampling Medium [2]	Air Volume and Sampling Rate [2]
3646 Low	107-86-8	3-Methyl-2-butenal	3-Methyl-2-butenal; 3, 3-dimethylacrylaldehyde; 3, 3-dimethylacrolein; 3-methylcrotonaldehyde; senecioaldehyde [6]	None	No Data in NPG				
3647 Low	556-82-1	3-Methyl-2-buten-1-ol	2-Buten-1-ol, 3-methyl-; dimethylallyl alcohol; gamma, gamma-dimethylallyl alcohol; 3, 3-dimethylallyl alcohol; prenol; prenyl alcohol [6]	None	No Data in NPG				
3667 Low	101-84-8 2047	Diphenyl ether	Diphenyl oxide; phenoxy benzene; phenyl oxide; phenyl ether [3]	TWA 1 ppm (7 mg/m^3)	100 ppm	Irritating to respiratory tract	SLTC in-house file	XAD-7 tube (100/50 mg)	20 L 0.2 L/min
3779 High	7783-06-4 1480	Hydrogen sulfide	Hydrosulfuric acid; sewer gas; sulfuretted hydrogen [3]	C 20 ppm 50 ppm [10-minute maximum peak]	100 ppm	Irritating to respiratory tract, Pulmonary edema	OSHA 1008	Special sampling tube containing uncoated GFF followed by Na_2CO_3 - coated GFF followed by two $AgNO_3$ - coated silica gel beds (200/200 mg)	7.5 L 0.5 L/min ceiling 5 L 0.5 L/min Peak
3860 Low	624-89-5	Methyl ethyl sulfide		None	No Data in NPG				
3897 High	75-33-2 S248	2-Propanethiol	Isopropanethiol; 2-propanethion; 2-mercaptopropane [3]	None	No Data in NPG				
3898 High	5724-81-2	1-Pyroroline		None	No Data in NPG				

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FEMA No. and Priority[1]	CAS No. and OSHA IMIS [2] No.	Substance	Synonyms	PEL	IDLH [3]	Respiratory Acute [3,4]	Analytical Method [2]	Sampling Medium [2]	Air Volume and Sampling Rate [2]
3909 Low	108-94-1 0830	Cyclohexanone	Anone; cyclohexyl ketone; pimelic ketone [3]	TWA 50 ppm (200 mg/m^3)	700 ppm	Irritating to respiratory tract	OSHA 1	Chromosorb 106 tube (100/50 mg)	10 L 0.2 L/min
3946 Low	583-60-8 1765	2-Methylcyclo-hexanone	*o*-Methylcyclohexanone [3]	TWA 100 ppm (460 mg/m^3) [skin]	600 ppm	Irritating to respiratory tract	NIOSH 2521	Porapak Q tube (150/75 mg)	6 L 0.05 L/min
3965 Low	78-96-6 A606	1-Amino-2-Propanol	Isopropanolamine; 1-aminopropan-2-ol; aminopropyl alcohol; 2-hydroxypropylamine [3]	None	No Data in NPG		OSHA PV2122	NTIC-coated XAD-2 tube (80/40 mg)	20 L 0.1 L/min
	Not applicable 9135	Particulates not otherwise regulated (Total Dust)	PNOR (Total Dust)	15 mg/m^3			OSHA PV2121	Tared 37-mm low-ash PCV filter	960 L 2.0 L/min
	Not applicable 9130	Particulates not otherwise regulated (Respirable Fraction)	PNOR (Respriable Fraction)	5 mg/m^3			OSHA PV2121	Tared 37-mm low-ash PCV filter	10-mm Nylon Cyclone; 816 L 1.7 L/min

Notes:

[1] The high/flow Priority notations were assigned by the Flavoring Extract Manufacturers Association (FEMA). The priority levels were assigned based on inhalation exposure data, chemical structure, and volatility. FEMA stated that the higher priority chemicals pose a greater risk of respiratory injury, whereas, the lower priority chemicals pose a hazard only in more extreme circumstances of exposure.

NPG = NIOSH Pocket Guide to Chemical Hazards (referenced below).

References:

[2] OSHA Chemical Sampling Information http://osha.gov/dts/chemicalsampling/toc/toc_chemsamp.html

[3] NIOSH Pocket Guide to Chemical Hazards. http://www.cdc.gov/niosh/npg/

[4] International Chemical Safety Cards. http://www.cdc.gov/niosh/ipcs/ipcscard.html

[5] Lewis, R.J. *Hawley's Condensed Chemical Dictionary,* 14th Edition [CD-ROM] Wiley Interscience: New York, 2002.

[6] ChemWatch Material Data Safety Sheet. http://osha.chemwatch.us/ (accessed May 22, 2007 by paid subscription).

Appendix E
Description of Hazard at Gilster Lee, Jasper, Missouri

Introduction:

The microwave popcorn manufacturing plant evaluated by NIOSH in 2000 is located in Jasper, Mo. The facility has been in operation since 1986 and packages popcorn (microwave and plain popcorn kernels) for both national and international distribution.

Process Description:

Whole kernel corn from Missouri and Nebraska is air-cleaned on arrival, treated with an organophosphate insecticide, and transferred to silos. From the silo, the corn is processed by screening and air-cleaning on a gravity table. The corn is then sent to either the polyethylene packaging area or the microwave production area.

Packaging area: In the polyethylene packaging area, corn is packaged in polyethylene bags by machine without the addition of flavorings or additives. After packaging, the bags are boxed, stacked, wrapped in plastic, and transported to the warehouse by a forklift.

Microwave production area: In the microwave production area, the corn is prepared and packaged using a series of steps.

- In the flavor mixing area, where five of the ill former employees worked, salt, butter flavorings, and coloring agents are mixed by a single person and manually added to a large tank of heated soybean oil. This process produces visible dust, aerosols, and vapors with a strong buttery odor. High levels of diacetyl, methyl ethyl ketone, 2-nonanone, acetoin, acetaldehyde, and acetic acid were found.

  Concentrations of diacetyl were found from 0.25ppm to 97.9 ppm. The mean concentration was 32 ppm. Following the use of engineering controls, the mean dropped to 0.46 ppm.

- Following mixing, the oil/flavoring mixture is piped into holding tanks in the packaging area and maintained at a temperature of 140°F to keep the mixture from solidifying.

- In the packaging area – where the other four employees worked – the oil/flavoring mixture and the kernel popcorn are added to microwavable bags, and the bags are then wrapped in plastic and placed into boxes for distribution. The boxes are stacked on pallets and enclosed in plastic wrap. The pallets are sent to the warehouse.

Appendix F
CSHO Guidance for Employee Interviews

This appendix contains some questions that may assist CSHOs during employee interviews. This is not a specific questionnaire, but these questions may help to assess possible health issues in employees in the microwave popcorn manufacturing industry. The questions do not need to be asked verbatim, but the topics can guide the interview. ***It is very important to ask employees questions about a history of cough or breathing problems, and specifically ask if employees have ever been diagnosed with airways obstruction or bronchiolitis obliterans.*** *Please be aware that the answers to some of these questions may contain privileged medical information, which must be maintained in such a manner as to ensure employee confidentiality. The CSHO should also inform the employee that he/she is not a medical professional and cannot provide medical advice or treatment to the employee. The CSHO can provide the letter in Appendix B for the employee to take to his/her physician.*

A. Smoking history:

1. Do you currently smoke or have you smoked in the past? (If yes, ask how many packs/day and how long has the employee smoked, and when did the employee quit.)

B. Eye and Skin Irritation

Ask the employee about eye and skin irritation, and ask if the employee associates any symptoms with workplace exposure. For example:

1. Since working at the plant, have you had any symptoms of eye irritation, such as watery eyes, red eyes, burning or itching eyes?

2. Is there any exposure at work that you associate with eye irritation?

3. Have you seen a doctor for eye irritation? (If yes, ask if employee was given a specific diagnosis).

4. Since working at this plant have you developed any skin problems, such itching, rash, eczema, blisters, or burns?

5. Is there any exposure at work that you associate with skin problems?

6. Have you seen a doctor for skin problems? (If yes, ask if employee was given a specific diagnosis).

C. Respiratory Symptoms and History

Ask the employee about respiratory symptoms and ask if the employee associates any symptoms with workplace exposures. ***Be sure to specifically ask employees about breathing difficulty and cough.***

1. **Do you usually have a cough?** If yes, when did the cough start?

2. Have you seen a doctor for your cough? (If yes, ask if employee was given a specific diagnosis).

3. Have you ever had any symptoms of wheezing when you breathe? If yes, when did the wheezing start?

4. Have you seen a doctor for your wheezing? (If yes, ask if employee was given a specific diagnosis).

5. **Have you developed any trouble with your breathing, or do you ever feel short of breath?** If yes, when did this start?

6. How often do you have trouble with your breathing?

7. Does it ever get completely better?

8. Do you have breathing trouble when walking up a slight hill, or going up a flight of stairs, or hurrying on level ground**?** (If yes, please have employee describe when they have breathing difficulty).

9. Have you seen a doctor for your breathing problems? (If yes, ask if employee was given a specific diagnosis).

10. **Is there any exposure at work that you associate with any of your respiratory symptoms?**

Ask employee if they have a history of any lung disease. ***Be sure to specifically ask about any diagnosis of airways obstruction and bronchiolitis obliterans.***

1. Have you ever been diagnosed by a doctor with any lung or respiratory disease? For example: bronchitis, chronic bronchitis, pneumonia, emphysema, asthma, reactive airways disease.

2. If yes, what is your diagnosis and when were you diagnosed?

3. If yes, are you currently seeing a physician for this condition?

4. Have you ever been told by a doctor that you had airways obstruction or bronchiolitis obliterans?

5. Have you ever been told you had a lung disease or lung condition related to workplace exposures, including exposure to flavorings?

Appendix G
Recommended Engineering and Work Practice Controls:

1 Engineering and work practice controls are the primary methods for controlling exposures in the workplace and include: local exhaust and general dilution ventilation, isolation of process or source, and restricted access to areas where hazardous materials are used or stored.

- NOTE: NIOSH has recommended that the use of respiratory protection be **mandatory** for all mixers and employees entering the mixing room, until such time as the production process is reengineered or enclosed to eliminate exposures to flavoring chemicals.

2 CSHOs should investigate the employer's process to determine whether any of the following recommended engineering and work practice controls, which have been shown to help reduce employee exposures, are being utilized where applicable. CSHOs should also investigate whether other control measures, not listed below have been implemented. Recommended controls include:

a. Isolation of the mixing room from the rest of the plant using walls, doors, or other appropriate barriers.
b. Equipping the mixing room with a separate ventilation system or ensuring that negative air pressure (relative to the rest of the plant) is maintained in the mixing room to avoid the outward migration of contaminated air to adjacent areas of the plant.
c. Reducing the operating temperature of the holding and mixing tanks to that necessary to prevent solidification of the flavoring mixture (normally <120˚ F). This aids in reducing the volatilization of components not limited to the butter-flavoring and their release into the workroom air.
d. Equipping the head space of the mixing and holding tanks where flavorings are added to oil or held in pure form with local exhaust ventilation directed out of the plant.
e. Automation of the mixing process.
f. Covering the flavoring and finished oil tanks and ventilating the headspace to reduce emissions into the room.

g. Eliminating spillage from overfilling tanks, leaks in seals and fittings, and manual transfer of materials, all of which have been identified as sources of emissions. Establish standard procedures for cleaning workplace tanks and containers, and spills.

h. Reducing dust exposure during bag dumping by installing commercially available bag dumping stations equipped with local exhaust ventilation (three-sided canopy hood) and bag disposal.

i. Putting lids on transfer buckets to avoid residual vapor release and /or placing buckets in a ventilated area following transfer; or pumping flavoring from smaller to larger tanks to avoid manual transfer altogether.

j. Adding flavorings at room temperature.

k. If a flavoring must be heated prior to adding it to the flavoring tank or mixing tank, transfer the flavoring to the tank via a pumping system rather than manual transfer.

l. Providing additional general dilution ventilation using axial flow wall fans.
    - Note: During the cold months, adequate tempered make-up air is required.

m. Storing of volatile flavoring substances in cooled storage areas, with their own air handler that has minimum circulation.

n. Isolation of cleaning areas, and ensuring that vessels used for powdered butter-flavoring chemicals are not cleaned with compressed air. When vessel entry is necessary, ensuring compliance with the confined space entry requirements.

o. Maintaining good housekeeping in any areas where flavorings substances or their ingredients are handled.

Appendix H
Safety & Health Precautions for Compliance Staff

General

1. CSHOs should avoid all exposure to diacetyl and other butter-flavoring chemicals to the extent possible.

2. If a CSHO's exposure is unavoidable during inspection or sampling activities, the CSHO should wear full-face or half-face APRs with organic vapor/HEPA combo filters. In addition, wear protective clothing, such as disposable coveralls, and protective gloves. If there is any potential for contact with skin from splashes, or particulates, and the CSHO has only a half-face APR, also wear chemical splash goggles to protect eyes and/or a face shield.

The CSHO will review the employer's hazard assessment during the opening conference. Special attention shall be given to the types of personal protective equipment required by the employer for his employees. This will assist the CSHO in determining their own PPE needs prior to entering the facility. A CSHO must be vigilant about wearing PPE that is appropriate for the operations being performed at the establishment.

Appendix I

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14. OSHA Notice 07-03 (CPL 02) Site-Specific Targeting 2007 (SST-07) Effective, May 14, 2007.
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16. OSHA Instruction CPL 02-00-025 (CPL 2.25I), January 4, 1995, Scheduling System for Programmed Inspections.
17. OSHA Instruction CPL 02-02-038 (CPL 2-2.38D), March 20, 1998, Inspection Procedures for the Hazard Communication Standard.
18. OSHA Instruction CPL 02-00-120 (CPL 2-0.120), September 25, 1998, Inspection Procedures for the Respiratory Protection Standard.
19. Memorandum for Regional Administrators, Area Directors, State Plan Designees Consultation Program Managers, October 12, 2004, Subject: Popcorn/Flavoring Establishment Assistance.