Treatment Manual

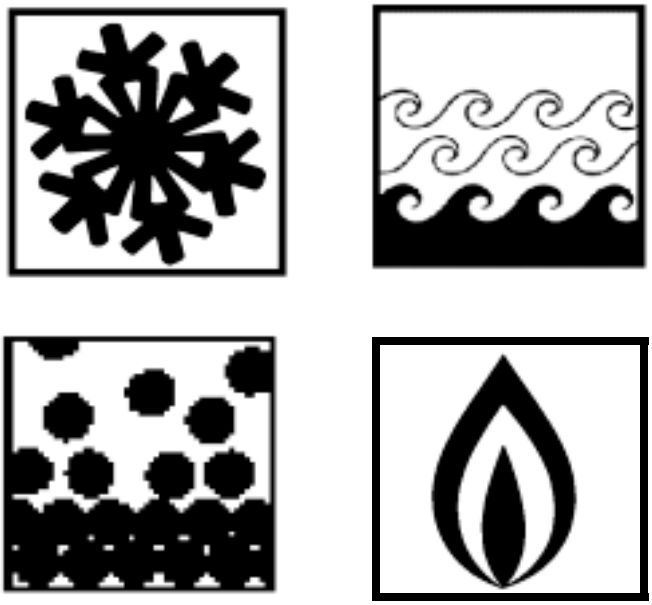
Revision 10/2002-04

United States Department of Agriculture

Marketing and Regulatory Programs

Animal and Plant Health Inspection Service

Plant Protection and Quarantine



Update Record

Record the transmittal number and the date you received the update in the appropriate columns.

Transmittal Number	Date Received	Transmittal Number	Date Received

Important

The information herein is supplied with the understanding that no discrimination is intended and that listing of commercial products, necessary to this manual, implies no endorsement by the authors or Plant Protection and Quarantine (PPQ) of APHIS, USDA. Criticism of products or equipment not listed is neither implied nor intended.

Due to constantly changing laws and regulations, PPQ can assume no liability for the suggested use of chemicals contained herein. (Pesticides should be used according to the label directions on the pesticide container.)

NOTICE

If you are missing updates or manual parts, contact Distribution in Riverdale, Maryland. (Phone 1-301-734-4474; Fax 1-301-734-8455)

Treatment Manual

Contents

Tables
page v
Figures
page ix
Introduction
page-1-1-1
Chemical Treatments
Overview *page 2-1-1*
Fumigants *page 2-2-1*
Fumigants • Methyl Bromide *page 2-3-1*
Fumigants • Methyl Bromide • Tarpaulin Fumigation *page 2-4-1*
Fumigants • Methyl Bromide • Chamber Fumigation *page 2-5-1*
Fumigants • Methyl Bromide • Ship Fumigation *page 2-6-1*
Fumigants • Methyl Bromide • Structure Fumigation *page 2-7-1*
Fumigants • Methyl Bromide • Special Procedures for Container Fumigations Without a Tarpaulin *page 2-8-1*
Fumigants • Sulfuryl Fluoride *page 2-9-1*
Fumigants • Phosphine • Tarpaulin (NAP Chamber or Container) *page 2-10-1*
Aerosols and Micronized Dusts *page 2-11-1*
Dips *page 2-12-1*
Dusts *page 2-13-1*
Sprays *page 2-14-1*
Nonchemical Treatments
Overview *page 3-1-1*
Heat *page 3-2-1*
Heat • Hot Water Immersion Treatment *page 3-3-1*
Heat • Steam Treatments *page 3-4-1*
Heat • Vapor Heat Treatment *page 3-5-1*
Heat • Forced Hot Air *page 3-6-1*
Cold Treatment (CT) *page 3-7-1*
Irradiation *page 3-8-1*
Residue Monitoring
Overview *page 4-1-1*
Instructions for Collecting, Packaging, and Shipping Residue Monitoring Samples *page 4-2-1*
Treatment Schedules
Index to Schedules *page 5-1-1*
T100 - Schedules for Fruit, Nuts, and Vegetables *page 5-2-1*

T200 - Schedules for Propagative Plant Material *page 5-3-1*
T300 - Schedules for Miscellaneous Plant Products *page 5-4-1*
T400 - Schedules for Miscellaneous Products *page 5-5-1*
T500 - Schedules for Plant Pests or Pathogens *page 5-6-1*
Certifying Facilities
Overview *page 6-1-1*
Certifying Facilities
Certification of Vacuum Fumigation Chambers *page 6-2-1*
Certification of Atmospheric Fumigation Chambers *page 6-3-1*
Certification of Cold Treatment *page 6-4-1*
Certification of Hot Water Immersion Facilities *page 6-5-1*
Certification of Forced Hot Air and Vapor Heat Treatment Facilities *page 6-6-1*
Certification of Niger Seed Treatment Facilities *page 6-7-1*
Certification of Irradiation Treatment Facilities *page 6-8-1*
Emergency Aid and Safety
Fumigation Exposure *page 7-1-1*
Pesticide Exposure *page 7-2-1*
Guidelines for Managing Pesticide Spills *page 7-3-1*
Hazard Communication and Material Safety Data Sheets *page 7-4-1*
Equipment
Glossary
Appendixes
page A-1-1
Appendix A
Forms *page A-1-1*
Appendix B
Coast Guard Regulations *page B-1-1*
Appendix C
Maintenance: Supporting and Updating Manuals *page C-1-1*
Appendix D
Conversion Tables *page D-1-1*
Appendix E
Directory of Treatment Facilities *page E-1-1*
Appendix F
List of Integral Containers Approved for Intransit Cold Treatment *page F-1-1*
Appendix G
List of Vessels Equipped for Intransit Cold Treatment *page G-1-1*
Appendix H
Reference Guide to Commercial Suppliers of Treatment and Related Safety Equipment *page H-1-1*
Appendix I
Contacts *page I-1-1*
Appendix J

Frequently Asked Questions (FAQ's) *page J-1-1*
Appendix K
Information Resources *page K-1-1*
Index
page Index-1-1
Comment Sheet

Tables

TABLE 2-4-1:Determine Reporting Requirements *page 2-4-4*

TABLE 2-4-2:Determine the Temperature for the Proper Dosage Rate *page 2-4-15*

TABLE 2-4-3:Determine the Need to Add Gas and Adjust Exposure *page 2-4-23*

TABLE 2-4-4:Determine the Extended Exposure Period *page 2-4-25*

TABLE 2-4-5:Determine Gas Concentration Values and Corrections for Fruits and Vegetables at the 30 Minute Reading of T101-a-1 or Equivalent Schedules. *page 2-4-27*

TABLE 2-4-6:Determine Gas Concentration Values and Corrections for Fruits and Vegetables at the 2 Hour Reading of T101-a-1 or Equivalent Schedules. *page 2-4-28*

TABLE 2-4-7:Determine the Need to Monitor Aeration *page 2-4-29*

TABLE 2-4-8:Determine Responsibility for Aerating the Commodity *page 2-4-30*

TABLE 2-4-9:Determine the Aeration Procedure *page 2-4-31*

TABLE 2-4-10:Determine When to Release the Commodity *page 2-4-33*

TABLE 2-4-11:Determine When to Release the Commodity for Outdoor Fumigations *page 2-4-34*

TABLE 2-4-12:Determine When to Release the Commodity for Indoor Fumigations *page 2-4-34*

TABLE 2-4-13:Determine Number of Fans *page 2-4-35*

TABLE 2-4-14:Determine When to Release the Commodity *page 2-4-36*

TABLE 2-4-15:Determine when to Realease the Commodity *page 2-4-37*

TABLE 2-4-16:Determine When to Release the Commodity for Indoor Fumigations *page 2-4-38*

TABLE 2-4-17:Determine when to Realease the Commodity *page 2-4-39*

TABLE 2-4-18:Determine when to Realease the Commodity *page 2-4-40*

TABLE 2-5-1:Determine Whether to Use Commodity or Air Temperature for Determining Dosage Rate *page 2-5-3*

TABLE 2-5-2:Determine the Responsibility for Monitoring the Aeration *page 2-5-4*

TABLE 2-5-3:Determine the Aeration Procedure *page 2-5-4*

TABLE 2-5-4:Deterimine When to Release the Commodity *page 2-5-5*

TABLE 2-5-5:Determine When to Release the Commodity *page 2-5-6*

TABLE 2-5-6:Determine When to Release the Commodity *page 2-5-7*

TABLE 2-6-1:Determine Pre-fumigation Procedures *page 2-6-7*

TABLE 2-6-2:Determine Time for Extended Exposure *page 2-6-12*

TABLE 2-6-3:Determine the Responsibility for Monitoring the Aeration *page 2-6-12*

TABLE 2-7-1:Deterimne the Number of Sampling Tubes *page 2-7-9*

TABLE 2-7-2:Determine the Responsibility for Monitoring the Aeration *page 2-7-15*

TABLE 2.2.30:Effect of Hose Inside Diameter on Rate of Gas Introduction through a 25 Foot Hose *page 2-8-4*

TABLE 2-30-1: Effect of Hose Length on Rate of Gas Introduction through a inch Inside Diameter Hose *page 2-8-4*

TABLE 2-31-1:Amount of Phosphine Liberated by Various Products *page 2-9-3*

TABLE 2-32-1Determine Reporting Requirements *page 2-10-4*

TABLE 2-32-2Determine the Temperature for the Proper Dosage Rate *page 2-10-10*

TABLE 2-32-3Determine the Need to Add Gas and Adjust Exposure *page 2-10-16*

TABLE 2-32-4: Determine the Extended Exposure Period *page 2-10-18*

TABLE 2-32-5: Determine Gas Concentration Values and Corrections for Fruits and Vegetables at the 30 Minute Reading of T101-a-1 or Equivalent Schedules *page 2-10-21*

TABLE 2-32-6: Determine Gas Concentration Values and Corrections for Fruits and Vegetables at the 2 Hour Reading of T101-a-1 or Equivalent Schedules *page 2-10-22*

TABLE 2-32-7Determine the Need to Monitor Aeration *page 2-10-23*

TABLE 2-32-8Determine Responsibility for Aerating the Commodity *page 2-10-24*

TABLE 2-32-9Determine the Aeration Procedure *page 2-10-25*

TABLE 2-32-10 *page 2-10-26*

TABLE 2-32-11Determine When to Release the Commodity *page 2-10-27*

TABLE 5-2-1: Determine Dip Time Based on Origin of Fruit *page 5-2-49*

TABLE 5-2-2: Determine Dip Time Based on Origin of Fruit *page 5-2-49*

TABLE 5-2-3: Determine Dip Time Based on Origin of Fruit *page 5-2-49*

TABLE 5-2-4:Maximum Commercial Size of Citrus Varieties Authorized by PPQ for Shipment with Treatment T103-a-1 *page 5-2-51*

TABLE 5-2-5:Countries and fruits for which Cold Treatment is Authorized *page 5-2-67*

TABLE 5-2-6: Countries, States, and Associated Fruit for Which T108 is Authorized *page 5-2-72*

TABLE 5-4-1: Amount of Phosphine Liberated by various Products. Calculate amount of product needed by using the amount of phosphine released as shown in the right column. *page 5-4-28*

TABLE 5-5-1: Airbus Industries *page 5-5-26*

TABLE 5-5-2: Antonov *page 5-5-26*

TABLE 5-5-3: ATR *page 5-5-27*

TABLE 5-5-4: BAC (British Aircraft Corp) *page 5-5-27*

TABLE 5-5-5: BAC (Aerospatiale) *page 5-5-27*

TABLE 5-5-6: Boeing *page 5-5-27*

TABLE 5-5-7: Canadair *page 5-5-29*

TABLE 5-5-8: Casa *page 5-5-29*

TABLE 5-5-9: ATR *page 5-5-29*

TABLE 5-5-10: Convair *page 5-5-30*

TABLE 5-5-11: de Havilland *page 5-5-30*

TABLE 5-5-12: Dornier *page 5-5-31*

TABLE 5-5-13: Embraer *page 5-5-31*

TABLE 5-5-14: Fairchild *page 5-5-31*

TABLE 5-5-15: Fokker *page 5-5-31*

TABLE 5-5-16: Lockheed *page 5-5-32*

TABLE 5-5-17: McDonnel-Douglas *page 5-5-32*

TABLE 5-5-18: SAAB *page 5-5-34*

TABLE 5-5-19: Shorts *page 5-5-34*

TABLE 5-5-20: Sidely *page 5-5-35*

TABLE 5-5-21: Tupolev *page 5-5-35*

TABLE 5-5-22: Vickers *page 5-5-35*

TABLE 5-5-23: Military Aircraft *page 5-5-35*

TABLE 5-5-24:Amount of Phosphine Liberated by Various Products *page 5-5-43*

TABLE 7-1-1:Fumigant Monitoring Devices and Sources of Exposure *page 7-1-6*

TABLE 8-1-1:Approximate MB Concentration Associated with Flame Color *page 8-1-10*

TABLE 8-1-2:Threshold Limit Values of Fumigants *page 8-1-12*

TABLE A-1-1: Distribution of APHIS Form 2061 *page A-1-3*

TABLE A-1-2: Root and Tuber Vegetables *page A-1-4*

TABLE A-1-3: Leaves of Root and Tuber Vegetables *page A-1-4*

TABLE A-1-4: Bulb Vegetables *page A-1-4*

TABLE A-1-5: Leafy Vegetables (Other Than Brassica) *page A-1-5*

TABLE A-1-6: Brassica (Cole) Leafy Vegetables *page A-1-5*

TABLE A-1-7: Legume Vegetables *page A-1-5*

TABLE A-1-8: Foliage of Legume Vegetables *page A-1-6*

TABLE A-1-9: Fruiting Vegetables Except Cucurbits *page A-1-6*

TABLE A-1-10: Fruiting Vegetables (Cucurbits) *page A-1-6*

TABLE A-1-11: Citrus Fruits *page A-1-6*

TABLE A-1-12: Pome Fruits *page A-1-7*

TABLE A-1-13: Stone Fruits *page A-1-7*

TABLE A-1-14: Small Fruits and Berries *page A-1-7*

TABLE A-1-15: Cereal Grains *page A-1-8*

TABLE A-1-16: Forage, Fodder, and Straw of Cereal Grains *page A-1-8*

TABLE A-1-17: Grass Forage, Fodder, and Hay *page A-1-8*

TABLE A-1-18: Nongrass Animal Feeds *page A-1-8*

TABLE A-1-19: Tree Nuts *page A-1-9*

TABLE A-1-20: Herbs and Spices *page A-1-9*

TABLE A-1-21: Miscellaneous Fruits *page A-1-10*

TABLE A-1-22:Determine Distribution of PPQ Form 523 (Emergency Action Notification) *page A-1-23*

TABLE D-1-1:Conversion Tables *page D-1-1*

Figures

FIGURE 2-4-1: Container Arrangement in Two Rows *page 2-4-9*
FIGURE 2-4-2: Container Arrangement in Two Rows *page 2-4-9*
FIGURE 2-4-3: Gas Lead Position (Side View) *page 2-4-12*
FIGURE 2-4-4: Typical Stack Arrangement with Fans, Leads, Introduction Line, Padding, and Sand Snakes *page 2-4-14*
FIGURE 2-10-1 Fan Placement *page 2-10-8*
FIGURE 3-7-1: Position of Temperature Sensors in Containers *page 3-7-18*
FIGURE 6-1-1: U Tube Manometer *page 6-2-6*
FIGURE 6-1-2: Generalized Plan of Atmospheric Fumigation Chamber Showing Heat and CIrculation Systems *page 6-2-7*
FIGURE 6-1-3: Generalized Plan of an Atmospheric Fumigation Chamber *page 6-2-8*
FIGURE 6-1-4: Forced-air Circulation Plan for Fumigation Chamber *page 6-2-9*
FIGURE 7-1-1: Abbreviated Spill Plan, Personal Reference Card (Wallet-size) *page 7-3-2*
FIGURE 7-1-2: Emergency Contacts for Pesticide Spills *page 7-3-3*
FIGURE 7-1-3: Poison Control Center *page 7-3-4*
FIGURE 7-1-4: Medical Emergency Facility *page 7-3-4*
FIGURE 7-1-5: Federal Aviation Administration (FFA) Office *page 7-3-5*
FIGURE 7-1-6: Community-Right-To-Know or Emergency Planning Coordinator (Fire Marshall) *page 7-3-6*
FIGURE 7-1-7: Fish and Game Department *page 7-3-6*
FIGURE 7-1-8: Regional Veterinary Services (VS) Office *page 7-3-6*
FIGURE 7-1-9: Regional Safety and Health Coordinator *page 7-3-7*
FIGURE 7-1-10: Local Police *page 7-3-7*
FIGURE 7-1-11: Local Hazardous Waste Official *page 7-3-7*
FIGURE 7-4-1: Appendix E—Guidelines for Employer Compliance *page 7-4-2*
FIGURE 8-1-1: Fumiscope reading of 20 ounces per 1,000ft3 *page 8-1-8*
FIGURE 8-1-2: Halide Gas Leak Detector Using Disposable Propane Tank *page 8-1-11*
FIGURE 8-1-3: Methyl Bromide Volatilizer Coil *page 8-1-25*
FIGURE 8-1-4: Liquid Fumigant Vaporizer *page 8-1-26*
FIGURE 8-1-5: Auxiliary Pump *page 8-1-28*
FIGURE 8-1-6: Open-arm Manometer *page 8-1-30*
FIGURE A-1-1: Example of APHIS Form 2061 (Residue Sample for Food or Feed Product) *page A-1-2*

FIGURE A-1-2: Example of PPQ Form 429 (Fumigation Record) (Front) *page A-1-11*
FIGURE A-1-3: Example of PPQ Form 429 (Fumigation Record) (Back) *page A-1-12*
FIGURE A-1-4: Example of PPQ Form 519 (Compliance Agreement) *page A-1-16*
FIGURE A-1-5: Example of PPQ Form 523 (Emergency Action Notification) *page A-1-19*
FIGURE A-1-6: PPQ Form 449-R (Temperature Recording Installation Report) *page A-1-24*
FIGURE A-1-7: PPQ Form 203 (Foreign Site Certificate of Inspection and/or Treatment) *page A-1-25*
FIGURE A-1-8: PPQ Form 556 (In Transit Cold Treatment Clearance Report) *page A-1-26*
FIGURE A-1-9: APHIS Form 205-R (Instructions and Worksheet for Calibrating Portable Temperature Sensors) *page A-1-27*
FIGURE A-1-10: APHIS Form 206-R (Test of the Accuracy of the Permanent RTD Sensors Installed in Hot Water Tanks) *page A-1-28*
FIGURE A-1-11: APHIS Form 207-R (Sensor Location Diagram Fruit Weights and Pulp Temperatures) *page A-1-29*
FIGURE A-1-12: Calibration of Temperature Probes (Cold Treatment) *page A-1-31*
FIGURE A-1-13: Certificate of Loading and Calibration for Cold Treatment in Self Refrigerated Containers (Cold Treatment) *page A-1-32*
FIGURE A-1-14: Location of Temperature Sensors in Containerized Cargo (Cold Treatment) *page A-1-33*
FIGURE A-1-15: Certificate of Loading and Calibration for Cold Treatment in Self Refrigerated Containers (Cold Treatment) *page A-1-34*
FIGURE A-1-16: Application for USDA-APHIS Approval of Self-Refrigerated Containers (for use in conducting quarantine in-transit cold treatment under USDA regulations) *page A-1-35*
FIGURE A-1-17: Application for USDA-APHIS Approval of Self-Refrigerated Containers (for use in conducting quarantine in-transit cold treatment under USDA regulations) *page A-1-36*
FIGURE A-1-18: General Requirements for Approval of Integral Containers Used for Cold Treatment. *page A-1-37*

1 Introduction

Treatment Manual

Contents

Purpose **page-1-1-1**
Restrictions **page-1-1-1**
Scope **page-1-1-2**
Users **page-1-1-2**
Related Documents **page-1-1-3**
Application **page-1-1-3**
How to Use This Manual **page-1-1-3**
Reporting Problems **page-1-1-4**
Conventions **page-1-1-4**

Purpose

The procedures and treatment schedules listed in this manual are administratively authorized for use in Plant Protection and Quarantine (PPQ). The treatment of listed commodities prevents the movement of agricultural pests into or within the United States. An officer may determine that other commodities require treatment to prevent similar pest movement.

Important

Do not treat unlisted commodities until consulting and receiving approval from the Center for Plant Health Science & Technology (CPHST) in Raleigh, North Carolina.

Also, approval from CPHST must be obtained each time a treatment schedule is used that is not an approved schedule from this manual.

Restrictions

Treatment recommendations listed in this manual are based on uses authorized under provisions of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended. Directions appearing on the label, Section 18 Emergency Exemptions, and manual instructions must be followed. Nevertheless, some treatments may damage commodities.

PPQ personnel may not make any warranty or representations, expressed or implied, concerning the use of these pesticides.

The occasional use of registered trade names in this manual does not imply an endorsement of those products or of the manufacturers by the U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA, APHIS).

Scope

This manual covers all treatments for import, export, and those domestic plant pests which are of quarantine significance. This manual is broadly divided into ten sections:

- Chemical Treatments
- Nonchemical Treatments
- Residue Monitoring
- Treatment Schedules
- Certifying Facilities
- Emergency Aid and Safety
- Equipment
- Glossary
- Appendixes
- Index

Each section is tabbed and contains a Table of Contents, an Overview, and where appropriate, a Methods and Procedures section. The Overview is a broad, general description of what is covered in the section. Methods and Procedures cover the “how to” of that particular activity as well as procedural and reference material for performing tasks associated with each activity.

The Appendixes contain information directly associated with treatment activities, but are placed in the back so they do not interfere with the flow of procedural instructions.

Users

This manual is used primarily by PPQ officers, Headquarters personnel, and State cooperators involved in conducting treatments. The secondary users of this manual are other government agencies, fumigators, pest control operators, foreign governments, and other interested parties.

Related Documents

The following documents are related to the treatment manual:

- Pesticide labels and labelling
- Material Safety Data Sheet (MSDS)
- APHIS Safety and Health manual
- Federal Insecticide, Fungicide, Rodenticide Act as amended
- Plant Import manuals (Propagative and Nonpropagative)
- Code of Federal Regulations (CFR)
  - Title 7 (Agriculture)
  - Title 46 (Shipping) Chapter 1, Part 147—Interim Regulations for Shipboard Fumigation
- Occupational Safety and Health Administration (OSHA) treatment manual

Application

This manual serves both as a field manual for employees conducting treatments and as a reference for PPQ officers, program managers, and staff officers. Under APHIS policy, only certified pesticide applicators may conduct or monitor treatments. This manual will also serve as a reference for researching the types of treatments available for imports and to answer questions from importers, industry, and foreign countries.

How to Use This Manual

Review the content of this manual to get a feel for the scope of material covered. Glance through the section that you will be using and familiarize yourself with the organization of information. Major headings such as Chemical Treatments and subheadings such as Fumigants will be tabbed. Each section is divided by tabs so when you want to find information on taking residue samples, you would turn to the tab labeled “Residue Monitoring” and check the Table of Contents for the page number.

Use the Table of Contents which follows each tab to quickly find information. If the Table of Contents is not specific enough, then turn to the Index to find the topic and page number.

Reporting Problems

If you want to suggest an improvement or identify a problem with the content of this manual, complete and mail the “Comment Sheet” at the back of this manual. If the problem is urgent, call John Patterson at the Professional Development Center at (240) 629-1934. If you disagree with the guidelines or policies contained in this manual, contact Quarantine Policy, Analysis and Support (QPAS) through channels.

Conventions

The following are terms that are widely recognized and used throughout this manual:

DANGER	Indicates that people can easily be hurt or killed
WARNING	Indicates that people could possibly be hurt or killed
CAUTION	Indicates that people could possibly be endangered and slightly hurt
NOTICE	Indicates a possibly dangerous situation, goods might be damaged
Important	Indicates helpful information

EXAMPLE: indicates additional information that helps to clarify the content in the manual

Treatment schedules which are FIFRA Section 18 Exemptions (such as the sample below) are followed by an “Important” note to help you determine the current exemption status.

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At: 0.5 hrs	2 hrs	3 hrs	3.5 hrs
90 °F or above	2 lbs	26	19	19	—
80-89 °F	2.5 lbs	32	24	24	—
70-79 °F	3 lbs	38	29	24	—
60-69 °F	3 lbs	38	29	—	24

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

2

Treatment Manual

Chemical Treatments

Overview

Contents

Overview **page-2-1-1**
Fumigants **page-2-2-1**
Aerosols and Micronized Dusts **page-2-11-1**
Dips **page-2-12-1**
Dusts **page-2-13-1**
Sprays **page-2-14-1**

The Chemical Treatments section of this manual is organized by chemicals tabbed as follows:

- Fumigants
- Aerosols and Micronized Dust

Use the Contents in this section to quickly find the information you need. The subjects listed in the Contents are also marked on the tabs in this manual. If the Contents is not specific enough, then turn to the Index to find the topic and its page number.

2

Treatment Manual

Chemical Treatments

Fumigants

Contents

Fumigants • Methyl Bromide **page-2-3-1**
Fumigants • Sulfuryl Fluoride **page-2-9-1**
Fumigants • Phosphine • Tarpaulin (NAP Chamber or Container) **page-2-10-1**

Introduction

Fumigation is the act of releasing and dispersing a toxic chemical so it reaches the target organism in a gaseous state. Chemicals applied as aerosols, smokes, mists, and fogs are suspensions of particulate matter in air and are not fumigants.

The ideal fumigant would have the following characteristics:

- Highly toxic to the target pest
- Nontoxic to plants and vertebrates (including humans)
- Easily and cheaply generated
- Harmless to foods and commodities
- Inexpensive
- Nonexplosive
- Nonflammable
- Insoluble in water
- Nonpersistent
- Easily diffuses and rapidly penetrates commodity
- Stable in the gaseous state (will not condense to a liquid)
- Easily detected by human senses

Unfortunately, no one fumigant has all the above properties, but those used by APHIS and PPQ have many of these characteristics.

The toxicity of a fumigant depends on the respiration rate of the target organism. Generally, the lower the temperature, the lower the respiration rate of the organism which tends to make the pest less susceptible. Fumigation at lower temperatures requires a higher dosage rate for a longer exposure period than fumigation at higher temperatures.

Fumigants vary greatly in their mode of action. Some kill rapidly while others kill slowly. In sublethal dosages, some fumigants may have a paralyzing effect on the pest while others will not allow the pest to recover. Some fumigants have no effect on commodities while others are detrimental even at low concentrations. Commodities vary in their sorption of fumigants and in the effort required to aerate the commodities after fumigation.

Due to the reduction in number of labeled fumigants, there is seldom a choice in selecting fumigants. When there is a choice, factors such as the commodity to be treated, pest and stages present, type of structure, and cost should be considered in selecting a fumigant.

The only authorized fumigants are the following:

- Methyl bromide (MB)
- Sulfuryl fluoride (SF) (Vikane)
- Phosphine (PH) (There are two chemicals used for phosphine, AP—aluminum phosphide and MP—magnesium phosphide)

Much of the information on fumigants is based on MB with modification as needed for the other fumigants.

Monitoring of Quarantine Treatments

Monitoring of program fumigations is performed to ensure that effective fumigant concentration levels are maintained throughout the treatment to prevent the introduction of quarantine pests. Quarantine fumigations employing restricted use pesticides require careful monitoring to assure efficacy and personal safety, to maintain pesticide residues within acceptable limits, and to preserve commodity quality. These requirements are included in the fumigant label, and it is a violation of Federal law to use fumigants and pesticides in a manner inconsistent with its labeling.

Nonperishable Commodities in Temporary Enclosures

PPQ officers will provide onsite monitoring from introduction of the fumigant through completion of the 2 hour gas concentration readings. Half hour and 2 hour readings are required for these treatments. These readings and general observations permit the officer to determine how a particular treatment is progressing and to make necessary corrections to the enclosure or fumigant concentration level.

Perishable Commodities in Temporary Enclosures

The monitoring officer will remain on the site through the entire fumigation of perishable commodities. Continuous monitoring allows the officer to alert the pest control operator at any time to implement

necessary corrective measures. Due to the nature of the commodity and the length of treatment, onsite monitoring of yam and chestnut fumigations may be interrupted after the 2 hour reading when efficacy and safety considerations warrant.

These instructions do not prevent the officer from leaving the immediate fumigation site for brief periods when it is necessary and safe to do so. The pest control operator must be notified of the PPQ officer's intended absence. These absences would ordinarily be limited to 20 minutes and do not constitute a break in service. These practices are in place in many locations and will require only minor modifications in other areas.

Fumigation Guidelines

The following fumigation guidelines are in common usage throughout this manual:

- Dosage rate is based on 1,000 cubic feet of enclosure space, whether chamber, tarpaulin, van, freight car, ship hold, etc. Dosage should be calculated from the volume of the tarped fumigation enclosure.
- Dosages are listed by weight in the Treatment Schedules. If liquid measures are needed, convert from weight to volume by using the conversion figures.
- Ounces per 1,000 cubic feet (oz/1000 ft^3) is equal to milligrams per liter (mg/liter) and is equal to grams per cubic meter (g/m^3).
- Volume of commodity being treated should not exceed two-thirds of enclosure volume unless otherwise specified in a schedule.
- Specified vacuum should be held throughout the exposure period.
- Blowers or fans should be operated as follows:
  - for propagative material (T200-series schedules), the entire period of exposure, whether NAP or vacuum
  - under tarpaulin (and vacuum fumigation for other than propagative material), fans should operate for 30 minutes after gas introduction, or until T/C readings indicate uniform gas distribution
  - for all bulk material, forced recirculation is required, check for uniform gas distribution by taking T/C readings at four or five locations including at least three from the commodity

Important

Phosphine fumigations do not require fans.

- In this section, all NAP treatments that refer to chamber fumigations should be conducted in USDA-approved chambers. (See Section 6, **Certification of Vacuum Fumigation Chambers**).
- Methyl bromide treatment schedules are indicated as "MB." MB generally refers to any methyl bromide label. Specific MB label restrictions are noted in this manual for the "Q" label. Always check the label of the fumigant to be sure the commodity is listed on the label. Commodities that are not listed on the fumigant's label are not authorized for fumigation with the manufacturer's gas.

Physical Properties of Fumigants

Fumigant	Chemical Formula	Boiling Point	Specific Gravity[1]	Flammability Limits in Air
Methyl Bromide	CH_3Br	3.6 °C 40.1 °F	3.27	Normally nonflammable. Flame propagation at 13.5 to 14.5% by volume only in the presence of an intense source of ignition.
Phosphine	PH_3	–87.4 °C –126 °F	1.214	1.79% by volume
Sulfuryl fluoride	SO_2F_2	–55.2 °C –67 °F	2.88	Nonflammable

1 Air = 1, anything greater is heavier than air.

Fumigant	Odor	Effects on Metals	General
Methyl Bromide	No odor at low concentration. Strong musty or sweet at high concentrations.	Reacts with aluminum, may damage electronic equipment	Discharged from cylinders, 1.5 lb cans
Phosphine	Garlic-like or carbide due to impurities	Copper, brass, gold and silver severely damaged; electronic equipment damaged. Other metals slightly affected in high humidity.	Evolved from aluminum phosphide or magnesium phosphide preparations
Sulfuryl fluoride	None	Non-corrosive	Discharged from cylinders

2

Treatment Manual

Chemical Treatments

Fumigants • Methyl Bromide

Contents

Properties and Use **page-2-3-1**
"Q Labels" and Section 18 Exemption Treatment Schedules **page-2-3-2**
Leak Detection and Gas Analysis **page-2-3-4**
Effects of Temperature and Humidity **page-2-3-4**
Penetration and Aeration of Boxes and Packages **page-2-3-5**
Plastic Wrappings and Impermeable Papers **page-2-3-5**
Kraft Paper and Corrugated Cartons **page-2-3-5**
Wooden Boxes **page-2-3-5**
Sorption **page-2-3-5**
Residual Effect **page-2-3-6**

Properties and Use

Methyl bromide (MB) (CH_3Br) is a colorless, odorless, nonflammable fumigant. MB boils at 38.5 °F and has a very low solubility in water. As a gas, MB is three times heavier than air. As a liquid at 32 °F, 1 pound of MB is equivalent to 262 ml. For ease in transportation and handling, MB is compressed and stored in metal cylinders as a liquid.

MB is an effective fumigant for treating a wide variety of plant pests associated with a wide variety of commodities. MB is the most frequently used fumigant in quarantine fumigations. MB may also be used to devitalize plant material. MB is effective in treating the following pests:

- Insects (all life stages)
- Mites and ticks (all life stages)
- Nematodes (including cysts)
- Snails and slugs
- Fungi (such as oak wilt fungus)

MB is effective over a wide range of temperatures (40 °F and above). In general, living plant material tolerates the dosage rate specified, although the degree of tolerance varies with species, variety, stage of growth, and condition of the plant material. MB accelerates the decomposition of plants in poor condition.

Since MB is three times heavier than air, it diffuses outward and downward readily, but requires fans to ensure upward movement and equal gas distribution. Fan circulation also enhances penetration of

MB into the commodity. A volatilizer is used to heat the liquid MB in order to speed up its conversion to a gas. Once the gas is evenly distributed, it maintains that condition for the duration of the treatment unless an outside event such as excessive leakage occurs.

"Q Labels" and Section 18 Exemption Treatment Schedules

Methyl bromide fumigants, except those with "Q" labels, may be subject to requirements of the FIFRA Section 18 Quarantine Exemption. When commodities intended for food or feed are fumigated with methyl bromide under the FIFRA Section 18 Quarantine Exemption, one additional EPA *requirement* must be met: PPQ must monitor aeration by sampling the gas concentration to determine when a commodity may be released.

In this manual, fumigation schedules under the FIFRA Section 18 Quarantine Exemption are followed by an "Important" note to help you determine the current exemption status. For example:

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

CAUTION

Always use the label of the fumigant to determine if the commodity can be treated. Fumigation schedules in this publication are intended to clarify and expand commercial labels for methyl bromide. The EPA only authorizes fumigation for commodities that are listed on the label of the gas being used for the fumigation. Also, to comply with State requirements, a fumigant must be registered in the State where it is being used. If you are uncertain that a fumigant is registered in a state where the fumigation is being performed, contact a major port in that state or the Oxford Plant Protection Laboratory.

To better accommodate the requirements of quarantine and regulatory fumigations with methyl bromide, the Animal and Plant Health Inspection Service (APHIS) and the Great Lakes Chemical Corporation have developed a premium 100 percent methyl bromide fumigant that is only intended for quarantine and regulatory use. This methyl bromide fumigant is provided by several companies and generally

referred to as a "Q label". It is labeled for many uses which were previously covered by FIFRA Section 18 Exemptions. Additional features of the "Q label" include the following:

- Fumigation for rodents and warm blooded pests is allowed at temperature down to 20 ° F.
- Use of additional fumigant to maintain the required concentration is allowed.
- The commodity must be allowed to aerate for at least one hour before completely removing the tarp. However, the aeration procedures described in this manual require a longer period than required on the label, and must be followed. Be sure that the fumigator is placed under a compliance agreement, and that he follows the aeration procedures outlined in this manual.

Although there is some overlap in the "Q label" and other methyl bromide labels, substitution of the products may result in non-compliance. Use the Treatment Manual to determine when a "Q" labeled fumigant must be used:

- When the treatment schedule is marked MB, any methyl bromide fumigant may be used for the fumigation if the commodity is on the fumigant label.

Important

When the treatment schedule is marked MB ("Q" label only), the fumigation is restricted to methyl bromide "Q" labels. This restriction is based on the "Q" label replacement of FIFRA Section 18 exemptions.

- A few schedules restrict the use of a label based on temperature range. In this case, the specific temperature range is marked and noted ("Q" label only).

Always read and follow the "Q label" label and use directions. The "Q-label" allows fumigation of certain commodities and pests at sites and rates that are not allowed under other labels. The label is purposely flexible to handle unforeseen emergencies and other special situations formerly covered by FIFRA Section 18 label exemptions.

Although the use of "Q label" fumigants eliminates the requirements for residue and aeration monitoring, the "Q label" requires fumigations using the product be conducted under the monitoring of a state or federal agency. Monitoring does not necessarily require the actual presence of a regulatory agent during the entire fumigation, but does mean that the monitoring agent be able to certify that the fumigant was done in compliance with the label and other requirements.

To show that the fumigation using the "Q" label was monitored by a regulatory agent, the fumigator should record the name, title, telephone number and mailing address of the monitoring regulatory agent(s) in his restricted use pesticide application records, even if the same information is recorded on other documents (e.g., phytosanitary certificate).

Leak Detection and Gas Analysis

Use a thermal conductivity (T/C) unit to measure gas concentration levels in tarpaulins and chambers. The halide detector is used primarily to check for leaks around tarpaulins, chambers, application equipment, and as a safety device around the fumigation site. Colorimetric tubes, which are supplied by the fumigator, are used to measure gas concentration levels during aeration.

During a fumigation, a fumigant is volatilized in a chamber at atmospheric pressure, a positive pressure is created, which may then be continuously reduced by leakage of the air-fumigant mixture. Because PPQ approved chambers must be sufficiently tight to retain the fumigant during the exposure period, chambers should be tested for leakage before they are used for fumigation.

Effects of Temperature and Humidity

MB is effective at the same temperatures plants are generally handled (usually 40 °F and above). In general, increases in temperature give a corresponding increase in the effectiveness of MB. All treatment schedule temperatures are listed with the corresponding dosage rate. Follow the dosage rates listed. A Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 3 registration (the labeled rate of MB provided), or a Section 18 Exemption must be in effect at the time of treatment.

For live plant material which is actively growing or with leaves, maintain a high percentage of humidity (above 75 percent) in the chamber by placing wet sphagnum or excelsior in the chamber or by wetting the chamber walls and floor. Protect actively growing or delicate plants from the direct air flow of fans. Do not add any moisture to the chamber when fumigating seeds. Too much moisture on the material to be fumigated may prevent the fumigant from reaching some of the pests.

Penetration and Aeration of Boxes and Packages

Plastic Wrappings and Impermeable Papers

Plastic wrappings such as cellophane, films, and shrink wrap, and papers that are waxed, laminated, or waterproofed are not readily permeable and must be perforated, removed, or opened before fumigation. If wrappings are perforated to facilitate fumigation, holes should be at least 3/16-inch in diameter every 3 square inches or 1/4-inch in diameter every 4 square inches over the entire surface of the wrapping. Also acceptable are plastic wraps containing numerous pinholes (at least 49 per square inch). These holes enhance permeability through the plastic fruit trays, which are frequently used for transport of fruit.

Important

Inform prospective importers that the wrappings on their shipments may have to be perforated to PPQ specifications, removed, or opened if PPQ requires fumigation. If wrappings on shipments are designed to satisfy PPQ requirements for fumigation readily, importers could save time and money. Shippers may send samples of prospective wrapping materials (a piece at least 12in X 12in) to Oxford Plant Protection Laboratory for evaluation.

Kraft Paper and Corrugated Cartons

Kraft paper is permeable to MB and does not need to be removed prior to fumigation. Corrugated cartons are also permeable to MB and unless impermeable liners are present, aeration will be satisfactory, although it will be slower in closed boxes.

Wooden Boxes

Although MB penetrates wooden boxes, aeration of tight boxes may be slow, particularly if sorptive packing materials are present. To aid in aeration, have the lids removed and boxes placed on their sides prior to fumigation. If removing lids is not practical, then increase the aeration time.

Sorption

Sorption is the process of chemically or physically binding free MB on or within the fumigated commodity. Sorption makes the fumigant unavailable to kill the plant pest. There are three types of sorption—absorption, adsorption, and chemisorption. Sorption rate is high at first, then gradually reduces to a slow rate. Sorption increases the time required for aeration.

Commodities known or believed to be highly sorptive should not be fumigated in chambers unless concentration readings can be taken to ensure the required minimum concentration is met. Additional readings may be necessary in order to properly monitor gas concentration sorptive commodities in chambers.

For tarpaulin fumigation, additional T/C unit readings are necessary to monitor concentration of gas to determine the rate of sorption. The following is a partial list of commodities known to be highly sorptive:

- bales of burlap
- myrobalan
- carpet backing
- pistachio nuts
- cinnamon quills
- polyamide waste
- cocoa mats
- polystyrene foam (Styrofoam)
- cotton
- potato starch
- flour and finely milled products
- rubber (crepe or crude)
- gall nuts
- vermiculite
- hardboard (Masonite™)
- wood products (unfinished)
- incense
- wool (raw, except pulled)

Call the Oxford Plant Protection Laboratory if you are concerned about the sorptive properties of other commodities. (Telephone: 919-693-5151)

Residual Effect

MB may adversely affect the shelf life of fresh fruits and vegetables, the viability of dormant and actively growing plants, and the germination of seed. Although MB may adversely affect some commodities, it is a necessary risk in order to control pests. Some

dosage rates are near the maximum tolerance of the commodity, so care must be exercised in choosing the proper treatment schedule and applying the treatment.

MB may also adversely affect nonplant products. In general, articles with a high sulfur content may develop “off-odors” on contact with MB. In some commodities the odors are difficult or impossible to remove by aeration. If possible or practical, remove from the area to be fumigated any items that are likely to develop an undesirable odor.

Ordinarily, the following items should *not* be fumigated:

- Any commodity which is not listed on the label or lacks a FIFRA Section 18 Exemption
- Any commodity which lacks a treatment schedule
- Automobiles
- Baking powder
- Blueprints
- Bone meal
- Butter, lard, or fats, unless in airtight containers
- Charcoal (highly sorptive)
- Cinder blocks or mixed concrete and cinder blocks
- Electronic equipment
- Feather pillows
- Felt
- Furs
- High protein flours (soybean, whole wheat, peanut)
- Horsehair articles
- Leather goods, particularly kid leather
- Machinery with milled surfaces
- Magazines and newspapers (made of wood pulp)
- Magnesium articles (subject to corrosion)
- Paper with high rag or sulfur content
- Photographic chemicals and prints (not camera film or X-rays)
- Natural rubber goods, particularly sponge rubber, foam rubber, and reclaimed rubber including pillows, mattresses, rubber stamps, and upholstered furniture
- Rug pads

- Silver polishing papers
- Woolens (especially angora), soft yarns, and sweaters; viscose rayon fabrics
- Yak rugs

2

Treatment Manual

Chemical Treatments

Fumigants • Methyl Bromide • Tarpaulin Fumigation

Contents

Methods and Procedures **page-2-4-2**
Materials Needed **page-2-4-2**
PPQ Officer Provides **page-2-4-2**
Fumigator Provides **page-2-4-2**
Preparing to Fumigate **page-2-4-3**
Step 1—Selecting a Treatment Schedule **page-2-4-3**
Step 2—Issuing a PPQ Form 523 (Emergency Action Notification) **page-2-4-4**
Step 3—Determining Section 18 Exemptions and Sampling Requirements **page-2-4-4**
Step 4—Selecting a Fumigation Site **page-2-4-4**
Step 5—Arranging the Stack **page-2-4-7**
Step 6—Arranging and Operating Fans **page-2-4-10**
Step 7—Placing the Gas Introduction Lines **page-2-4-11**
Step 8—Placing the Gas Sampling Tubes **page-2-4-11**
Step 9—Padding Corners **page-2-4-13**
Step 10—Measuring the Temperatures **page-2-4-14**
Step 11—Covering the Stack **page-2-4-16**
Step 12—Sealing the Tarpaulin **page-2-4-16**
Step 13—Measuring the Volume **page-2-4-17**
Step 14—Calculating the Dosage **page-2-4-17**
Step 15—Making a Final Check **page-2-4-18**
Conducting the Fumigation **page-2-4-19**
Step 1—Introducing the Gas **page-2-4-19**
Step 2—Testing for Leaks **page-2-4-20**
Step 3—Taking Concentration Readings **page-2-4-21**
Step 4—Determining the Need to Add Gas and Adjust Exposure **page-2-4-23**
Special Procedures for Adding Gas and Extending Exposure Period **page-2-4-23**
Special Procedures for Fruits, Vegetables, or Perishable Commodities Using Schedule T101-a-1 or Equivalent **page-2-4-25**
Special Procedures for Adding Gas to Oak Logs and Lumber Using T312 or Equivalent **page-2-4-28**
Step 5—Exhausting the Gas **page-2-4-29**
Aerating the Enclosure **page-2-4-29**
Responsibility for Aerating the Commodity **page-2-4-29**
Materials Needed **page-2-4-30**
Securing the Area **page-2-4-30**
Wearing Respiratory Protection **page-2-4-31**
Aerating Nonsorptive, Containerized Cargo—Indoors and Outdoors **page-2-4-32**
Step 1—Installing Exhaust System **page-2-4-32**
Step 2—Aerating the Commodity **page-2-4-32**
Aerating Nonsorptive, Noncontainerized Cargo—Indoors and Outdoors **page-2-4-33**
Step 1—Installing the Exhaust System **page-2-4-33**
Step 2—Aerating the Commodity **page-2-4-33**

Aeration Procedures for Fresh Fruits, Vegetables, and Cut Flowers—Indoors or Outdoors **page-2-4-35**
Step 1—Installing Exhaust System **page-2-4-35**
Step 2—Aerating the Commodity **page-2-4-35**
Aerating Sorptive, Noncontainerized Cargo—Indoors and Outdoors **page-2-4-36**
Step 1—Installing the Exhaust System **page-2-4-36**
Step 2—Aerating the Commodity **page-2-4-37**
Aerating Sorptive Commodities in Containers—Indoors and Outdoors **page-2-4-38**
Step 1—Installing the Exhaust System **page-2-4-38**
Step 2—Aerating the Commodity **page-2-4-38**

Methods and Procedures

The procedures covered in this section provide PPQ Officers and commercial fumigators with the methods, responsibilities, and precautions for tarpaulin fumigation.

Materials Needed

PPQ Officer Provides

- Calculator (optional)
- Colorimetric tubes (Draeger/Kitagawa)
- Desiccant (Drierite®)
- Forms (PPQ Form 429 and APHIS Form 2061 if necessary)
- Halide leak detector
- Self-contained breathing apparatus (SCBA) or supplied air respirator to be used by PPQ officer
- Tape measure (as back-up for fumigator)
- Thermal conductivity unit[1], [2]
- Thermometer (as back-up for fumigator)

Fumigator Provides

- Auxiliary pump for purging long gas sample tubes
- Carbon dioxide filter (Ascarite®)
- Colorimetric tubes (Draeger/Kitagawa)
- Desiccant (Drierite®, anhydrous calcium sulfate)

1 If fumigating oak logs or lumber for export, the unit must be capable of reading 400 oz.
2 T/C unit must be calibrated annually by the Center for Plant Health Science & Technology (CPHST) in Raleigh, North Carolina. If requested, CPHST will calibrate a commercial fumigator's T/C unit.

- Electrical wiring (grounded, permanent type), three prong extension cords
- Exhaust blower and ducts
- Fans (circulation, exhaust, and introduction)
- Framework and supports
- Gas introduction line
- Gas sampling tubes (leads)
- Heat supply
- Insecticides and spray equipment
- Loose sand
- Measuring Tape
- Methyl bromide
- Padding
- Sand or water snakes or adhesive sealer
- Scales or dispensers
- Self-contained breathing apparatus (SCBA) or supplied air respirator
- Tape
- Tarpaulin and supports (See **page-2-4-13** for specifications)
- Thermal conductivity unit[3], [4]
- Thermometer
- Volatilizer
- Warning signs
- Tape measure
- Thermometer

Preparing to Fumigate

Step 1—Selecting a Treatment Schedule

Select a treatment schedule to effectively eliminate the plant pest without damaging the commodity being fumigated.

3 If fumigating oak logs or lumber for export, the unit must be capable of reading 400 oz.
4 T/C unit must be calibrated by the Center for Plant Health Science & Technology (CPHST) in Raleigh, North Carolina. If requested, CPHST will calibrate a commercial fumigator's T/C unit.

Turn to the Treatment Schedule Index and look up the available treatment schedule(s) by commodity (example—apples, pears, or citrus) or by pest (example—Mediterranean fruit fly). Some commodities may have several treatment schedules. The "Fumigants—Methyl Bromide" section on Residual Effects lists those commodities which may be damaged by MB. Each treatment schedule lists the target pest or pest group (e.g., *Ceratitis capitata*, surface feeders, wood borers...), commodity, or both pest and commodity. If there is no schedule, contact the Center for Plant Health Science & Technology (CPHST) in Raleigh, North Carolina, to see if a schedule is available under a FIFRA Section 18 Exemption. If a treatment is required, go to **Table 2-4-1**.

TABLE 2-4-1: Determine Reporting Requirements

If a treatment is required:	Then:
As a result of a pest interception	GO to Step 2
As a condition of entry	GO to Step 3

Step 2—Issuing a PPQ Form 523 (Emergency Action Notification)

When an intercepted pest is identified and confirmed by a PPQ Area Identifier as requiring action, issue a PPQ Form 523 (Emergency Action Notification) to the owner, broker, or representative. Be sure to list all treatment options when completing the PPQ Form 523 (Emergency Action Notification). Follow instructions in Appendix 1 for completing and distributing the PPQ Form 523 (Emergency Action Notification).

Step 3—Determining Section 18 Exemptions and Sampling Requirements

After selecting the treatment schedule, you will be able to determine which treatment schedules are FIFRA Section 18 Exemptions by the presence of broad, bold, vertical lines on the borders of the treatment schedule table listed in the reference. Some treatment schedules are only FIFRA Section 18 Exemptions at specific temperature ranges. Check the treatment schedule and temperature to determine if the fumigation will be a FIFRA Section 18 Exemption.

Food or Feed Fumigations

Residue monitoring by taking samples of the commodity prior to the start of the fumigation and after aeration is no longer required.

Step 4—Selecting a Fumigation Site

Consider the following factors in selecting a fumigation site:

- A well-ventilated, sheltered area
- Ability to heat area (in colder areas)
- An impervious surface

- A nonwork area which can be effectively marked and safeguarded or isolated
- Electrical power supply
- Water supply
- A well-lighted area
- Aeration requirements

A Well-Ventilated, Sheltered Area

Select sites which are well-ventilated and in a sheltered area. A well-ventilated site is required for exhausting gas before and when the tarpaulin is removed from the stack. Most piers and warehouses have high ceilings and a number of windows/doors which can be used for ventilation. Some gas will escape from the tarpaulin even in the best conditions. Avoid areas where strong drafts are likely to occur.

In warehouses, an exhaust system must be provided to exhaust MB to the outside of the building. Ensure that the exhausted gas does not reenter the building nor endanger people working outdoors.

When treatments are conducted in a paticular location on a regular basis, a permanent site should be designated. At such sites, the fan used to remove the fumigant from the enclosure during aeration must be connected to a permanent stack extending above the roof level.

If fumigations are conducted outside, select a site that is semi-sheltered such as the leeward side of a warehouse, pier, or building that offers some protection from strong winds.

Ability to Heat Area

When cooler temperatures (below 40 °F) are expected, the site must be heated to maintain commodity temperatures above 40 °F. Take the ambient temperature 12 inches above the floor.

NOTICE

Do not use flame or exposed electrical element heaters under the tarpaulin during treatment because MB may cause the formation of hydrogen bromide. Hydrogen bromide (hydrobromic acid) is a highly corrosive chemical which can cause damage to the heater and to surrounding materials including the commodity. Hot air or radiator type heaters can be used for heating under tarpaulins. When using space heaters to heat warehouses, there must be adequate ventilation.

An Impervious Surface

Select an asphalt, concrete, or tight wooden surface—not soil, gravel, or other porous material. If you must fumigate on a porous surface, cover the surface with asphalt (tar) paper or plastic tarpaulins. For large fumigations, covering the surface is not usually practical because pallets must be rearranged and heavy equipment used to move the commodity. On docks, wharfs, and piers, check for cracks, holes, and manhole covers which will allow the MB to escape through the floor. Have all cracks, holes, and manhole covers sealed with plastic or asphalt paper.

A Nonwork Area

Select a secure area where traffic and people are restricted from entering and which is isolated from people working. You want a nonwork area to help prevent accidents such as a forklift piercing a tarpaulin and for other safety reasons. Consider either the entire structure area or an area which extends 30 feet from the tarpaulin and is separated by a physical barrier such as ropes, barricades, or walls as the fumigation area. If a wall of gas-impervious material is less than 30 feet from the tarpaulin, the wall may serve as the edge of the secured area. Some states, for example California, require a 100 foot buffer zone. Place placards clearly in sight of all who come near. Placards must meet label requirements regarding specific warnings, information, and language. Placards generally include the name of the fumigant, the fumigation date, time, and the name of the company conducting the fumigation. Restrict access to the fumigation area to the fumigator's employees and PPQ employees monitoring the treatment. Use rope or marker tape to limit access within 30 feet of the enclosure. Do not allow motor vehicles (includes forklifts) to operate within 30 feet of the enclosure during the fumigation and aeration periods. The area outside the 30-foot perimeter is usually regarded as a safe distance from the tarpaulin. Gas concentrations exceeding 5.0 ppm (TLV for MB) are seldom recorded by gas monitoring, except during aeration. PPQ Officers that work within the 30-foot primeter must wear (and use) respiratory protection (SCBA), unless the gas levels are safe to breath and validated as safe by gas monitioring. The 30-foot perimeter is not specifically mentioned on the MB label, but is required for PPQ Officers. When space is tight, it is permissible to overlap two adjoining 30-foot perimeters. However, there must be sufficient space for a person wearing SCBA to walk between the tarpaulins.

Electrical Power Supply

An adequate electrical source must be available to run the circulation fans and the T/C unit. A separate line should be available for the T/C unit. Electrical outlets must be ground and conveniently located in relation to the fumigation area. Do *not* use generators as a power source, except under emergency conditions.

Water Supply

A water supply is necessary for safety purposes. Water is necessary for washing off MB if the liquid form is spilled on someone. Water is also used to fill the volatilizer. If no permanent water is present on site, the fumigator must provide a portable, 5-gallon supply of clean water.

Well-Lighted Areas

The area should have adequate lighting for safety purposes and for ease in reading T/C units, thermometers, and for determining whether a tarpaulin has holes or tears.

Aeration Requirements

Assuming that you've already restricted access and secured the fumigation area, you now must restrict access to the area where the exhaust duct extends beyond the enclosure. Before you start a fumigation, make sure the exhaust duct is located in a safe place.

During the first 10 minutes of aeration, there should be no people within 200 feet down wind of the exhaust duct outlet. If the exhaust duct is not used, then the requirement for a 200 foot down-wind buffer zone does not necessarily apply. However, personnel in the immediate area should be aware that a release of fumigant gas is about to take place and given the option of wearing SCBA if they choose to continue working in the area. If it is impossible to restrict people from the area of aeration during regular work hours, consider aeration during another time of the day. When securing the duct outlet area, consider the direction of the wind. Face the duct outlet toward an open area, and away from people. Point the duct outlet upward to aid in dispersing the exhausted gas.

After the first 10 minutes of aeration, if an exhaust duct is not used, then a perimeter of 30 feet or more from the stack is usually regarded as a safe distance for personnel. However, for personal safety, gas levels should occasionally be monitored at greater distances, especially downwind. Experience provides the best guide.

Step 5—Arranging the Stack

Break Bulk Cargo

Have the cargo arranged in a square or rectangular shape, if possible, to make it easy to cover and to calculate the volume of the stack. An even shaped stack is easy to tarp. The height of the stack should be uniform so dosage can be calculated accurately. For loose cargo, the tarpaulin should be 2 feet above the load and one foot from the sides and ends. Unless specified in the treatment schedule, cargo should not exceed two-thirds of the volume of the area to be fumigated. The maximum size for an enclosure is 25,000 ft^3. Contact the Center for Plant Health Science & Technology (CPHST) in Raleigh, North Carolina, to get approval for any enclosures larger than 25,000 ft^3. For very large enclosures, it may be necessary to:

- install extra circulation fans
- add more samplig leads
- introduce the fumgant at several sites, using multiple volatilizers
- run the circulation fans longer than just the first 30 minutes, if the difference between the highest and lowest gas concentration readings exceeds 4 ounces

Once CPHST has approved the site and enclosure, it does not require additional approvals for subsequent fumigations. The commodity should be on pallets to permit air movement along the floor and between the cargo. Allow an inch or more of space between pallets. By arranging the stack evenly and with space between pallets or cartons, the fumigant will be effectively distributed and dosage calculation should be easier and more accurate. Dosages are easier to calculate when the dimensions are uniform.

When the fumigation involves multiple stacks, allow 10 feet of space between each uncovered stack. After the stack is tarped, there should be approximately 5 feet between enclosures.

Containerized Cargo

Place no more than eight containers that are 20 to 40 feet in length under a single tarpaulin. APHIS recommends that containers not be stacked. Stacking may create too great a safety risk to the person placing the tarp, fans, and gas monitoring leads. If fumigating multiple containers in a single row, have all the rear doors opening on the same side. If multiple containers are placed in two rows, then have all the doors opening on a center aisle toward each other (See **Figure 2-4-1**). The aisle must be at least 3 feet wide. The aisle must be at least 3 feet wide. All doors should be completely open, if possible.

However, APHIS will allow fumigation of containerized cargo with one door open on each container using a configuration such as the one shown in **Figure 2-4-2**, or in a single row of eight containers. Gas should be introduced at both ends of this long row configuration, either at the same time or half at one end and half at the other end. In any case, the single open door on each container must be kept from closing during the fumigation, either taped or blocked open.

CAUTION

APHIS recommends that perishable commodities be fumigated outside their containers. Because it is difficult to aerate the container, the commodity may be damaged by the fumigant if left in the container. Therefore, it is best to remove perishable commodities from their containers before fumigation. When a commodity is removed from the container, spray the emptied container with Malathion as a precaution against leaving the container contaminated with live pests. Pests such as hitchhikers may not remain with the commodity.

However, because of the cost of devanning the commodity most importers choose to have their commodity fumigated inside the container.

Due to safety considerations, containers to be fumigated should not be stacked. Also, to conserve methyl brombide use, CPHST recommends that containers be removed from their chassis prior to fumigation. (If this is not done, then the space beneth the container must be calculated as part of the total volume being fumigated.

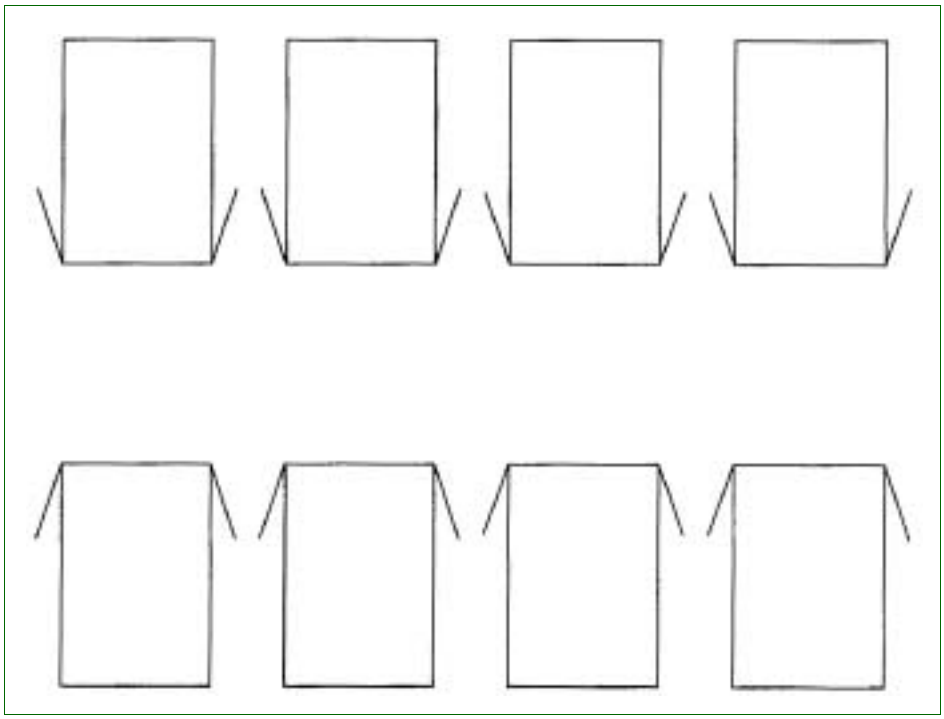


FIGURE 2-4-1: Container Arrangement in Two Rows

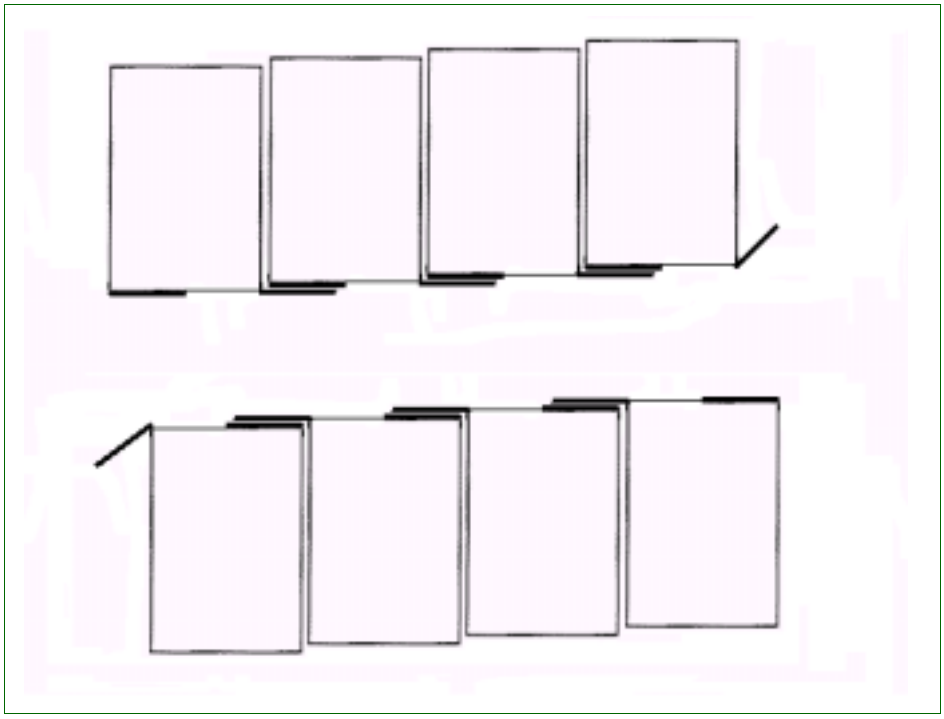


FIGURE 2-4-2: Container Arrangement in Two Rows

Containers should ordinarily not be loaded beyond 80 percent of their capacity. A space of 20 percent (18 inches) should be provided above the commodity. This allows a crawl space for placing the gas

monitoring leads and fans, and to facilitate uniform gas distribution. (Some restacking of cargo may be necessary to meet this requirement.) Adequate space (2 inches) should be provided below the commodity. No additional head space is required between the roof of the container and the tarp, unless the pest is found on the outside of the container.

If fumigating multiple containers in a single row, the rear doors should all open on the same side of the stack. If containers are parked parallel to one another and close together, it is permissible to open only the door on the right side of each container, overlapping and taped to the closed left door of the container adjacent to it. In such circumstances, however, one must have a fan positioned high, blowing into the open door of each container, to assure uniform fumigant distribution. If containers are not parked closely together, all doors must be completely open.

Gas Penetration and Distribution

MB will penetrate most cargo easily. When fumigating finely milled products (such as flour, cottonseed meal, and baled commodities), provide space every 5 feet in any direction. Penetration is enhanced by the availability of free MB.

Some of the more common types of impermeable materials are cellophane, plastic, wax coated materials, laminated, and waterproofed papers. Tight wooden packing cases are also relatively gastight. Impermeable materials will allow some gas to penetrate, but make it difficult to aerate and evacuate the gas. Remove, perforate, or open all impermeable materials.

For impermeable wrappers or containers, open the entire top or side and place the package with the open portion on the side.

Step 6—Arranging and Operating Fans

Break Bulk Cargo

Use fans which have the capacity to move a volume in cubic feet per minute equivalent to the total volume of the enclosure. For a 5,000 ft^3 enclosure, use two axial-type (blade) fans of approximately 2,500 cfm. Place one fan on the floor at the rear of the stack facing the front and the other fan at the top front (where the gas is introduced) facing the rear. For enclosures from 5,000 to 7,500 ft^3, add a third fan near the upper middle facing the rear. For enclosures from 7,501 to 10,000 ft^3, add a fourth fan on the floor near the middle facing the front. Enclosures from 10,001 to 25,000 ft^3 may require up to seven fans to provide adequate gas circulation. Enclosures larger than 25,000 ft^3 require approval from the Center for Plant Health Science & Technology (CPHST) in Raleigh, North Carolina.

Turn on all fans to make sure they work. Operate fans during gas introduction and for 30 minutes after the gas is introduced. If after taking gas concentration readings the fumigant is not evenly distributed, run the fans until the gas is evenly distributed as

indicated by concentration readings (within 4 oz. of each other). Operate fans when adding gas, but only long enough to get even gas distribution.

Containerized Cargo

Use an appropriate number of fans which have the capacity to move the equivalent cubic feet per minute of the total volume of the enclosure. In addition, place one additional fan of at least 2,500 cfm at the top of the load (near door) of each container facing the opposite end of the container.

Place air introduction ducts, for aeration, into the far ends of each container. Also, place exhaust ducts on the ground in front of the end doors of the containers. Place the end of the ducts near the edge of the tarpaulin so they can be pulled under the tarpaulin when aeration begins.

Step 7—Placing the Gas Introduction Lines

Break Bulk Cargo

Place the gas introduction line directly above the upper front fan. Attach the line to the top of the fan to prevent movement of the hose. An unsecured introduction line could tear the tarpaulin, move the line, or direct it out of the airflow. The fan should be firmly attached to the cargo or have a base that prevents it from toppling (not a pedestal type). Place a piece of impermeable sheeting (example—plastic or rubberized canvas) over the commodity below and to the front of each gas supply line. The sheet will prevent any liquid MB from coming in contact with the cargo.

Containerized Cargo

The number and placement of gas introduction lines will depend upon the number and arrangement of containers to be fumigated.

For single containers, place the introduction line directly above the fan near the rear door of the container.

For multiple containers, place the introduction line near the door end of the containers, but aimed across the open doors rather than directly into one container.

If you are fumigating four or more containers under one tarpaulin, then use two gas introduction lines.

Step 8—Placing the Gas Sampling Tubes

Break Bulk Cargo

Place a minimum of three gas sampling tubes for fumigations up to 10,000 ft^3. Position the gas sampling tubes in the following locations:

- Front low—front of the load, 3 inches above the floor
- Middle center—center of the load, midway from bottom to top of load
- Rear high—rear of the load, at the extreme top of the load

See **Figure 2-4-3**

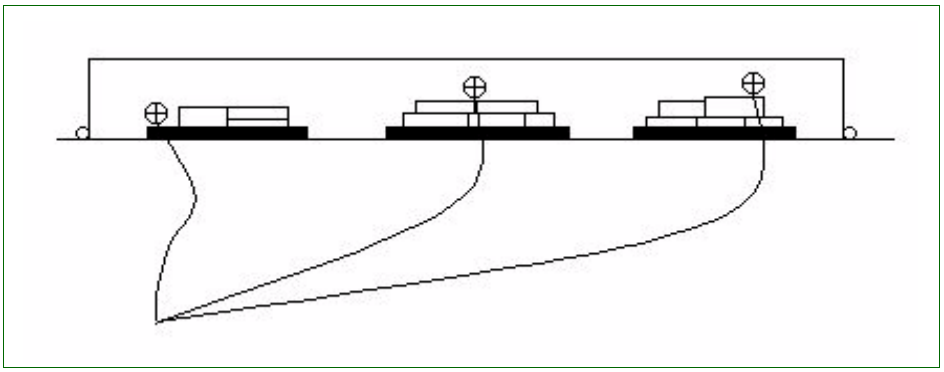


FIGURE 2-4-3: Gas Lead Position (Side View)

For fumigations from 10,001 to 25,000 ft^3, use six gas sampling tubes. Position the gas sampling tubes in the following locations:

- Front low—front of the load, 3 inches above the floor
- Upper front quarter section
- Middle center—center of the stack, midway from bottom to top
- Upper rear quarter section
- Lower rear quarter section
- Rear high—rear of the stack, at the extreme top

Contact the Center for Plant Health Science & Technology (CPHST) in Raleigh, North Carolina, for approval of fumigations larger than 25,000 ft^3, for instructions for number of gas sampling tubes, and for other technical information.

Important

For khapra beetle cargo containing baled, packaged, finely milled, or closely packed commodities, place two additional gas sampling tubes in the center of the bags, packages, or bales. Before placing gas sampling tubes in commodities, place burlap over the end of the tube and secure the burlap to the tube with tape.

Containerized Cargo

For multiple containers (either 20 or 40 feet in length) under the same tarpaulin, use at least three tubes per container. Also, for single containers, use at least three tubes, and for khapra beetle infestations, use two additional tubes. Position the gas sampling tubes as follows:

- Front low—near the floor at the door end of the container
- Rear high—rear of the load at the high end opposite the fan
- Middle center (use only for single container fumigation)

If treating commodities for khapra beetle, you will need the following additional gas sampling tubes:

- High (in the commodity)
- Low (in the commodity)

Cover the end of the gas sampling tube with burlap taped to the tube before insertion into the commodity.

Break Bulk and Containerized Cargo

Use gas sampling tubes of sufficient length to extend from the sampling position inside the enclosure to at least 30 feet beyond the tarpaulin. Have all the gas sampling tubes meet in one area for ease and safety in taking gas concentration readings. Do not splice gas sampling tubes. Before starting the fumigation, test all gas sampling tubes for tightness by connecting each gas sampling tube to the T/C unit and placing a finger over the far end of the gas sampling tube. The ball in the flow meter will fall to zero if the gas sampling tube connections are tight. Replace any defective gas sampling tubes. Before starting the fumigation, check for gas sampling tube blockage or pinching by connecting each tube for a short time. If the tube is blocked, the flow meter will drop sharply.

Fix all gas sampling tubes securely in place under the tarpaulin and label each one at the end where the gas concentration readings will be taken. By labeling each gas sampling tube, you will be able to record concentration readings easily.

Step 9—Padding Corners

Look for corners and sharp angles which could tear the tarpaulin. Never use commodity to support the tarpaulin. If the sharp angles or corners can not be eliminated, they must be covered with burlap or other suitable padding (example—old tires or cloth). (See **Figure 2-4-4** below.)

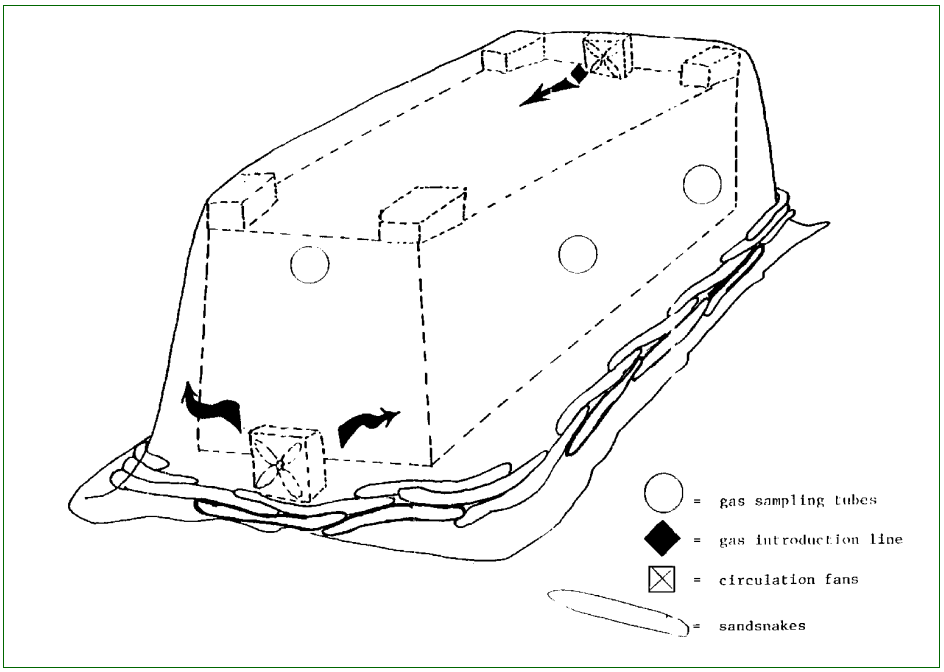


FIGURE 2-4-4: Typical Stack Arrangement with Fans, Leads, Introduction Line, Padding, and Sand Snakes

Step 10—Measuring the Temperatures

Important

Regardless of the commodity, never fumigate at temperatures below 40 °F.

Temperature recordings should be rounded to the nearest tenth of a degree (C ° or F °)

Determine the temperature to use in selecting the proper dosage rate:

- For fruits, pulpy vegetables, or logs use only the commodity temperature.
- For all other commodities use both the commodity and air temperature.

To take the temperature readings, use a bimetallic, mercury, or digital long-stem thermometer that has been calibrated. Use **Table 2-4-2** to determine which temperature to use when selecting the proper dosage rate for commodities other than fresh fruits, vegatables, or logs.

TABLE 2-4-2: Determine the Temperature for the Proper Dosage Rate

If the air temperature is:	And:	Then, for commodities other than fresh fruits or pulpy vegetables or logs and lumber:
Higher than the commodity temperature	→	Use the single lowest commodity temperature for determining the dosage rate (Do Not use the average commodity temperature).
Lower than the commodity temperature	By 9 degrees or less	
	By 10 degrees or more	Use the average of the single lowest air and commodity temperatures for determining the dosage rate (Never initiate a fumigation if any commodity temperature reads lower than 40°F.)

EXAMPLE: You are about to fumigate guar gum and the commodity temperature is 82 °F and the air temperature is 69 °F. Average the air and commodity temperatures to determine the dosage rate because the air is 13 degrees lower than the commodity temperature. The average of the two temperatures is 75.5 °F. Use 75 °F to determine the dosage rate.

If the commodity is fruits, pulpy vegetables, or logs, see the specific procedures that follow.

Fresh Fruits and Pulpy Vegetables

For fresh fruit and pulpy vegetables, insert the thermometer into the pulp. (for purposes of this paragraph, peppers are also included in the category of pulpy vegetables.) For commodities which have been refrigerated, probe the fruit that have the lowest pulp temperature. Again, fumigate only when the fruit pulp is at 40 °F or higher.

However, if the commodity has no pulp (for example, peas, beans, grains, herbs, spices, etc.), take the temperature of the air space immediately surrounding the commodity as well as the commodity temperature. With these temperatures, use **Table 2-4-2** to determine the correct temperature for use when selecting the proper dosage rate.

Logs and Lumber

Insert the thermometer into a crack or drill a hole 2 inches in depth in several representative locations within the stack. Wait at least 10 minutes, take temperature readings in each hole, and average the readings. All readings must be above 40 °F.

Take temperature readings in each hold. Base the dosage calculation on the lowest reading obtained. (Do not average temperatures.) All readings must be above 40°F to initiate the fumigation. If not, you must postpone it.

Record the temperatures in Block 22 of the PPQ Form 429.

Important

When the commodity and air temperature drastically differ, moisture may condense inside the gas sampling tubes or inside the T/C unit and cause inaccurate gas concentration readings. Check the gas sampling tubes frequently for possible puddling of condensed water, and drain it off, as needed, before taking a reading. Also, check the Drierite frequently, and change it as soon as it becomes saturated with water [turns pink], to obtain true gas concentration readings. Never fumigate commodities that are frozen.

Step 11—Covering the Stack

After covering the stack, check the tarpaulin for rips, tears, and holes. Look at the spots that have been taped, and verify they are properly sealed. Have the fumigator repair all holes.

The tarpaulin should be made of a material such as vinyl, polyethylene plastic, or coated nylon. 4 mil vinyl or polyethylene plastic tarpaulins are only approved for one usage; 6 mil vinyl or polyethylene plastic tarpaulins may be used up to four times with the officer's approval for each usage; 10 to 12 mil rubber or plastic coated nylon tarpaulins may be approved for multiple use with the officer's approval for each usage.

The fumigator should cover all corners and sharp ends with burlap or other padding to prevent the tarpaulin from ripping. Have the fumigator pull the tarpaulin over the stack, being careful not to catch or tear the tarpaulin. Make sure there is sufficient structural support to raise the tarpaulin 2 feet above and 1 foot beyond the sides of the commodity.

The tarpaulin must be large enough to provide a floor overlap of at least 18 inches around all sides of the stack. Carefully lay the tarpaulin out to prevent excess folds or wrinkles along the floor, especially around corners.

Important

Sealed containers and vans cannot be considered as "fumigation chambers," and therefore **must be covered by a tarpaulin**, unless they can pass the pressure-leakage test.

However, refrigerated containers (reefers) may be fumigated without a tarpaulin if specific requirements are met. See "Special Procedures for Container Fumigations Without a Tarpaulin.

Step 12—Sealing the Tarpaulin

Sealing may be accomplished with loose, wet sand, sand snakes, water snakes, adhesives, or a combination. If there is danger of crushing or crimping the gas sampling or introduction tubes, use the loose, wet sand. If using snakes, use two rows of snakes along the sides and three rows on the corners. The snakes should overlap each other by approximately 1 foot. The goal in sealing the tarpaulin is to get the tarpaulin to lie flat against the floor to prevent gas from leaking out.

When wind is not a factor, plastic tape may be used for sealing the tarp. The tarp must be at least 2 inches in width, and applied (only to a smooth surface) with the aid of high-tack spray adhesive.

Seal corners by laying two sand snakes around the corner and working the tarpaulin until it is flat. Place a third snake on top of the two other snakes to provide additional weight to force the tarpaulin against the floor. Loose, wet sand can be used in the area where the gas introduction line, electrical cords, and gas sampling tubes extend from under the tarpaulin.

Step 13—Measuring the Volume

Using a 100-foot tape measure, carefully measure the length, width, and height of the enclosure. *Never* estimate the measurements. An error in measurement of as little as 12 inches can result in miscalculation of the dosage by as much as 15 percent. When measuring, round off to the nearest quarter foot (example—3 inches = .25 feet). In the case of fumigations of edible commodities, an error can result in an unacceptable level of residue on the commodity. If the sides of the enclosure slope outward from top to bottom, measure both the top and bottom and average the two to determine the dimension. Enclosure height should always be uniform and not require adjustment.

Formula for determining volume:

Length × width × height = volume in cubic feet

EXAMPLE: A stack with measurements H=10′6″, L=42′3″, and W=10′9″ 10.50 × 42.25 × 10.75 = 4,768.9 ft^3 round to 4,769 ft^3

Record volume in Block 26 of the PPQ Form 429.

Step 14—Calculating the Dosage

Calculate dosage by doing the following:

1. Refer to the treatment schedule for the correct dosage rate (lbs./1,000 ft^3) based on temperature (°F) (Step 10).
2. Multiply by the dosage (lbs./1,000 ft^3) rate by the volume (ft^3) to get the dosage in pounds.
3. Rules for rounding. Round to nearest 1/4 pound.

Formula for calculating dosage:

$$\text{dosage (lbs.)} = \text{volume}(ft^3) \times \text{dosage rate (lbs./1,000 } ft^3)$$

$$= \frac{\text{volume}(ft^3) \times \text{dosage rate (lbs.)}}{1{,}000\ ft^3}$$

EXAMPLE: You need to determine the dosage for a stack with a volume of 3,000 ft^3. For 72 °F (air and commodity temperatures), the treatment schedule lists the dosage rate at 2 pounds MB/1,000 ft^3. Determine dosage by doing the following:

1. Volume = 3,000 ft^3
2. Dosage rate = 2 lbs. MB/1,000 ft^3
3. Dosage (lbs.) = volume (ft^3) × dosage rate (lbs./1,000 ft^3)

$$= 3{,}000\ ft^3 \times 2\ \text{lbs. MB}/1{,}000\ ft^3$$

$$= \frac{3{,}000\ ft^3 \times 2\ \text{lbs. MB}}{1{,}000\ ft^3}$$

$$= 6\ \text{lbs. MB}$$

Step 15—Making a Final Check

Just prior to introducing the gas, do the following:

- Turn on all fans and T/C unit to make sure they work.
- Warm up T/C unit at least 30 minutes before zeroing in.
- If contaminant, CO_2, is detected, test again with Ascarite®. If you get a zero reading, proceed. If you don't get a zero reading, suspect a leak.
- Start volatilizer and heat water to 200 °F or above. A minimum temperature of 150 °F is required at all times during the introduction process.
- Place fumigant cylinder with gas introduction line on scale and take initial weight reading. Make sure the gas introduction line is attached to the cylinder. After obtaining the correct weight, subtract the dosage to be introduced into the enclosure. After you have introduced the proper amount of gas, the scale will be balanced.
- Check that tarpaulin is placarded and the area is secured. Only people working on the fumigation may be in the area.
- Check tarpaulin to make sure it is free from rips and tears.
- Check that all gas sampling tubes are labeled and are not crimped or crushed. Inspect tubes visually, or use an electric or Mityvac hand pump to check tubes. Either a fumiscope or vacuum pump may be used to test leads for unrestricted flow.

Important

When conducting fumigations with methyl bromide, sulfuryl fluoride or phosphine, erroneous readings may occur if the monitoring leads become blocked or crimped. It would be impossible to install a new monitoring lead during a fumigation treatment. Therefore, to avoid an unsuccessful fumigation, you should test monitoring leads before the treatment begins.

CPHST has developed the following procedure to detect blocked monitoring leads with the use of a Mityvac hand-held pump (for supplier, see **Vacuum Pump**, **Appendix H**):

1. Prior to fumigant introduction, connect the Mityvac hand-held vacuum pump to a monitoring lead.
2. Squeeze the handle on the Mityvac unit. If the lead is blocked, a vacuum will be indicated on the vacuum gauge of the Mityvac unit. (The handle should be squeezed two or three times for monitoring leads longer than 25 feet. The Mityvac hand-held pump has the capacity to attain and hold 25 inches of Hg vacuum and a minimum of 7 psig pressure.)
3. Disconnect the Mityvac hand-held pump from the monitoring lead, and repeat this procedure for each monitoring lead. (Connect monitoring leads to the gas analyzer prior to fumigant introduction.)

- Check that there is enough gas in the cylinder and if necessary, that other cylinders are available.
- Check the gas introduction line connections to make sure they are tight and free of leaks (wearing the SCBA).
- Check all safety equipment, especially SCBA, is available and in working order.
- Install Drierite® tube on gas sample line attached to the T/C unit and check to make sure granules are blue, if pink—replace Drierite®. If humidity is high, additional Drierite® tubes or frequent changes may be necessary.

Conducting the Fumigation

Step 1—Introducing the Gas

CAUTION

The acceptable air concentration level for methyl bromide (MB) is 5 ppm. A respirator (approved SCBA or MSHA/NIDSH) is required if the MB concentration level in the air is greater than 5 ppm at any time. You and the fumigator must use your SCBA while introducing the gas, checking for leaks, and when taking aeration readings.

Turn on all fans before introducing the gas. When using large cylinders of MB, have the fumigator open the cylinder valve slightly, then close the valve. With a halide detector, check all connections on the gas introduction line for leaks. If leaks are found, advise the fumigator to tighten the connections and repeat the test. If no leaks are found, then open the valve to the point where 3 to 4 pounds of MB

are being introduced per minute. The water temperature in the volatilizer should never go below 150 °F at any time during gas introduction. The water in the volatilizer may include an antifreeze and should be handled with the appropriate safeguards.

CAUTION

Don't touch the introduction line with your bare hands—you could get burned! Close the cylinder valve once the proper dosage has been introduced.

The fumigation time begins once all the gas has been introduced. Record the time gas introduction was started and completed in Block 32 on the PPQ Form 429. Run the fans for 30 minutes to achieve even gas distribution. Take the initial concentration reading 30 minutes after all the gas has been introduced.

When evacuating large cylinders, getting the final amount of gas out may take a long time. Consider taking a T/C unit reading 30 minutes after the gas was first introduced. If the gas distribution is even (all readings within 4 ounces of each other) and at a significantly high concentration, then turn off the fans. Running the fans longer may contribute to gas leakage. Allow the remainder of the gas to discharge with intermediate running of the fans. Normally, all the gas should be introduced within 30 minutes.

Important

Do **not** begin counting fumigation time until all the gas has been introduced and valve on the MB tank is closed.

Step 2—Testing for Leaks

Wear the SCBA while checking for leaks. Use a halide detector to test for leaks before the 30 minute reading or anytime when the concentration level is unknown or above 5 ppm. Test around the perimeter of the tarpaulin on the floor, corners, and especially where electric cords, gas sampling tubes, or gas introduction lines are present. When you detect leaks, have them sealed using more sand or sand snakes for floor leaks and tape for sealing small holes in the tarpaulin.

If you detect excessive leakage (concentration readings of 50 percent or less of the minimum concentration) in a tarpaulin which cannot be corrected in a practical way, do not attempt to correct the problem by adding more gas. Quickly evacuate the remaining gas from the enclosure, eliminate the problem, and construct a new enclosure. Aerate as usual following procedures on **page-2-2-3**. Restart the fumigation in the new enclosure.

CAUTION

Commodities used for food or feed may not be re-treated. If commodities fall into this category, the only options are the following:

- Return to the country of origin
- Re-exported to another country if they will accept the shipment
- Destroy by incineration

Step 3—Taking Concentration Readings

Important

Before taking a reading, always purge sampling lines with a mechanical or hand pump. After connecting the T/C unit to the sampling lead, always adjust the gas flow rate to 1.0, and wait until the meter registering "ounces per thousand cubic feet" stabilizes before taking a reading. (This may take a minute or more, depending upon the length of the tubing and whether or not an auxiliary pump is used.). If you're using treatment schedule T101 or **T401-a** to fumigate fresh fruit or vegetables, see "Special Procedures for Fruits, Vegetables, or Perishable Commodities Using Schedule **T101-a-1** or Equivalent" on **page-2-4-28**.

Take concentration readings with a T/C unit to determine the gas concentration and distribution within the enclosure. Check desiccant tubes before each reading and change Drierite® if its color is pink. Depending upon the length of exposure period, take concentration readings at the following times:

- 30 minutes
- 2 hours
- 4 hours (optional)
- 6 hours (optional)
- 12 hours (optional)
- 24 hours[5]
- 36 hours (optional)
- 48 hours
- 72 hours

Any final concentration reading (see following example)

EXAMPLE: If the treatment schedule lists a 6 hour exposure period, then the 6 hour reading would be required and not optional as shown in step 3. If the treatment schedule lists a 16 hour exposure period, you must take a 16 hour reading.

5 If fumigating oak logs or lumber for export, see "Special Procedures for Adding Gas to Oak Logs and Lumber."

CAUTION

Avoid using hand-held two-way radios near the T/C unit. Using two-way radios near the T/C unit will interfere with an accurate concentration reading.

Thirty Minute Reading

The 30 minute reading shows the initial concentration and distribution of gas. The 30 minute reading can indicate leakage, sorption, incorrect dosage calculation, or error in fumigant introduction—all of which require immediate attention. Concentration readings should not differ more than 4 ounces among the leads.

Two Hour Reading

In comparison with the 30 minute reading, the 2 hour reading also will indicate if the tarpaulin is leaking or the commodity is sorbing gas. Readings more than 15 percent lower than the 30 minute reading will require close monitoring and possible corrective action.

EXAMPLE: Your dosage for the fumigation was 4 pounds (64 ounces). The 30 minute reading was 50 ounces (3.125 pounds). The 2 hour reading is 42 ounces (2.625 pounds). The 2 hour reading is more than 15 percent less than the 30 minute reading and would indicate that either a leak or sorption problem may exist. You would need to monitor the fumigation closely until the concentration level stabilizes.

Four, Six, Twelve, or Thirty-Six Hour Reading

Not required if previous readings are satisfactory and experience with similar fumigations indicate successful treatment can be expected. If either the 4, 6, 12, or 36 hour reading is the final reading, then you must take the reading. If you are unfamilar with the treatment schedule, optional concentration readings may be necessary to ensure a successful fumigation.

Final Reading

The final reading is required for all tarpaulin fumigations in order to determine if the fumigation has been successfully completed. You may start the final reading before the finishing time of the treatment so that aeration commences at the finishing time. Starting the final reading before finishing time is especially critical when fumigating perishables. Do not add gas after the final reading.

Additional Readings

Decide the need to take additional readings based on the following:

- Rate of gas concentration decrease
- Any condition which could change the gas concentration such as severe winds, or rain.

When concentration readings differ by more than 4 ounces, run the fans to equalize the gas and record readings on the APHIS 429. Generally, at the 1/2 hour reading, gas should be evenly distributed, and you should not have to restart the fans unless you added gas.

Severe winds (30 mph or higher including any amount severe enough to cause damage) are a good reason to take additional readings on an outdoor fumigation. Any sharp or unusual decreases of the readings in relation to previous readings is a clue to take corrective action and supplementary readings. Take additional readings every 30 minutes until problems are rectified. Adverse weather conditions may indicate the need for additional readings.

Sorptive commodities may also require additional concentration readings.

Step 4—Determining the Need to Add Gas and Adjust Exposure

Use the following table to determine when to add gas or extend the exposure period:

TABLE 2-4-3: Determine the Need to Add Gas and Adjust Exposure

If the average T/C unit readings are:	And the schedule is:	Then:
Below the required minimum concentration	T101-a-1* or equivalent	ADD gas and extend fumigation. SEE "Special Procedures for Fruits, Vegetables, or Perishable Commodities Using Schedule T101-a-1 or Equivalent" on **page-2-4-25**
	Other than T101-a-1 or equivalent	ADD gas using ""Special Procedures for Adding Gas to Oak Logs and Lumber Using T312 or Equivalent" on **page-2-4-28**
At or above required minimum concentration	T101-a-1* or equivalent	SEE pages **page-2-4-21** for corrections at 0.5 hour and 2 hour readings
	Other than T101-a-1	No action necessary

Important

* T101-a-1 or equivalent treatment schedules are those schedules that are not greater than 2 hours long (exposure time), and the dosage rate is not greater than 4lbs per 1000ft^3, anywhere on the schedule.

Special Procedures for Adding Gas and Extending Exposure Period

Adding Gas to Commodities that are Fumigated Using Treatment Schedules other than T101-a-1 or Equivalent (may include perishables)

Important

T101-a-1 or equivalent treatment schedules are those schedules that are **not** greater than 2 hours long (exposure time), and the dosage rate is **not** greater than 4lbs per 1000ft^3.

NOTICE

To avoid injuring the commodity, add fumigant using the following formula:

1.6 × number of oz. below minimum × volume in ft.3/1,000 ft.3 = oz. of gas to add or oz. of gas to add/16 oz/lbs. = pounds (lbs.) of gas to add.

When adding gas, these procedures must be followed:

1. Heat water in volatilizer.
2. Turn on fans.
3. Take weight of the cylinder.
4. With SCBA on, open valve on cylinder and introduce the gas.
5. Close valve when the weight of the cylinder indicates that the needed amount of gas has been added.
6. Record quantity of fumigant added in Block 34 and the additional fan time in Block 30 of the PPQ Form 429.

Note the time the fumigator started introducing additional gas and the time the fumigator finished introducing gas and record in Block 40 (Remarks) of the PPQ Form 429. Run the fans until there is even gas distribution throughout the stack. Turn off fans, then take a concentration reading 30 minutes after the gas has been introduced. If all readings are above minimum concentration levels, then proceed as usual with the remaining scheduled concentration readings.

Excessive leakage in any one tarpaulin enclosure, which cannot be eliminated in a practical way, must ***not*** be corrected by the addition of MB. (Excessive leakage has occured when concentration readings are less than or equal to 50 percent of minimum concentration reading). Quickly evacuate remaining gas from such an enclosure, eliminate the problem, and construct a new enclosure. Start a new treatment in the new enclosure.

CAUTION

Commodities used for food or feed may not be re-treated. If commodities fall into this category, the only options are the following:

- Re-export to another country if they will accept the shipment
- Destroy by incineration

Extending the Exposure Period for Food, Nonfood, Feed, or Nonfeed Commodities

Use the following table to determine how long to extend the exposure period.

TABLE 2-4-4: Determine the Extended Exposure Period

If the exposure time is:	And the reading is below minimum by:[1]	Then extend exposure:
Less than 12 hours	10 oz. or less	10 percent of the time lapse since the last acceptable reading
	11 oz. or more	30 minutes
12 hours or more	10 oz. or less	10 percent of the time lapse since the last acceptable reading
	11 oz. or more	2 hours or 10 percent of time lapse since last acceptable reading, whichever is greater

1 If a reading is 50 percent or more below the minimum concentration reading, then abort the treatment. For example, if the minimum reading is 38 ounces then the reading 50 percent below the minimum is 19 ounces [38 ounces – (38 ounces × .50) = 19 ounces]. (See the following special procedures for fruits and vegetables using T101 or equivalent.) For oak logs and oak lumber (T312-a and T312-b), the rule for adding exposure time does not apply. Refer to the schedules for specifics.

Special Procedures for Fruits, Vegetables, or Perishable Commodities Using Schedule T101-a-1 or Equivalent

Use these instructions only for fruits and vegetables being fumigated under treatment schedule T101-a-1 or equivalent.

CAUTION

Fresh fruits and vegetables are sensitive to MB so you should double check volume calculations and dosage measurements to avoid accidental overdoses. If any 30 minute readings are 50 percent or more above the minimum concentration, it indicates a miscalculation of the dosage. Include a brief report on the PPQ Form 429 stating possible reasons for the overdose. Exposure periods are decreased for fumigations where concentration readings are much higher than required. See table on the following pages to determine when to reduce exposure periods.

Use **Table 2-4-5** and **Table 2-4-3** on the following pages for fresh fruits and vegetables to determine if you need to add gas or extend or decrease the exposure time. Average your concentration readings before using the tables. Select the proper table based on the time of the T/C unit concentration reading (30 minutes or 2 hours).

Important

These tables apply **only** to those T101 schedules lasting 2 hours or less at a dosage rate of 4lbs/1000ft^3 or less. They do not apply to schedules of longer duration.

Adding Gas

NOTICE

To avoid injuring the commodity, add fumigant using the following formula:

1.6 × number of oz. below minimum × volume in ft.3/1,000 ft.3 = oz. of gas to add or oz. of gas to add/16 oz/lbs. = pounds (lbs.) of gas to add.

When adding gas, these procedures must be followed:

1. Heat water in volatilizer.
2. Turn on fans.
3. Take weight of the cylinder.
4. With SCBA on, open valve on cylinder and introduce the gas.
5. Close valve when the weight of the cylinder indicates that the needed amount of gas has been added.
6. Record quantity of fumigant added in Block 34 and additional fan time in Block 30 of the PPQ Form 429.

Note the time the fumigator started introducing additional gas and the time the fumigator finished introducing gas and record in Block 40 (Remarks) of the PPQ Form 429. Run the fans until there is even gas distribution throughout the stack. Turn off fans, then take a concentration reading 30 minutes after the gas has been introduced. If all readings are above minimum concentration levels, then proceed as usual with the remaining scheduled concentration readings.

TABLE 2-4-5: Determine Gas Concentration Values and Corrections for Fruits and Vegetables at the 30 Minute Reading of T101-a-1 or Equivalent Schedules.

If the schedule is:	Add the minimum concentration reading (oz.) in schedule is:	And the average concentration reading (oz.) is:	Then:
40-49 °F 4 lbs for 2 hrs	48	73 or higher*	EVACUATE excess gas immediatley
		65 or greater[1]	REDUCE exposure by 15 minutes
		64-48	TAKE 2 hour reading as scheduled
		47 or lower	1. ADD gas, and 2. EXTEND exposure 15 minutes
50-59 °F 3 lbs for 2 hrs	38	58 or higher*	EVACUATE excess gas immediatley
		52 or greater	REDUCE exposure by 15 minutes
		51-38	TAKE 2 hour reading as scheduled
		37 or lower	1. ADD gas, and 2. EXTEND exposure 15 minutes
60-69 °F 2.5 lbs for 2 hrs	32	49 or higher*	EVACUATE excess gas immediatley
		48 or greater	REDUCE exposure by 15 minutes
		47-32	TAKE 2 hour reading as scheduled
		31 or lower	1. ADD gas, and 2. EXTEND exposure 15 minutes
70-79 °F 2 lbs for 2 hrs	26	40 or higher*	EVACUATE excess gas immediatley
		37 or greate	REDUCE exposure by 15 minutes
		36-26	TAKE 2 hour reading as scheduled
		25 or lower	1. ADD gas, and 2. EXTEND exposure 15 minutes
80-89 °F 1.5 lbs for 2 hrs	19	30 or higher*	EVACUATE excess gas immediatley
		27 or greater	REDUCE exposure by 15 minutes
		26-19	TAKE 2 hour reading as scheduled
		18 or lower	1. ADD gas, and 2. EXTEND exposure 15 minutes

1 *If concentration reading is more than 50 percent above the minimum concentration reading, it indicates that something is radically wrong and an immediate check should be made to determine the cause and to correct it.

TABLE 2-4-6: Determine Gas Concentration Values and Corrections for Fruits and Vegetables at the 2 Hour Reading of T101-a-1 or Equivalent Schedules.

If the schedule is:	And the average concentration reading at 2 hours is:	Then do not add gas, but:
40-49 °F 4 lbs for 2 hours	38 and above	AERATE commodity (see **page-2-4-29**)
	37-28	EXTEND exposure by 15 minutes
	27-25	EXTEND exposure by 30 minutes
50-59 °F 3 lbs for 2 hrs	29 and above	AERATE commodity (see **page-2-4-32**)
	28-24	EXTEND exposure by 15 minutes
	23-21	EXTEND exposure by 30 minutes
60-69 °F 2.5 lbs for 2 hrs	24 and above	AERATE commodity (see **page-2-4-32**
	23-21	EXTEND exposure by 15 minutes
	20-18	EXTEND exposure by 30 minutes
70-79 °F 2 lbs for 2 hrs	19 and above	AERATE commodity (see **page-2-4-32**
	18-16	EXTEND exposure by 15 minutes
	15-13	EXTEND exposure by 30 minutes
80-89 °F 1.5 lbs for 2 hrs	14 and above	AERATE commodity (see **page-2-4-32**)
	13-12	EXTEND exposure by 15 minutes
	11-10	EXTEND exposure by 30 minutes

Special Procedures for Adding Gas to Oak Logs and Lumber Using T312 or Equivalent

After taking the 24 hour concentration reading, if necessary, add gas to bring the concentration level up to 240 ounces. Subtract the 24 hour concentration reading from 240 to determine how many ounces the concentration is below 240 ounces. Use the following formula in calculating how much gas to add:

1.6 × number of oz. below 240 × volume in ft^3/1,000 ft^3 = oz. of gas to add or

$$\frac{\text{oz. of gas to add}}{16\frac{\text{oz.}}{\text{lbs.}}} = \text{pounds (lbs.) of gas to add}$$

EXAMPLE: You're fumigating a 10,000 ft^3 enclosure of oak logs for export. At the 24 hour reading, the T/C unit readings indicate a 160 oz. concentration level. To determine how much gas to add, do the following:

240 oz. – 160 oz. = 80 oz. below 240 oz.
1.6 × 80 oz. × 10,000 ft^3/1,000 ft^3 = 1,280 oz. or

$$\frac{1{,}280\text{oz.}}{16\frac{\text{oz.}}{\text{lbs.}}} = 80 \text{ pounds (lbs.) of gas to add}$$

Take concentration readings 30 minutes after adding gas and record on the PPQ Form 429.

Step 5—Exhausting the Gas

Exhaust the gas at the completion of the exposure period. If the treatment schedule is a FIFRA Section 18 Exemption, then you must monitor the aeration of the commodity. Use the following table to determine the need to monitor the aeration of the fumigation.

TABLE 2-4-7: Determine the Need to Monitor Aeration

If the treatment schedule is:	Then:
A FIFRA Section 18 Exemption	MONITOR the aeration of the commodity. FOLLOW "Aerating the Enclosure" steps which follow.
A labelled treatment	RELEASE the commodity and RELEASE the fumigation to the fumigator for aeration.

Aerating the Enclosure

Aeration procedures are designed to provide safe working conditions during the aeration period and to assure that commodities are safe for handling, storage, and transportation. A fumigant must be aerated in accordance with Environmental Protection Agency (EPA) label requirements, the Occupational Safety and Health Administration (OSHA), and the PPQ Treatment Manual.

When treatments are conducted in a paticular location on a regular basis, a permanent site should be designated. At such sites, the fan used to remove the fumigant from the enclosure during aeration must be connected to a permanent stack extending above the roof level.

Aeration of fumigated structures and ships are covered within those particular sections.

Responsibility for Aerating the Commodity

The label requires that at least two people trained in the use of the fumigant must be present at all times during gas introduction, treatment, and aeration. The PPQ officer, however, is not required to be continuously present at the fumigation site throughout the aeration process unless specified by the label or by State or local regulations.

If the fumigation is performed under a Section 18 Exemption, then a PPQ officer must be present at the initiation of aeration and to verify the final aeration readings.

TABLE 2-4-8: Determine Responsibility for Aerating the Commodity

If the Treatment Schedule is:	Then:
A FIFRA Section 18 Exemption	1. MONITOR the aeration of the enclosure, and 2. USE the table 2-4-9 to determine which aeration procedure to follow
A labeled Treatment Schedule	1. RELEASE the fumigation to the fumigator to aerate according to label instructions and the conditions of the compliance agreement. 2. RELEASE the commodity.

Materials Needed

The following materials will be needed to aerate the enclosure:

- SCBA[6]
- Colorimetric tubes (Draeger or Kitagawa for example)
- Exhaust fan[7]
- Exhaust duct[8]
- Danger signs[9]
- Materials for limiting access to area (barricades, rope)[10]
- PPQ Form 429

The following procedures apply to the aeration of all tarpaulin fumigations.

Securing the Area

Assuming that you have already restricted access and secured the fumigation area, you now must restrict access to the area where the exhaust duct extends on the ground beyond the enclosure.

CAUTION

During the first 10 minutes of aeration, it is recommended that no people should be within 200 feet of the exhaust duct outlet.

If this buffer zone is regulated by the State or municipality where the fumigation takes place, local regulations must be followed.

6 Materials required for both PPQ and commercial fumigator.
7 Materials to be furnished by the commercial fumigator.
8 Materials to be furnished by the commercial fumigator.
9 Materials to be furnished by the commercial fumigator.
10 Materials to be furnished by the commercial fumigator.

If it is impossible to restrict people from the area of aeration during regular work hours, consider aeration during another time of the day. When securing the duct outlet area, consider the direction of the wind. Face the duct outlet toward an open area, and away from people. Point the duct outlet upward to aid in dispersing the exhausted gas.

Advise the fumigator to use a physical barrier such as ropes, barricades, or walls to secure the area.

Placard the secure area near the exhaust outlet with the appropriate DANGER/PELIGRO signs. Make sure the placards meet the appropriate fumigant label or labeling requirements. The skull and crossbones should be present as well as "AREA UNDER FUMIGATION, DO NOT ENTER/NO ENTRE"; date of the fumigation; name of the fumigant used; and the name, address, and telephone number of the fumigator.

Unless you authorize their use, do *not* allow motorized vehicles to operate within the secure area.

Wearing Respiratory Protection

The fumigator and the PPQ officer monitoring the aeration must wear approved respiratory protection (SCBA, air supplied respirator, or a combination unit) when:

- Installing the exhaust system
- Opening the tarpaulin for aeration
- Removing the tarpaulin if measured levels of fumigant are above 5 ppm
- Any time during the aeration process when a risk of exposure to concentrations above 5 ppm exists. This includes any time the concentration is unknown.

TABLE 2-4-9: Determine the Aeration Procedure

If:	And:	And:	Then:
Nonsorptive	Containerized	→	GO to **page-2-4-32**
	Noncontainerized	Fresh fruits and vegetables, and cut flowers	GO to **page-2-4-33**
		Other than fresh fruits and vegetables, and cut flowers	GO to **page-2-4-33**
Sorptive, including yams and chestnuts	Containerized	→	GO to **page-2-4-38**
	Noncontainerized	→	GO to **page-2-4-36**

Aerating Nonsorptive, Containerized Cargo—Indoors and Outdoors

Step 1—Installing Exhaust System

Advise the fumigator to:

1. Install an exhaust fan (minimum of 5,200 cfm capacity) to a 16 inch, or greater, diameter duct located at the floor near rear doors of the container.
2. Install an air introduction duct system consisting of a 3,750 cfm, or greater, fan attached to a 12 inch, or larger, duct which reaches two-thirds of the length of the container at the top of the load. Have the ducts installed prior to the start of the fumigation. For indoor fumigation, extend the exhaust duct at least 30 feet beyond the building or through a vertical stack extending through the roof. For outdoor fumigations, extend the exhaust duct at least 30 feet beyond the container.

Important

(1) Volume of enclosure (in cubic feet) divided by the sum of cubic feet per minute (cfm) of the exhaust fan(s) or exhaust blower equals the number of minutes required per complete gas volume exchange. (2) Sixty minutes divided by the number of minutes per gas volume exchange equals the number of complete gas exchanges per hour. The result should be in the range of 4 to 15. The faster the rate of aeration the better, particularly for perishable commodities. If the exhaust flow is•connected to a methyl bromide recovery system, this device must not impede the flow rate to less than 4 volumes per hour.

Step 2—Aerating the Commodity

Advise the fumigator to:

1. Connect the exhaust duct to the exhaust fan.
2. Start the exhaust fan(s) and lift the end of the tarpaulin opposite the end at which the exhaust fan and duct are located.
3. Aerate for 3 hours.
4. Stop the aeration fans.
5. Use a colorimetric tube to take a concentration reading in the exhaust duct.

After the fumigator takes the concentration reading, you must record the date, concentration reading, and time in Block 39 of PPQ Form 429. Then use the following table to determine when to release the commodity.

TABLE 2-4-10: Determine When to Release the Commodity

If the gas concentration level is:	Then:
5 ppm or less	RELEASE the commodity
6 ppm or more	1. CONTINUE aeration until the concentration is 5 ppm or less[1], then 2. RELEASE the commodity

1 Take concentration readings with colormetric tubes 4 feet from the base of the stack and 1 foot inside the stack at two locations between the cartons, but not inside the cartons.

Aerating Nonsorptive, Noncontainerized Cargo—Indoors and Outdoors

Step 1—Installing the Exhaust System

Important

This step is optional for outdoor fumigations, but must be done for indoor fumigations.

Advise the fumigator to:

1. Install an exhaust duct (minimally one 3,500 cfm capacity fan connected to an exhaust duct). An exhaust duct is optional for outdoor fumigations.
2. Extend the exhaust duct outlet to an outside area where there is adequate ventilation and at least 30 feet away from the building or through a vertical exhaust stack extending through the roof.

Important

(1) Volume of enclosure (in cubic feet) divided by the sum of cubic feet per minute (cfm) of the exhaust fan(s) or exhaust blower equals the number of minutes required per complete gas volume exchange. (2) Sixty minutes divided by the number of minutes per gas volume exchange equals the number of complete gas exchanges per hour. The result should be in the range of 4 to 15. The faster the rate of aeration the better, particularly for perishable commodities. If the exhaust flow is•connected to a methyl bromide recovery system, this device must not impede the flow rate to less than 4 volumes per hour.

Step 2—Aerating the Commodity

Advise the fumigator to:

1. Start the exhaust fan.

2. Lift the end of the tarpaulin opposite the end with the exhaust fan and duct (if used).
3. Aerate the enclosure for 2 hours.

Outdoor Fumigations

Advise the fumigator to:

1. Stop the fans.
2. Remove the tarpaulin.
3. Take concentration readings with colormetric tubes 4 feet form the base of the stack and 1 foot inside the stack at two locations between the cartons, but not inside the cartons.

After the fumigator takes the concentration reading, you must then record the date, concentration reading, and time in Block 39 of PPQ Form 429. If you are not at the fumigation site, have the fumigator call and give you the information. Then use the following table to determine when to release the commodity.

TABLE 2-4-11: Determine When to Release the Commodity for Outdoor Fumigations

If the gas concentration level is:	Then:
5 ppm or less	RELEASE the commodity
6 ppm or more	1. CONTINUE aeration and take concentration readings until the level is 5 ppm or less, then 2. RELEASE the commodity

Indoor Fumigations

Advise the fumigator to:

1. Stop the fans.
2. Take concentration readings with colorimetric tubes in the exhaust duct.

After the fumigator takes the concentration reading, you must record the date, concentration reading, and time in Block 39 of PPQ Form 429. Then use the following table to determine when to release the commodity.

TABLE 2-4-12: Determine When to Release the Commodity for Indoor Fumigations

If the gas concentration level is:	Then:
5 ppm or less	1. ADVISE fumigator to REMOVE the tarpaulin, and 2. RELEASE the commodity
6 ppm to 99 ppm	1. ADVISE fumigator to REMOVE the tarpaulin, and 2. CONTINUE aeration until the concentration is 5 ppm or less, then 3. RELEASE the commodity
100 ppm or above	1. CONTINUE aeration and take concentration readings until the concentration level is below 100 ppm, then remove the tarpaulin, and 2. CONTINUE aeration until concentration is 5 ppm or less, then 3. RELEASE the commodity

Aeration Procedures for Fresh Fruits, Vegetables, and Cut Flowers—Indoors or Outdoors

Important

Do **not** use these procedures for fresh chestnuts or yams. (See procedures for sorptive commodities on **page-2-4-38**)

Step 1—Installing Exhaust System

Use the following table to determine which size fan to use.

TABLE 2-4-13: Determine Number of Fans

If the enclosure is:	Then:
Evenly stacked up to 25,000 ft^3	USE two 5,000 cfm fans connected to 3 foot diameter exhaust ducts
Irregularly stacked of any size	USE three 5,000 cfm fans connected to 3 foot diameter exhaust ducts
More than 25,000 ft^3	CONTACT the Center for Plant Health Science & Technology (CPHST) in Raleigh, North Carolina.
Up to 1000 cu ft	USE one fan, 67-350 cfm
1001-15,000 cu ft	USE one or 2 fans. The volume of the enclosure divided by the sum of the cfm of the fans should equal a figure of 15 or less. Connect fan(s) to 3-ft diameter exhaust duct(s) 3 ft in diameter.
15,001-25,000 cu ft	USE two fans, each 1,000 to 5,000 cfm. The volume of the enclosure divided by the sum of the cfm of the fans should equal a figure of 15 or less. Connect fan(s) to exhaust duct(s) 3 ft in diameter.
More than 25,000 cu ft	CONTACT the Center for Plant Health Science and Technology (CPHST) in Raleigh, North Carolina, for advice prior to conducting the first fumigation.

An alternate procedure to using exhaust fans and ducts is to aerate through a vertical stack.

Important

(1) Volume of enclosure (in cubic feet) divided by the sum of cubic feet per minute (cfm) of the exhaust fan(s) or exhaust blower equals the number of minutes required per complete gas volume exchange. (2) Sixty minutes divided by the number of minutes per gas volume exchange equals the number of complete gas exchanges per hour. The result should be in the range of 4 to 15. The faster the rate of aeration the better, particularly for perishable commodities. If the exhaust flow is•connected to a methyl bromide recovery system, this device must not impede the flow rate to less than 4 volumes per hour.

Step 2—Aerating the Commodity

Advise the fumigator to:

1. Connect the exhaust duct to the exhaust fan.
2. Start the exhaust fan(s) and lift the end of the tarpaulin opposite the end at which the exhaust fan and duct are located.
3. Aerate for 2 hours.
4. Remove the tarpaulin and allow 2 hours for passive aeration.
5. Take a final reading.

After the fumigator takes the concentration reading, you must record the date, concentration reading, and time in Block 39 of PPQ Form 429. Then use the following table to determine when to release the commodity.

TABLE 2-4-14: Determine When to Release the Commodity

If the gas concentration level is:	Then:
5 ppm or less	RELEASE the commodity
6 ppm or more	1. CONTINUE aeration and take concentration readings until the level is 5ppm or less, then 2. RELEASE the commodity

Important

Give the original and one copy to your supervisor for review. The supervisor should keep the original for port files and send one copy to:

USDA, APHIS, PPQ, CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606

Aerating Sorptive, Noncontainerized Cargo—Indoors and Outdoors

Step 1—Installing the Exhaust System

Important

This step is optional for outdoor fumigations, but must be done for indoor fumigations.

Advise the fumigator to:

1. Install an exhaust duct (minimally one 3,500 cfm capacity fan connected to an exhaust duct).
2. Extend the exhaust duct outlet to an outside area where there is adequate ventilation and at least 30 feet away from the building or through a vertical exhaust stack extending through the roof.

Step 2—Aerating the Commodity

Outdoor Fumigations

Advise the fumigator to:

1. Lift both ends of the tarpaulin.
2. Start the circulation fans and exhaust fans (if available).
3. Run the fans for 4 hours.
4. Remove the tarpaulin.
5. Take concentration readings with colormetric tubes 4 feet from the base of the stack and 1 foot inside the stack at two locations between the cartons, but not inside the cartons.

After the fumigator takes the concentration reading, you must record the date, concentration reading, and time in Block 39 of PPQ Form 429. Then use the following table to determine when to release the commodity.

TABLE 2-4-15: Determine when to Realease the Commodity

If the gas concentration level is:	Then:
5 ppm or less	RELEASE the commodity
6 ppm or more	1. CONTINUE aeration and take concentration readings until the level is 5ppm or less, then 2. RELEASE the commodity

Indoor Fumigations

Advise the fumigator to:

1. Complete the installation of the exhaust duct.
2. Start the circulation fans and exhaust fans.
3. Lift the end of the tarpaulin opposite the exhaust fan.
4. Run the fans for 4 hours.
5. Stop the fans and take concentration readings with colorimetric tubes in the exhaust duct within 2 feet of the enclosure.
6. Remove the tarpaulin.

After the fumigator takes the concentration reading, you must then record the date, concentration reading, and time in Block 39 of PPQ Form 429. Then use the following table to determine when to release the commodity. Take successive readings at intervals of not less than 2 hours. Take concentration readings with colormetric tubes 4 feet

from the base of the stack and 1 foot inside the stack at two locations between the cartons, but not inside the cartons. You, as well as the fumigator, may take concentration readings.

TABLE 2-4-16: Determine When to Release the Commodity for Indoor Fumigations

If the gas concentration level is:	Then:
5 ppm or less	1. REMOVE the tarpaulin, and 2. RELEASE the commodity
6 ppm to 99 ppm	1. REMOVE the tarpaulin, and 2. CONTINUE aeration until the concentration is 5 ppm or less[1], then 3. RELEASE the commodity
100 ppm or above	1. CONTINUE aeration and take concentration readings until the concentration level is below 100 ppm, then remove the tarpaulin, and 2. CONTINUE aeration until concentration is 5 ppm or less, then 3. RELEASE the commodity

1 Take concentration readings with colormetric tubes 4 feet from the base of the stack and 1 foot inside the stack at two locations between the cartons, but not inside the cartons.

Aerating Sorptive Commodities in Containers—Indoors and Outdoors

Step 1—Installing the Exhaust System

Important

This step is not required for outdoor fumigations.

Advise the fumigator to:

1. Install an exhaust fan (minimum of 5,200 cfm capacity) to a 16 inch or greater diameter duct located at the floor near rear doors or the container.
2. Install an air introduction duct system consisting of a 3,750 cfm or greater fan attached to a 12 inch or greater duct which reaches two-thirds of the length of the container at the top of the load. Have the ducts installed prior to the start of the fumigation. For indoor fumigations, extend the exhaust duct at least 30 feet beyond the building or through a vertical stack extending through the roof. For outdoor fumigations, extend the exhaust duct 30 feet beyond the container.

Step 2—Aerating the Commodity

Indoors

Advise the fumigator to:

1. Complete installation of exhaust duct and begin exhaust fan operation.
2. Lift both ends of the tarpaulin and begin exhaust fan operation. Do not remove the tarpaulin until the gas concentration level is below 100 ppm (see **Table 2-4-17**).
3. Start the circulation and air introduction fans. Sorptive commodities generally require 12 hours or longer to aerate. Since sorptive commodities vary in their rates of desorption, aeration may be completed in less than 12 hours. Require a minimum of 4 hours aeration for all sorptive commodities.
4. Take concentration readings with colorimetric tubes in the exhaust duct 2 feet within the enclosure. Record your readings on PPQ Form 429. Take successive readings within the enclosure 4 feet from the floor, at two representative locations. Take the readings between the cartons, but not inside the cartons.

After the fumigator takes the concentration reading, you must record the date, concentration reading, and time in Block 39 of PPQ Form 429. Then use **Table 2-4-17** to determine when to release the commodity.

TABLE 2-4-17: Determine when to Realease the Commodity

If the gas concentration level is:	Then:
5 ppm or less	1. ADVISE fumigator to REMOVE the tarpaulin, and 2. RELEASE the commodity
6 ppm to 99 ppm	1. HAVE fumigator REMOVE the tarpaulin, and 2. CONTINUE aeration until the concentration is 5 ppm or less, then 3. RELEASE the commodity
100 ppm or above	1. CONTINUE aeration and take concentration readings until the concentration level is below 100 ppm, then remove the tarpaulin, and 2. CONTINUE aeration until concentration is 5 ppm or less, then 3. RELEASE the commodity

Outdoors

Advise the fumigator to:

1. Complete installation of exhaust duct and begin exhaust fan.
2. Lift both ends of the tarpaulin that are furthest from exhaust fan.
3. Start the circulation and air introduction fans. Sorptive commodities generally require 12 hours or longer to aerate. Since sorptive commodities vary in their rates of desorption, aeration may be completed in less than 12 hours. Require a minimum of 4 hours aeration for all sorptive commodities.
4. Remove the tarpaulin after 4 hours aeration.

5. Stop the circulation fans and take concentration readings with colorimetric tubes 4 feet from the ground and 1 foot inside the outer edge of the stack between the cartons but not inside the cartons. One location is sufficient.

After the fumigator takes the concentration reading, you must record the date, concentration reading, and time in Block 39 of PPQ Form 429. If you are not at the fumigation site, have the fumigator call and give you the information. Then use **Table 2-4-18** to determine when to release the commodity.

TABLE 2-4-18: Determine when to Realease the Commodity

If the gas concentration level is:	Then:
5 ppm or less	RELEASE the commodity
6 ppm or more	1. CONTINUE aeration and take concentration readings until the level is 5ppm or less, then 2. RELEASE the commodity

2

Treatment Manual

Chemical Treatments

Fumigants • Methyl Bromide • Chamber Fumigation

Contents

Methods and Procedures **page-2-5-2**
Conducting the Fumigation **page-2-5-2**
Step 1—Selecting a Treatment Schedule **page-2-5-2**
Step 2—Determining Section 18 Exemptions and Sampling Requirements **page-2-5-2**
Step 3—Measuring the Temperature **page-2-5-3**
Step 4—Calculating the Dosage **page-2-5-3**
Step 5—Conducting the Fumigation **page-2-5-4**
Aerating the Chamber **page-2-5-4**
Normal Atmospheric Pressure Chamber—Aerating Noncontainerized Cargo **page-2-5-5**
Step 1—Securing the Area **page-2-5-5**
Step 2—Aerating the Chamber **page-2-5-5**
Step 3—Taking Concentration Readings **page-2-5-5**
Normal Atmospheric Pressure Chamber—Aerating Containerized Cargo **page-2-5-6**
Step 1—Securing the Area **page-2-5-6**
Step 2—Aerating the Chamber **page-2-5-6**
Step 3—Taking Concentration Readings **page-2-5-6**
Vacuum Fumigation Chambers—Aerating Containerized and Noncontainerized Cargo **page-2-5-6**
Step 1—Securing the Area **page-2-5-6**
Step 2—Aerating the Chamber **page-2-5-7**
Step 3—Taking Concentration Readings **page-2-5-7**

Methods and Procedures

Materials Needed

The procedures covered in this section provide commercial fumigators with the methods, responsibilities, and precautions for chamber fumigation.

- Colorimetric tubes (Draeger, Kitagawa, or equivalent)[1]
- Halide leak detector[1]
- Methyl bromide
- Scale or graduated cylinder for volume (liquid measurements)
- SCBA or supplied air respirator[1]
- Thermal conductivity (T/C) unit
- Thermometer[1]
- Volatilizer
- Warning signs

The chamber operator is responsible for supplying the above materials as well as ensuring that the chamber is certified for conducting PPQ quarantine treatments.

Conducting the Fumigation

Step 1—Selecting a Treatment Schedule

Select an appropriate treatment schedule to effectively eliminate the plant pest without damaging the commodity to be fumigated.

Turn to the treatment schedule Index and look up by commodity or by pest the treatment schedule(s) available. Treatment schedules which are approved for chambers will be listed as either “NAP” (normal atmospheric pressure) or as “vacuum.”

Step 2—Determining Section 18 Exemptions and Sampling Requirements

After selecting the treatment schedule, you will be able to determine which treatment schedules are FIFRA Section 18 Exemptions by the presence of broad, bold lines on the border of the treatment schedule table. Some treatment schedules are Section 18 Exemptions only at specific temperature ranges. Check the treatment schedule and temperature to determine if the fumigation will be a Section 18

1 You will need to bring these items unless the chamber is operated by PPQ, in which case all materials are provided by PPQ.

Exemption. Once you've determined that a treatment schedule is a Section 18 Exemption, look in the far right column of the table to determine if a sample is required. If a sample is required, you must take a sample prior to the start and another after the aeration. See instructions in the section tabbed "Monitoring."

Step 3—Measuring the Temperature

Determine the temperature to use in selecting the proper dosage rate:

- For fruits, pulpy vegetables, or logs use only the commodity temperature.
- For all other commodities use both the commodity and air temperature.

To take the temperature readings, use a bimetallic, mercury, or digital long-stem thermometer that has been calibrated. Use **Table 2-5-1** to determine which temperature to use when selecting the proper dosage rate for commodities other than fresh fruits, vegetables, or logs. Record the temperatures in Block 22 of the PPQ Form 429.

Important

Commodity and space temperatures must be 40 °F or above.

TABLE 2-5-1: Determine Whether to Use Commodity or Air Temperature for Determining Dosage Rate

If the air temperature is:	And:	Then, for commodities other than fresh fruits or vegetables or logs and lumber[1]:
Higher than the commodity temperature	→	Use the commodity temperature for determining the dosage rate
Lower than the commodity temperature	By 9 degrees or less	
	By 10 degrees or more	Use the average of the air and commodity temperature for determining the dosage rate

1 Use commodity temperature for fresh fruits or vegetables or logs and lumber.

Step 4—Calculating the Dosage

In order to calculate dosage, you must have the following information:

- Treatment schedule
- Volume of the fumigation chamber (ft^3)
- Temperatures of commodity and air (°F)

Refer to the specific treatment schedule to determine the dosage rate (pounds/ft^3).

The formula for calculating dosage is:

$$\text{dosage(lbs.)} = \text{volume}(ft^3) \times \text{dosage rate(lbs./1,000 } ft^3)$$

$$= \frac{\text{volume}(ft^3) \times \text{dosage rate(lbs.)}}{1{,}000\ ft^3}$$

EXAMPLE: Using a fumigation chamber which has a volume of 500 ft^3, you determine the temperature of the commodity and space is 72 °F. The treatment schedule requires 2 lbs. MB/1,000 ft^3 at 70 °F or above. To calculate dosage multiply the volume (500 ft^3) by the dosage rate (2 lbs. MB/1,000 ft^3). This equals 1.0 lbs. of MB needed for the dosage.

Step 5—Conducting the Fumigation

Since fumigation chambers vary by manufacturer and model, refer to the manufacturer's operating manual to determine how to use the chamber. However, in any case, circulation fans in a chamber should be kept running for 15 minutes following introduction of the gas.

Aerating the Chamber

Responsibility for aerating the chamber and releasing the commodity depends on whether the treatment schedule used was a labelled use or FIFRA Section 18 Exemption. Use the following table to determine responsibility for monitoring the aeration of the fumigation.

TABLE 2-5-2: Determine the Responsibility for Monitoring the Aeration

If the fumigation chamber is:	And the treatment schedule is:	Then:
Privately or State owned	A labelled treatment	RELEASE the fumigation to the fumigator to aerate and release the commodity
	A FIFRA Section 18 Exemption (noted in the treatment schedules)	1. MONITOR the aeration, and 2. USE the following table to determine which aeration procedures to follow
PPQ owned	→	

Use the following table to determine which procedures to follow for aerating normal atmospheric pressure (NAP) and vacuum chambers.

TABLE 2-5-3: Determine the Aeration Procedure

If the chamber is:	And the cargo is:	Then:
NAP	Noncontainerized	Use the procedures on **page-2-5-5**
	Containerized	Use the procedures on **page-2-5-6**
Vacuum	→	Use the procedures on **page-2-5-6**

Each chamber must be equipped with at least one permanent, metal gas sampling tube to allow you to take colorimetric tube readings during the aeration. Any extensions of the gas sampling tube or flexible connectors must be made of Teflon™ tubing or metal. The gas sampling tube must be located in the vicinity of the exhaust duct inside the chamber. The gas sampling tube must extend outside the chamber to allow for colorimetric tube readings.

Normal Atmospheric Pressure Chamber—Aerating Noncontainerized Cargo

Step 1—Securing the Area

Assuming that you've already secured the fumigation area, allow only the chamber operator and the PPQ officer monitoring the fumigation into the secure area.

WARNING

Do ***not*** allow motorized vehicles to operate within the secure area.

Step 2—Aerating the Chamber

Run the exhaust long enough to obtain at least four complete changes of air (about 4 to 15 minutes per change of air or 1 hour).

Step 3—Taking Concentration Readings

Draw an air sample from the chamber into a colorimetric tube. Air samples must be taken near the floor of the chamber in the vicinity of the exhaust duct. This can be accomplished by installing a metal tube in the chamber to transport the sample from the floor to a convenient opening in the chamber walls.

Use **Table 2-5-4** to determine when to release the commodity.

TABLE 2-5-4: Deterimine When to Release the Commodity

If the gas concentration is:	Then:
5 ppm or less	RELEASE commodity
6 ppm or above	1. TAKE concentration readings, and 2. RELEASE commodity when the concentration level is 5 ppm or less

Normal Atmospheric Pressure Chamber—Aerating Containerized Cargo

Step 1—Securing the Area

Assuming that you've already secured the fumigation area, allow only the chamber operator and the PPQ officer monitoring the fumigation into the secure area.

WARNING

Do ***not*** allow motorized vehicles to operate within the secure area.

Step 2—Aerating the Chamber

Run the exhaust long enough to obtain at least four complete changes of air (about 4 to 15 minutes per change of air or 1 hour). If the containers have internal fans, run them unless they are operated by internal combustion engines. Remove container from the chamber at the conclusion of four complete changes of air to an outdoor secure area for passive aeration. Wear the SCBA while the container is being moved outdoors.

Step 3—Taking Concentration Readings

Wearing your SCBA, draw an air sample 3 feet inside the container and 3 feet above the floor.

Use the following table to determine when to release the commodity.

TABLE 2-5-5: Determine When to Release the Commodity

If the gas concentration is:	Then:
5 ppm or less	RELEASE commodity
6 ppm or above	1. CONTINUE passive aeration 2. TAKE concentration readings, and 3. RELEASE commodity when the concentration level is 5 ppm or less

Vacuum Fumigation Chambers—Aerating Containerized and Noncontainerized Cargo

Step 1—Securing the Area

Assuming that you've already secured the fumigation area, allow only the chamber operator and the PPQ officer monitoring the fumigation into the secure area.

WARNING

Do ***not*** allow motorized vehicles to operate within the secure area.

Step 2—Aerating the Chamber

Adjust any vacuum remaining at the end of the fumigation to zero by temporarily opening the air intake valve, then closing it. Draw a 15 inch vacuum and adjust it to zero. Repeat this process of drawing a 15 inch vacuum and releasing it four times or as many times as experience indicates is necessary.

Step 3—Taking Concentration Readings

Draw an air sample from the chamber through the gas sampling tube into a colorimetric tube. Use **Table 2-5-6** to determine when to release the commodity.

TABLE 2-5-6: Determine When to Release the Commodity

If the gas concentration is:	Then:
5 ppm or less	RELEASE commodity
6 ppm or above	1. Do two more vacuum washes 2. TAKE concentration readings, and 3. RELEASE commodity when the concentration level is 5 ppm or less

Important

Some vacuum chambers do not have sampling tubes. After four air washes, while wearing the SCBA, open chamber door and take colorimetric reading.

2

Treatment Manual

Chemical Treatments

Fumigants • Methyl Bromide • Ship Fumigation

Contents

Methods and Procedures **page-2-6-1**
Materials Needed **page-2-6-2**
PPQ Officer Provides **page-2-6-2**
Fumigator Provides **page-2-6-2**
Taking Safety Measures When Fumigating Ships **page-2-6-3**
Preparing to Fumigate **page-2-6-4**
Step 1—Meeting With Ship's Captain and Agent **page-2-6-4**
Step 2—Selecting a Treatment Schedule **page-2-6-4**
Step 3—Determining Section 18 Exemptions and Sampling Requirements **page-2-6-5**
Step 4—Preparing Areas to Be Fumigated **page-2-6-5**
Step 5—Arranging and Operating Fans **page-2-6-5**
Step 6—Placing Gas Sampling Tubes **page-2-6-6**
Step 7—Placing the Gas Introduction Lines **page-2-6-6**
Step 8—Measuring the Temperature **page-2-6-7**
Step 9—Heating the Cargo Hold **page-2-6-7**
Step 10—Sealing Stores **page-2-6-7**
Step 11—Measuring Volume **page-2-6-9**
Step 12—Calculating Dosage **page-2-6-9**
Step 13—Making a Final Check **page-2-6-9**
Conducting the Fumigation **page-2-6-10**
Step 1—Introducing the Gas **page-2-6-10**
Step 2—Taking Concentration Readings **page-2-6-11**
Step 3—Testing for Leaks **page-2-6-11**
Step 4—Adding Gas and Extending Exposure **page-2-6-11**
Step 5—Exhausting the Gas **page-2-6-12**
Aerating the Hold or Storeroom **page-2-6-13**
Step 1—Securing the Area **page-2-6-13**
Step 2—Aerating the Area **page-2-6-13**
Step 3—Taking Concentration Readings to Determine When to Release the Ship **page-2-6-13**

Methods and Procedures

The procedures covered in this section provide commercial fumigators with the methods, responsibilities, and precautions for ship fumigation.

CAUTION

These procedures are used primarily for fumigation of ships that are infested with khapra beetle.

Generally, fumigation of commodities within the structure of a ship, such as cargo holds, cannot meet APHIS standards for fumigation, and these fumigations are not recommended by APHIS. However, on a case by case basis, commodities may be fumigated within the structure of a ship if Methods Development first approves the fumigation. For approval, call the Center for Plant Health Science & Technology (CPHST) (tel: 919-513-2496)

In general, ship fumigations present problems not encountered in other types of fumigations. The large amount of gas required and the varying space configurations from ship to ship make it essential that experienced pest control operators and PPQ officers with extensive fumigation experience perform ship fumigations.

Materials Needed

PPQ Officer Provides

- PPQ Form 429
- Calculator (optional)
- Colorimetric tubes (Draeger/Kitagawa)
- Desiccant (Drierite®)
- Halide leak detector
- SCBA or supplied air respirator
- Tape measure
- Thermal conductivity unit[1]
- Thermometer

Fumigator Provides

- Adhesive sealer, tape, and putty or other pliable material for sealing off holes around pipes
- Auxiliary pump for purging long gas sample tubes
- Carbon dioxide filter (Ascarite®)
- Colorimetric tubes (Draeger/Kitagawa)
- Electrical wiring (ground, permanent type), three prong extension cords
- Exhaust blower and ducts

1 T/C unit must be calibrated annually by the Center for Plant Health Science and Technology (CPHST) in Raleigh, North Carolina. If requested, CPHST will calibrate a commercial fumigator's T/C unit.

- Fans (circulation, exhaust, and introduction)
- Framework and supports
- Gas sampling tubes (leads)
- Gas supply line
- Heat supply
- Insecticides and spray equipment
- Methyl bromide
- Padding
- Portable generator as backup unit to operate T/C unit, auxiliary pump, and lights
- Sand or water snakes
- Scales or dispensers
- SCBA or supplied air respirator
- Tape
- Tarpaulin and supports
- Thermal conductivity unit
- Volatilizer
- Warning signs

PPQ officer and fumigator should be prepared to use auxiliary power if shore power is not available as most ships' power is 220 volts.

Taking Safety Measures When Fumigating Ships

The most important consideration when fumigating ships is the protection of human life. The commercial fumigator has the following safety responsibilities when fumigating ships:

- Observe all safety precautions while fumigating
- Prevent access of unauthorized personnel, including the ship's crew, to the fumigated area
- Conduct fumigation properly to result in an effective treatment
- Evacuate gas from ship and aerate when fumigation is completed
- Test, with a gas detector, all areas aboard ship to ensure freedom from MB before allowing crew members access to the ship

The commercial fumigator must abide by the following guidelines when fumigating ships:

- Have a representative present throughout the entire fumigation. The representative must be familiar with directions for using the fumigant, warnings, antidotes, etc., shown on the label, on the gas cylinder, and contained in the manufacturer's application manual.
- Have adequate first-aid equipment, SCBA, and other safety equipment available
- Have all areas of the ship tested with a gas detector prior to crew re-entry. Pay particular attention to all fumigated areas, crew quarters, and the engine rooms
- Provide for immediate contact with the responsible ship's officer to provide information and access to areas of the ship which may be needed to assure a safe fumigation

Preparing to Fumigate

Step 1—Meeting With Ship's Captain and Agent

When planning a ship fumigation, meet with the ship's captain, agent, and the fumigation company representative to discuss the conditions of the fumigation. If cargo is present in an area about to be fumigated, determine if any materials might be adversely affected by the fumigant (see Methyl Bromide—Properties for a list of commodities adversely affected by MB). Notify the ship's agent of possible effects and if conditions permit, allow removal of the material from the hold for an alternate treatment.

Discuss plans for removing all crew from the ship. It is the responsibility of the commercial fumigator to comply with all label requirements, and with State, local, and U.S. Coast Guard regulations (see **Coast Guard Regulations** in **Appendix B**) concerning shipboard fumigation.

Step 2—Selecting a Treatment Schedule

Refer to treatment schedule T402 (SHIPS) for the correct treatment. Select a treatment schedule based on the plant pest and commodity to be fumigated. Consider all the commodities present in the area to be fumigated when determining the best treatment available. In the case of khapra beetle fumigation, determine if finely milled products (example—flour) will be fumigated. If finely milled products are to be fumigated, give the captain the option to use the 12 hour schedule. Have the finely milled products destroyed either by incineration or by sterilization after the fumigation has been completed. If the captain elects not to remove and destroy the finely milled products, then use the 24 hour treatment schedule.

Treating Deck Areas

Areas which may be pest contaminated or suspected of being contaminated, such as the deck, hatch covers, drain channels, crevices around hatches, hallways, and similar areas that cannot be fumigated, should be treated with a 3 percent malathion emulsion spray (0.5 pint, 57 percent premium grade to a gallon of water). Spray at the rate of 2 gallons/1,000 sq. ft., or to the point of runoff.

CAUTION

Malathion emulsion sprays may break down asphalt surfaces. For asphalt surfaces, prepare a spray from a 25 percent wettable powder (1 pound to a gallon of water), rather than the emulsion.

Step 3—Determining Section 18 Exemptions and Sampling Requirements

After selecting the treatment schedule, you will be able to determine if the schedule is a FIFRA Section 18 Exemption by the presence of broad, bold, vertical lines on the borders of the treatment schedule table listed in the reference. Some treatment schedules are FIFRA Section 18 Exemptions only at specific temperature ranges. Check the treatment schedule and temperature to determine if the fumigation will be a FIFRA Section 18 Exemption.

If food is fumigated, alert the captain that there may be higher than permitted residues.

Step 4—Preparing Areas to Be Fumigated

Storerooms

Open all bins, drawers, and cupboards. Stack all bagged commodities so gas can penetrate all sides of the commodity. Stacking bagged commodities on pallets will facilitate gas distribution and penetration.

Cargo Holds

Prepare to fumigate the entire hold regardless of the location of the infestation within the hold. If you want to fumigate a single deck (lower hold, lower 'tween deck, upper 'tween deck, etc.), you must get approval from your Regional Director. The decision to approve single deck fumigations should only be made after all sections of the hold have been inspected and there is no possibility of gas escaping to other parts of the hold.

In most cases, it is unnecessary to open or rearrange cargo containers within the hold. Occasionally, some rearrangement may be required to ensure uniform gas distribution. Have the hatch coverings between decks opened in such a manner as to permit adequate distribution and circulation of the gas.

Step 5—Arranging and Operating Fans

Storerooms

Storerooms normally require a minimum of two, 1,800 cfm fans. Place one fan at a low level and the other at a high level. Fans with capacity above 1,800 cfm create strong air currents which could result in gas leakage around the seals. If you're fumigating an area which includes

the galley and adjoining storerooms, be sure to place the fans to evenly distribute gas. Make certain that fans can be turned on and off from an area outside the fumigation site.

Cargo Holds

Use the volume of the hold (ft^3) in determining how many fans you will need. The total cfm's of all the fans should approximate the volume of the hold. Use fans capable of 2,500 cfm or greater during gas introduction and for 30 minutes following the introduction. Placement of fans within holds depends on the presence or absence of cargo. Normally, place two fans in the lower hold at opposite ends facing across the hold. The number of fans can be reduced by using fans greater than 2,500 cfm. Fans should be labeled as to location and have the capability of being turned on and off individually in case of low readings in certain locations or pockets of gas.

Test all fans to ensure that they are in good operating condition. Operate fans during the gas introduction and for 30 minutes after introduction is completed.

Step 6—Placing Gas Sampling Tubes

Place gas sampling tubes in areas and commodities which will give representative samples within the fumigated area. Have all leads brought to one central point at least 30 feet up- wind from the area being fumigated. Label all gas sampling tubes so they can be easily identified when you take concentration readings. Label each tube by identifying the level of the hold and whether the gas sampling tube is in a commodity or space.

Storerooms

Place a minimum of two gas sampling tubes in open space and at least one gas sampling tube within the commodity considered to be the most difficult for the fumigant to penetrate.

Cargo Holds

Within cargo holds, the exact location will depend primarily on the location of cargo within the hold. Place a minimum of two leads for each level of empty hold space. The average size hold of three levels is approximately 125,000 ft^3. Use one additional lead for every 50,000 ft^3 over 125,000 ft^3.

When cargo is present in the hold, place two additional gas sampling tubes in the commodity at each hold level. For mixed cargo, place additional gas sampling tubes in the cargo considered to be the most difficult for the fumigant to penetrate.

Step 7—Placing the Gas Introduction Lines

Storerooms, Galley, Quarters

Numerous gas introduction lines may be necessary in order to obtain even gas distribution throughout the fumigation area. Place the gas introduction line directly through an opening from the outside (example—a door or window) directly above a fan. Attach the introduction line securely to the top of the fan to prevent movement of

the hose. An unsecured introduction line could move the line out of the airflow. Place a piece of nonpermeable sheeting (example—plastic or rubberized canvas) over the commodity in front of and below each gas supply line. The nonpermeable sheet will prevent any liquid MB from coming in contact with commodities and will prevent damage.

Cargo Holds

Numerous gas introduction lines may be necessary in order to obtain even gas distribution throughout the fumigation area. Place the gas introduction line directly into the air stream in front of one of the fans on the upper 'tween deck. Attach the introduction line securely to the top of the fan because gas passing through the line will cause the line to vibrate. An unsecured introduction line could be moved out of the airflow. Additional introduction lines can be used to hasten introduction and distribution of the gas. Place a piece of nonpermeable sheeting (example—plastic or rubberized canvas) over the commodity in front of and below each gas introduction line. The sheet will prevent any liquid MB from coming in contact with the cargo and prevent damage.

Step 8—Measuring the Temperature

Take temperature readings of the air (space) and of the commodity. Use a calibrated thermometer. Record the temperatures in Block 22 on the PPQ Form 429. If the temperature is below the minimum listed for the treatment schedule, then you will need to heat the hold or other space to be fumigated.

TABLE 2-6-1: Determine Pre-fumigation Procedures

If the temperature is:	Then:
At or above the minimum temperature listed for the treatment schedule	GO to Step 10 (Sealing Stores)
Below the minimum temperature listed for the treatment schedule	GO to Step 9 (Heating the Cargo Hold)

Step 9—Heating the Cargo Hold

If heating a hold is necessary, negotiate the method with the fumigator and get the concurrence of the Center for Plant Health Science & Technology (CPHST), in Raleigh, North Carolina.

Step 10—Sealing Stores

One of the most important steps in preparing for a ship fumigation is sealing all openings and areas which have the potential to leak gas. Consider the entire area to be fumigated as a natural atmospheric chamber and make the area as gastight as possible. The most important task is to locate all openings (example—drain pipes, bilge drain holes, or air ducts) and seal them.

Do ***not*** seal out or make gastight recessed areas, ducts, or similar apertures which may harbor an infestation. In some cases it is better to seal sources of leaks on the outside of the area to be fumigated. Use caulking compound or tape for sealing small spaces. For sealing larger areas, use polyethylene or similar material secured with tape or adhesive spray. Seal doors and other openings with either polyethylene or spray with vinylite plastic. When practical, seal air ventilation ducts on the outside of the space being fumigated so sealing tape can be removed when you get ready to evacuate the gas and begin aeration. Large openings such as hatch cover openings should be covered with polyethylene and securely taped. When necessary, lace rope across the tarpaulin to prevent billowing in high winds. Look for and seal off the following ship areas when preparing a ship for fumigation:

- Wall plates
- Air vents
- Drains
- Pipes and other utility conduits through decks and bulkheads
- Dumb-waiter openings
- Heating, air conditioning, and ventilation systems common with or to cargo holds, engine room, crew quarters, storerooms, or other spaces that use intake from the vent systems common with cargo holds
- Engine room—recirculation air systems controlled from and common with the engine room areas—especially on newer ships; check for drilled holes or other openings in fore and aft bulkheads of engine room spaces, all engine room vent systems, and housing or casing leading into spaces to be fumigated
- All passageways, engine room, and other crew areas for electric pipeline or other duct work common with cargo holds
- Speaking tubes and fire and smoke detector systems from fumigated areas
- Emergency escape hatches from shaft alley and escape hatches from all holds
- CO_2 piping to all cargo holds; degassing systems (older ships) which usually run from hold to hold
- Vents in shaft alley and gear lockers to holds; breaks in bulkhead
- Bilge and drainwell vents and drains to all cargo holds sometimes common with more than one hold or engine room bilges
- Steam-smothering systems for connection between holds

- Inner bottom and deep tank covers to ensure that they are closed prior to fumigating
- Galley intake and exhaust systems (may be common with the dry stores)

Step 11—Measuring Volume

Obtain the volume of the cargo holds from the chief mate, captain, or the ship's plan, which is usually posted outside the captain's office. If actual hold measurements are available, then figure the volume by multiplying the length, width, and height of the hold. If actual measurements are not available, then look on the ship's plan for the grain cube. Use the grain cube as the volume in lieu of actual hold dimensions. Consider all hold areas such as deep tanks, security lockers, and refrigerated spaces when calculating the volume of the area to be fumigated.

For dry stores, galleys, and crew quarters, measure the actual dimensions to calculate volume.

Step 12—Calculating Dosage

The formula for calculating dosage is:

$$\begin{aligned} \text{dosage(lbs.)} &= \text{volume(ft}^3\text{)} \times \text{dosage rate(lbs./1,000 ft}^3\text{)} \\ &= \frac{\text{volume(ft}^3\text{)} \times \text{dosage rate(lbs.)}}{\text{1,000 ft}^3} \end{aligned}$$

EXAMPLE: Number 3 Hold is infested with khapra beetle. The volume is 80,000 ft^3, and the temperature is 65 °F. The treatment schedule lists the dosage rate as 6 lbs. MB/1,000 ft^3. To calculate the dosage multiply the volume (80,000 ft^3) by the dosage rate (6 lbs./1,000 ft^3). This equals 480 lbs. of MB needed for the dosage.

Step 13—Making a Final Check

Just before introducing the gas, you and the fumigator must do the following:

- Prior to fumigation, use a halide detector to check all storeroom and reefer areas which have any refrigerating systems prior to fumigation. A halide detector will indicate any freon leaks. Freon, a halide gas like MB, will result in higher concentration readings. Also, after aeration is completed, freon leaks may falsely indicate that MB is still present within the fumigated area.
- Take T/C unit readings to determine if any contaminant gases are present
- Turn on all fans and T/C unit to make sure they work
- Start volatilizer and heat water to 200 °F or above

- Place fumigant cylinder with gas introduction line on scale and take initial weight reading. Make sure the gas introduction line is attached to the cylinder. After obtaining the correct weight, subtract the dosage to be introduced into the enclosure. When the entire dosage has been introduced, the scale will be balanced.
- Check to make sure the ship's gangway and areas to be fumigated are properly placarded and the area is secured. A guard should be present at the entrance to the gangway to restrict access to the ship. If the crew has been removed, walk through the quarters and other areas to make sure no one is aboard.
- Check all sealed areas to make sure they are securely taped and free from holes
- Check the gas introduction line connections to make sure they are tight
- Check to make sure all safety equipment is available and in working order

Conducting the Fumigation

Step 1—Introducing the Gas

CAUTION

PPQ Officers must wear the SCBA anytime they are within 30 feet of area being fumigated. You and the fumigator both must use SCBA while introducing the gas, checking for leaks, and when taking aeration readings.

Turn on all fans while introducing the gas. When using large cylinders of MB, have the fumigator slightly open the valve then close the valve. Using a halide detector, check all connections on the gas introduction line for leaks. If leaks are found, have the fumigator tighten the connections and repeat the test. If no leaks are found, have the fumigator open the valve to the point where 3 to 4 pounds of MB are being introduced per minute. The gas introduction line should always feel hot and the volatilizer must read at least 150 °F.

CAUTION

Do not touch the introduction line with your bare hands—you may get burned! Have the fumigator close the cylinder valve once the proper dosage has been introduced.

The fumigation time begins when all the gas has been introduced. Record the time gas introduction was started and completed in Block 32 on the PPQ Form 429. Run the fans for 30 minutes after all the gas has been introduced. You will take the initial concentration reading 30 minutes after all the gas has been introduced.

When using cylinders, getting the final amounts of gas out of the cylinder may take a long time. Consider taking T/C unit readings 30 minutes after the gas is first introduced. If the gas distribution is even (all readings within 4 ounces of each other) and at an adequately high concentration, then you can turn off the fans. Running the fans longer may contribute to gas leakage. Allow the remainder of the gas to discharge at its slow rate with intermittent running of the fans for dispersal.

Step 2—Taking Concentration Readings

Take concentration readings with a T/C unit to determine the gas concentration and distribution within the area being fumigated (galley, storeroom, or cargo holds). Check Drierite® tubes before each reading and change Drierite® if its color is pink. Depending upon the length of exposure period, take concentration readings at the following times after the introduction of the fumigant:

- 30 minutes
- 2 hours
- 4 hours
- 6 hours
- 12 hours
- 24 hours
- 48 hours
- 72 hours (for *Cochlicella*, *Helicella*, and *Monacha* spp.)

Consult the treatment schedule being used for the actual concentration readings. You may start the final concentration reading 30 minutes prior to the end of the exposure period.

Take additional readings when there is indication that the gas is not properly distributed or the minimum gas concentration is not being maintained. Record readings on PPQ Form 429.

Step 3—Testing for Leaks

Wearing the SCBA, use a halide detector to test for leaks after all the gas has been introduced. Test around the perimeter of the area being fumigated, especially where doors, windows, pipes, electric cords, gas sampling tubes, and gas introduction lines are present. If you detect leaks, be sure they are sealed with additional tape, adhesive, or by placing more polyethylene and adhesive over the leaking areas.

Step 4—Adding Gas and Extending Exposure

You may add gas at the following rate when concentration readings fall below the minimum:

1.6 × number of oz. below minimum × volume/1,000 = oz. of gas to add

EXAMPLE: You are fumigating a ship's storeroom for khapra beetle and the minimum concentration for the 2 hour reading is listed at 50 oz. but your readings average 45 oz. The volume of the storeroom is 1,500 ft^3. Using the above formula, you would figure the following:

1.6 × 5 (oz. below min.) × 1,500/1,000
8 × 1.50 = 12 oz. gas to be added

Extending Exposure Period

Use **Table 2-6-2** to determine how long to extend the exposure period:

TABLE 2-6-2: Determine Time for Extended Exposure

If the exposure time is:	And the reading is below minimum by:	Then extend exposure:
Less than 12 hours	10 oz. or less	10 percent of the time lapse since the last reading
	11 oz. or more	30 minutes
12 hours or more	10 oz. or less	10 percent of the time lapse since the last reading
	11 oz. or more	2 hours or 10 percent of time lapse since last reading, whichever is greater

Step 5—Exhausting the Gas

Exhaust the gas at the completion of the exposure period. If the treatment schedule is a FIFRA Section 18 Exemption, then you must monitor the aeration of the fumigated area. Use **Table 2-6-3** to determine if you need to monitor the aeration of the fumigated area:

TABLE 2-6-3: Determine the Responsibility for Monitoring the Aeration

If the treatment schedule is:	Then:
A FIFRA Section 18 Exemption	MONITOR the aeration of the commodity. FOLLOW "Aerating the Hold or Storeroom" steps which follow.
A labelled treatment	RELEASE the fumigation to the fumigator and RELEASE the ship.

Removal of the fumigant from cargo holds is facilitated by using an outside blower to force fresh air through portable canvas, plastic, or similar ducts. Another method is to use compressed air hoses to force fresh air into the bottom of the hold. Use fans or blowers within the fumigated space to help aerate the hold. Use suction type fans with portable ducts to evacuate gas from storerooms to outside, downwind areas away from crew areas, preferably on the offshore side of the ship. Do not point the ducts upward, since dissipation onto the deck may occur. Use the ship's aeration/ventilation equipment if possible. Make sure that use of ship's equipment will not distribute the exhausted gas to other areas within the ship.

Aerating the Hold or Storeroom

Step 1—Securing the Area

Assuming that you've already restricted access and secured the fumigation area, you now must restrict access to the area where the exhaust duct extends beyond the enclosure. During the first 10 minutes of aeration, there should be no people within 200 feet of the exhaust duct outlet. When securing the duct outlet area, consider the direction of the wind. Face the duct outlet toward an open area, and away from people. Point the duct outlet upward to aid in dispersing the exhausted gas.

Have the fumigator use a physical barrier such as ropes, barricades, or walls to secure the area.

Placard the secure area near the exhaust outlet with the appropriate DANGER/PELIGRO signs. Make sure the placards meet the appropriate fumigant label or labeling requirements. The skull and crossbones should be present as well as "AREA UNDER FUMIGATION, DO NOT ENTER/NO ENTRE"; date of the fumigation; name of the fumigant used; and the name, address, and telephone number of the fumigator.

Unless you authorize their use, do *not* allow motorized vehicles to operate within the secure area.

Step 2—Aerating the Area

Wearing the SCBA, advise the fumigator to make an opening (if possible) at the end furthest from the exhaust duct to allow entry of fresh air. The fumigator may open doors, hatches, tarpaulins, and areas to facilitate aeration. Start the exhaust system (minimum 3,500 cfm exhaust fan connected to an exhaust duct) and aerate the hold or storeroom.

Step 3—Taking Concentration Readings to Determine When to Release the Ship

Stop the aeration fans. Take a concentration reading with a colorimetric tube in the exhaust duct within 2 feet of the storeroom or within the first 2 feet of the exhaust duct where it exits the hold. If the concentration is above 5 ppm, but less than 100 ppm, advise the fumigator to remove the tarpaulin while wearing a SCBA.

Release the ship when the following conditions are met:

For Storerooms When the concentration is 5 ppm or less after taking readings 4 feet from the floor and 1 foot inside the fumigation perimeter at several representative locations (a minimum of two are required).

For Holds When the concentration is 5 ppm or less after taking readings by:

1. Drawing a sample for a minimum of 1 minute through a sampling tube with the auxiliary pump. The sampling tube should be teflon or metal to obtain accurate readings. If a polyethylene sampling tube is used, it should be replaced at frequent intervals due to adsorption of gas by the polyethylene.
2. Taking a concentration reading with a colorimetric tube in the sampling tube.
3. Taking a minimum of two readings for each level of the hold.

Record the date, concentration reading, and time on PPQ Form 429.

2

Treatment Manual

Chemical Treatments

Fumigants • Methyl Bromide • Structure Fumigation

Contents

Methods and Procedures **page-2-7-1**
Materials Needed **page-2-7-2**
PPQ Officer Provides **page-2-7-2**
Fumigator Provides **page-2-7-2**
Taking Safety Measures When Fumigating Structures **page-2-7-3**
Preparing to Fumigate **page-2-7-4**
Step 1—Determining Type of Treatment Required **page-2-7-4**
Step 2—Issuing a PPQ Form 523 (Emergency Action Notification) **page-2-7-7**
Step 3—Conducting Prefumigation Conference **page-2-7-7**
Step 4—Preparing Areas to Be Fumigated **page-2-7-8**
Step 5—Arranging and Operating Fans **page-2-7-8**
Step 6—Placing Gas Sampling Tubes **page-2-7-9**
Step 7—Measuring the Temperature **page-2-7-9**
Step 8—Sealing the Structure **page-2-7-10**
Step 9—Measuring Volume **page-2-7-10**
Step 10—Calculating Dosage **page-2-7-11**
Step 11—Placing the Gas Introduction Line(s) **page-2-7-11**
Step 12—Making a Final Check **page-2-7-12**
Conducting the Fumigation **page-2-7-13**
Step 1—Introducing the Gas **page-2-7-13**
Step 2—Testing for Leaks **page-2-7-14**
Step 3—Taking Concentration Readings **page-2-7-14**
Step 4—Adding Gas **page-2-7-14**
Step 5—Exhausting the Gas **page-2-7-15**
Aerating the Enclosure **page-2-7-15**
Step 1—Securing the Area **page-2-7-16**
Step 2—Aerating the Structure **page-2-7-16**
Step 3—Taking Concentration Readings **page-2-7-16**

Methods and Procedures

The procedures in this section provide guidelines for the methods, responsibilities, and precautions for structure fumigation. These procedures relate to structure fumigation primarily for khapra beetle.

In general, structure fumigations present problems not encountered in other types of fumigations. The large amount of gas required and the fact that the structure configurations vary from structure to structure make it essential that experienced fumigators and PPQ officers with extensive fumigation experience perform structure fumigations.

Materials Needed

PPQ Officer Provides

- Calculator (optional)
- Colorimetric tubes (Draeger/Kitagawa)
- Desiccant (Drierite®)
- Forms (PPQ Form 429 and APHIS Form 2061 if necessary)
- Halide leak detector
- SCBA or supplied air respirator
- Tape measure
- Thermal conductivity unit[1]
- Thermometer

Fumigator Provides

- Adhesive sealer, tape, and putty or other pliable material for sealing off holes around pipes
- Auxiliary pump for purging long gas sample tubes
- Carbon dioxide filter (Ascarite®)
- Colorimetric tubes (Draeger/Kitagawa)
- Device for adding nitrogen into MB cylinders
- Electrical wiring (ground, permanent type), three prong extension cords
- Exhaust blower and ducts
- Fans (circulation, exhaust, and introduction)
- Framework and supports
- Gas sampling tubes (leads)
- Gas supply line
- Heat supply
- Insecticides and spray equipment
- Methyl bromide
- Padding
- Portable generator as backup unit to operate T/C unit, auxiliary pump, and lights

1 T/C unit must be calibrated annually by the Center for Plant Health Science and Technology (CPHST) in Raleigh, North Carolina. If requested, CPHST will calibrate a commercial fumigator's T/C unit.

- Sand or water snakes
- Scales or dispensers
- SCBA or supplied air respirator
- Tape
- Tarpaulin and supports
- Thermal conductivity unit
- Volatilizer
- Warning signs

Taking Safety Measures When Fumigating Structures

The most important consideration when fumigating structures is the protection of human life. The commercial fumigator has the following safety responsibilities when fumigating structures:

- Observe all safety precautions while fumigating
- Prevent access of unauthorized personnel to the fumigated area
- Conduct fumigation properly to result in an effective treatment
- Evacuate gas from the structure and aerate when fumigation is completed
- Test, with a gas detector, the fumigated areas within the structure to ensure freedom from MB before allowing access to the fumigated areas

The commercial fumigator must abide by the following guidelines when fumigating structures:

- Have a representative present throughout the entire fumigation. The representative should be familiar with the directions for using the fumigant, warnings, antidotes, etc., shown on the label, on the gas cylinder, and contained in the manufacturer's application manual.
- Have adequate first-aid equipment, SCBA, and other safety equipment available
- Have all fumigated areas and any adjoining areas that were not fumigated tested with a gas detector prior to worker re-entry
- Contact all necessary local and State authorities (fire, police, etc.)

Preparing to Fumigate

Step 1—Determining Type of Treatment Required

Consider the following factors in selecting a treatment for the structure:

- Type of commodities involved (example—grain, spices, or flour)
- Degree of infestation (light, moderate, heavy)
- Potential risk of spread from infestation
- Nature of the business—business shipping materials that could spread pest (example—a spice wholesaler or specialty foods distributor)
- Availability of food supply—is food available or is the find incidental
- Type of structure(s) infested
- Environmental conditions—warm, humid areas favor reproduction

In locations where reproduction occurs, or the potential for reproduction exists (warm temperature, humidity, and available food supply), seriously consider fumigation. Fumigation is not mandated every time an infestation is found.

In locations where reproduction is not occurring or the potential for reproduction does not exist (unfavorable temperature, low humidity, and no available food supply), consider using alternative treatments.

Make the final determination of which type of treatment to use with the concurrence of the following:

- PPQ line (Officer in Charge and Regional Director)
- PPQ staff (Riverdale/Raleigh (CPHST))
- Responsible State regulatory official

Options consist of the following:

- Complete Property Fumigation and Treatment (Category 1)
- Selective Property Fumigation and Treatment (Category 2)
- Interior Fumigation (Category 3)
- Alternate Treatment (Category 4)
- Selective Property Fumigation plus Alternative Treatments (Category 5)

The following is a detailed description of each of the above options:

Category 1—Complete Property Fumigation and Treatment

Fumigate all structures of similar usage on a single property. Place all structures under a gastight tarpaulin(s) and fumigate with MB.

Spray the area surrounding the structure(s) within the confines of the property at least twice with a registered malathion formulation. Make the last application after covering the structure(s) with the tarpaulin.

Free the surface area of all debris by raking or sweeping all debris toward the structure, include the debris under the cover.

Depending upon local conditions as determined by the PPQ Officer in Charge and the responsible State regulatory official, you may unconditionally release the structure after fumigation or hold the release until a series of inspections are conducted as outlined in Category 2.

Category 2—Selective Property Fumigation and Treatment

This treatment is similar to Category 1 except not all structures of related usage are fumigated and the fumigation is followed by at least three inspections of the entire property.

Notify the owner of the establishment in writing on the PPQ Form 523 (Emergency Action Notification) of the inspection requirement prior to fumigating any structures (see Appendix A). To verify success of this treatment, conduct at least three inspections of the entire property within 1 year. In the Northeast and other cooler regions, inspections must extend through two summer seasons when khapra beetles are active. Allow at least 90 days to elapse between inspections. Make the last inspection within 30 days of the time the structure is to be released.

Category 3—Interior Fumigation

Treat all structures on the premises or only those structures known to be infested. Use interior fumigation when conditions make the use of complete fumigation impractical. Conduct three inspections of the property after the fumigation has been completed.

This method of fumigation is less desirable because khapra beetles may crawl into cracks, crevices, and other openings on both the interior and exterior of an infested structure. Seal all openings in the structure with masking tape, putty, polyethylene, or other materials from the outside of the structure. Make the structure as airtight as possible without sealing out any areas that may harbor khapra beetle.

Spray the area surrounding the structures or the structures within the confines of the property at least twice with a registered malathion formulation. Make the last application after sealing the structure prior to fumigation. Free the surface area of all debris by raking or sweeping all debris toward the building. Include the debris in the fumigated structure.

Notify the owner of the establishment in writing on the PPQ Form 523 (Emergency Action Notification) of the inspection requirement prior to fumigating any structures (see "Appendix A" on **page-1-A-1**). To verify success of this treatment, conduct at least three inspections of the entire property within 1 year. In the Northeast and other cooler regions, inspections must extend through two summer seasons when khapra beetles are active. Allow at least 90 days to elapse between inspections. Make the last inspection within 30 days of the time the structure is to be released.

Category 4—Alternative Treatment

Use alternative treatments in infested properties where little or no regulatory hazard exists (little or no chance for the pest to escape and spread). Typically, such properties may include unused structures or buildings, facilities that do not handle commodities or materials of regulatory significance, or facilities that by the nature or type of operation or for other reasons do not pose a regulatory hazard as a result of the commerce conducted there.

Alternative treatments include either a crack and crevice or broadcast application of a registered or exempt pesticide (including approved cleaning and sanitation prior to treatment) and may include one or more of the following procedures:

- A specified program of sanitation
- An extensive trapping program utilizing adult and larval traps treated with both an attractant and an insecticide
- The use of bait treated with an insecticide
- An intensive, repeated inspection program augmented by intensive larval and adult trapping

Apply one or more of the above treatments when the Port Director, Plant Health Programs in Riverdale, and the responsible State regulatory official believe treatment will result in eradication and no regulatory hazard.

Category 5—Selective Property Fumigation Plus Alternative Treatments

Fumigate selected structures with related usage on a single, infested property. Apply one or more alternative treatments to all structures which are on the property and are not fumigated.

Step 2—Issuing a PPQ Form 523 (Emergency Action Notification)

Once an infestation of khapra beetle is identified and confirmed by a PPQ area identifier, issue a PPQ Form 523 (Emergency Action Notification) to the owner of the premises, except when treatment is ordered under State or county regulations. Follow instructions in Appendix 1 for completing and distributing PPQ Form 523 (Emergency Action Notification).

Be sure to document the treatment selected plus any alternative treatments, inspections, and safeguards to be applied.

Step 3—Conducting Prefumigation Conference

Fumigating a structure presents problems not usually encountered in other types of fumigations. The quantity of fumigant, supplies, equipment needed, and the variations in building configurations make it essential that experienced commercial fumigators and PPQ officers conduct structure fumigations.

Arrange a meeting with the fumigator to discuss the conditions of the treatment. Discuss the following items:

- An accurate measurement of the cubic capacity (volume) of the enclosure.
- Fumigation schedule to be used.
- Adequate tarpaulin material—polyethylene or equivalent tarpaulin of 6 mil or greater thickness.
- Electrical power source sufficient to operate circulation fans and T/C unit.
- Gas sampling tubes—types and number.
- Auxiliary air pump—to quickly draw samples through gas sampling tubes.
- Pedestal type fans for fumigant distribution and aeration.
- Sufficient quantity of fumigant for initial dosage plus an additional amount of fumigant in case gas must be added.
- Commodities involved and identification of materials that may be adversely affected by the fumigant (see Methyl Bromide—Properties for a list of commodities). Advise the property owner of any possible adverse effects. Articles or materials that may be damaged should be subjected to an alternate treatment if possible. Office furniture and equipment with foam rubber can be affected and should be removed. Computer equipment may have to be completely sealed with polyethylene and a positive pressure maintained within the sealed enclosure during the exposure period.

- Provide a sheltered area for taking gas concentration readings. The area should be located a safe distance (30 feet or more) from the enclosure. All gas sampling tubes and the electrical source should be located within the sheltered area.
- Aeration of structure and commodities.
- Final release—This is the responsibility of the fumigator unless the structure contains commodities requiring a Section 18 Exemption.

In addition to the above, explain to the fumigator that it is the fumigator's responsibility to perform the fumigation in a manner which meets required treatment schedule, treatment procedures, and pest safeguards prescribed by the PPQ officer. The fumigator is also responsible for meeting all Federal, State, and local regulations. The fumigator must notify local fire, police, and health officials as required. The fumigator is also responsible for making arrangements for utility services such as electricity, telephone, and water.

Your responsibility is to determine that the prescribed procedures are followed, actually checking volume and dosage calculations, dosage applications, and that the required gas concentrations are maintained. When food commodities are involved, you must notify the local Food and Drug Administration (FDA) office so they can collect residue samples if they deem it necessary.

Step 4—Preparing Areas to Be Fumigated

In order to ensure uniform gas distribution and penetration, you may require commodities within the structure to be restacked. Place dense commodities such as flour and similar bagged commodities on pallets or other supports to improve gas circulation.

In the outside surrounding area, rake the surface area of all debris by raking the debris toward the structure.

Step 5—Arranging and Operating Fans

Use fans capable of 2,500 cfm or greater during gas introduction and for 30 minutes following gas introduction. Extend fan operation only if gas distribution is inadequate (concentration readings vary more than 4 oz.), or you need to add gas. If you must operate fans after the 30 minute reading, do so for the least amount of time required to get equal gas distribution.

Placing fans is largely determined by the configuration of the structure and the absence or presence of cargo, its nature, and quantity. Pedestal fans are preferred for large structures. Direct fan air movement upward to complement other fans and assure even gas distribution in every area of the enclosure. There is no definitive rule for determining the proper number of fans, but both you and the

commercial fumigator must be satisfied that circulation will be adequate for both gas introduction and recirculation. Extremely tall buildings may require fans at several levels to ensure gas distribution to the top of the structure. Arrange the electrical source and extension cords of the fan system so the fans can be turned on and off individually from the outside of the enclosure.

Step 6—Placing Gas Sampling Tubes

Place gas sampling tubes in areas and commodities which will give representative samples of the gas concentration within the fumigated area. All gas sampling tubes must be 0.25 inch interior diameter polyethylene tubing.

The recommended number of sampling tubes is as follows:

TABLE 2-7-1: Deterimne the Number of Sampling Tubes

If the size of the enclosure is:	Then use:
500,000 ft^3 or less	Six sampling tubes for the first 100,000 ft^3, and Add one tube for each additional 50,000 ft^3
Greater than 500,000 ft^3	Fourteen sampling tubes for the first 500,000 ft^3, and Add one tube for each additional 200,000 ft^3

In addition to the number of sampling tubes described above, you must place sampling tubes within commodities stored in the structure. Place the sampling tube as near as practical to the center of the packaging (example—boxes, bags, or bins). Before placing the sampling tube in the commodity, wrap a piece of burlap over the end of the sampling tube and secure the burlap to the tube with tape.

Use a minimum of three tubes for the first 10,000 ft^3 of commodity. Use additional tubes to assure sampling of all types of tightly packed and difficult to penetrate commodities. Take care in placing sampling tubes to avoid clogging or pinching. Label each sampling tube with the location. Indicate if tube is in a commodity prior to fumigation and at the point where the concentration readings will be taken. For safety purposes, the gas sampling tubes should extend a minimum of 30 feet up-wind from the enclosure. You should have extra tubing on hand to extend beyond 30 feet if necessary.

Step 7—Measuring the Temperature

Take temperature readings of the air (space) and of the commodity. Use a calibrated thermometer. Record the temperatures in Block 22 on the PPQ Form 429. If the temperature is below the minimum listed for the treatment schedule, then you will have to heat the space to be fumigated or wait until the temperature rises to the level required by the schedule treatment.

Step 8—Sealing the Structure

Depending upon the method of fumigation, interior fumigation or tarpaulin fumigation, the effort required in this step will vary greatly.

Tarpaulin Fumigation

Locate and seal all openings which have the potential to leak gas. Since the entire structure will be tarped, do not cover openings to the exterior of the structure such as doors, windows, and air vents. Look for and seal all openings which may lead outside the structure such as manhole covers, drain pipes, and vent pipes. Seal these types of openings with polyethylene, tape, putty, or a combination of these materials. Do ***not*** seal out recessed areas, ducts, or similar areas which may harbor an infestation.

The structure or portion to be fumigated must be transformed into a gastight fumigation enclosure. This is accomplished by covering the entire structure with a 6 mil or greater, polyethylene tarpaulin. Tarpaulins may be joined together with mastic and tape or rolled and clamped together.

Have padding, such as burlap, placed on all corners of the structure and in any area where the tarpaulin may rub against rough or sharp edges of the structure.

Interior Fumigation

One of the most important steps in preparing for a structure interior fumigation is sealing all openings and areas which have the potential to leak gas. Consider the entire area to be fumigated as a natural atmospheric chamber and make the area as gastight as possible. The most important task is to locate all openings (example—drain pipes, or air ducts) and seal them.

Do ***not*** seal out or make gastight recessed areas, ducts, or similar apertures which may harbor infestations. In some cases, it is better to seal sources of leaks from the outside of the area to be fumigated. Use caulk compound or tape for sealing small spaces. For sealing larger areas, use polyethylene or similar material secured with tape or adhesive spray. Seal doors and other openings with either polyethylene or spray with vinylite plastic. When practical, seal air ventilation ducts on the outside of the space being fumigated so sealing tape can be removed when you get ready to evacuate the gas and begin aeration. Large openings should be covered with polyethylene and securely taped.

Step 9—Measuring Volume

For rectangular and square shaped buildings, multiply the length, width, and height. If the buildings are irregular, the volume of each unit can best be calculated separately and then added together.

Step 10—Calculating Dosage

The formula for calculating dosage is:

$$\text{dosage(lbs.)} = \text{volume(ft}^3\text{)} \times \text{dosage rate(lbs./1,000 ft}^3\text{)}$$

$$= \frac{\text{volume(ft}^3\text{)} \times \text{dosage rate(lbs.)}}{\text{1,000 ft}^3}$$

EXAMPLE: A structure infested with khapra beetle has a volume of 100,000 ft^3. The space and commodity temperature is 65 °F. The treatment schedule requires 6 lbs. MB/1,000 ft^3 at 65 °F. To calculate the dosage multiply the volume (100,000 ft) by the dosage rate (6 lbs. MB/1,000 ft). This equals 600 lbs. of MB needed for the dosage.

Step 11—Placing the Gas Introduction Line(s)

Introduce MB from the outside of the building with the introduction line going under the tarpaulin and directly into the airstream in front of a fan. Use the "hot gas" method of gas introduction by passing the fumigant through volatilizers after it leaves the cylinders. Depending upon the size of the structure being fumigated, you may want to have several gas introduction lines going into the structure to shorten the time required for gas introduction. Attach introduction lines to the top of the fans to prevent movement of the hose. Place a piece of nonpermeable sheeting (example—plastic or rubberized canvas) over the commodity in front of and below each gas introduction line. The sheet will prevent any liquid MB from coming in contact with the cargo and will prevent damage.

The other option of gas introduction is to release MB from inside the building. If this option is selected, cylinders should be placed by a team of two people and the location of each cylinder in the building should be mapped. The cylinders should be arranged so that fumigators can walk away from the released gas as they open each subsequent cylinder.

Because MB is heavier than air, it is advisable to increase slightly the amount of gas released on the top floor. Cylinders should be placed within a room for best distribution into all areas. Cylinders should be placed in an upright position and the shipping caps removed.

Because MB is heavier than air, it is advisable to attach standpipes (or curved pipes directed slightly upward) to the cylinder valves in order to reduce stratification at lower levels in the structure. If standpipes are used, they should be equipped with "T" fittings to direct the gas laterally and to prevent direct contact with the ceiling.

If the "inside release" option is used, provision must be made to have equipment in place to use the gas method of hot gas introduction to add fumigants as necessary to all areas of the structure.

You must be present during the introduction of the fumigant to ensure that the correct dosage is introduced into the enclosure.

Step 12—Making a Final Check

Just before introducing the gas, you and the fumigator must do the following:

- Make sure building is clear of all personnel and animals
- Make sure all areas requiring sealing are sealed
- Check the placement and identification of gas introduction lines and gas sampling tubes
- Turn on all fans and T/C unit to make sure they work
- Check that the tarpaulin is placarded with warning signs on all sides of the building
- Take T/C unit readings to determine if any contaminant gases are present (contaminant gases may affect concentration readings)
- Check that all gas sampling tubes are labelled and not crimped or crushed by attaching to T/C unit and watch the air flow meter to ensure that air is getting through
- Check that there is enough gas for dosage and additional gas in case you need to add gas
- Start volatilizer and heat water to at least 200 °F or above
- Place fumigant cylinders with gas introduction line on scale and take initial weight reading. Make sure the gas introduction line is attached to the cylinder. After obtaining the correct weight, subtract the dosage to be introduced into the enclosure. When you have introduced the proper amount of gas, the scale will be balanced
- Check gas introduction line connections to make sure they are tight
- Install Drierite® tube on gas sampling lines of T/C unit making sure the Drierite® granules are blue in color and have not turned pink
- Make sure all safety equipment is present and in working order

Conducting the Fumigation

Step 1—Introducing the Gas

CAUTION

You and the fumigator must wear the SCBA whenever:

- Concentration exceeds 5 ppm
- The concentration level is unknown, as with spills, leaks, and other emergencies
- Introducting gas
- Checking for leaks
- Taking aeration readings

In addition, the PPQ Officer must wear SCBA when they are within 30 feet of the enclosure.

Turn on all fans before introducing the gas. When using large cylinders of MB, have the fumigator slightly open the cylinder valve then close the valve. Using a halide detector, check all connections on the gas introduction line for leaks. If leaks are found, have the fumigator tighten the connections and repeat the test. Also, check all areas which are sealed. If you find a leak and it cannot be readily corrected, evacuate this partial dosage and reseal the area. If no leaks are found, then open the valve to the point where 3 to 4 pounds of MB are being introduced per minute. The gas introduction line should always be hot and the volatilizer should read at least 150 °F.

CAUTION

Do not touch the introduction line with your bare hands—you may get burned! Close the cylinder valve once the proper dosage has been introduced.

The fumigation time begins once all the gas has been introduced. Record the time gas introduction was started and completed in Block 32 on the PPQ Form 429. Run the fans for 30 minutes after all gas has been introduced. You will take the initial concentration reading 30 minutes after all the gas has been introduced.

When using large cylinders, getting the final amount of gas out of the cylinder may take a long time. Using a pressurized cylinder will shorten the time. Consider taking a T/C unit reading 30 minutes after the gas was first introduced. If the gas distribution is even (all readings within 4 ounces of each other) and at a sufficiently high concentration, then turn off the fans. Running the fans longer may contribute to gas leakage. Allow the remainder of the gas to discharge at its slow rate with intermittent running of the fans for dispersal.

Step 2—Testing for Leaks

Wear the SCBA while checking for leaks. Use a halide detector to test for leaks before the 30 minute reading. Test around the perimeter of the tarpaulin on the ground, corners, and especially where electric cords, gas sampling tubes, or gas introduction lines are present. If you detect leaks, be sure they are sealed by using more sand or water snakes for floor leaks and tape for small holes in the tarpaulin.

Step 3—Taking Concentration Readings

Take concentration readings with a T/C unit to determine the gas concentration and distribution within the enclosure. Check Drierite® tubes before each reading and change Drierite® if its color is pink. Depending upon the length of exposure period, take concentration readings at the following times after the introduction of the fumigant:

- 30 minutes
- 2 hours
- 4 hours
- 6 hours
- 12 hours
- 24 hours
- 36 hours
- 48 hours
- 72 hours

All times are after gas introduction is completed.

Use an auxiliary air pump when there are many gas sampling tubes or the gas sampling tubes are very long. The auxiliary air pump will lessen the time required to draw gas to the T/C unit.

You may start the final reading 30 minutes to 1 hour prior to completion of the exposure period. If final gas concentration levels meet minimum levels, start aeration immediately at the end of the exposure period.

Additional Readings

Adverse weather conditions may indicate the need for additional readings. Sorptive commodities and indications of a steady decline in gas concentration also indicate the need to take additional concentration readings.

Step 4—Adding Gas

For concentration readings below minimum levels, add gas at the following rate:

1.6 × number of oz. below × volume/1,000 = oz. of fumigant to add

Once you've determined that you need to add gas, follow the same procedures as introducing the gas (Step 1). That is—

1. Heat water in the volatilizer to at least 200 °F.
2. Turn on the fans.
3. Weigh the cylinder.
4. Use your SCBA.
5. Open valve on cylinder and introduce the gas.
6. Close valve when the weight of the cylinder indicates that the needed amount of gas has been added.
7. Record quantity of fumigant added in Block 34 on the PPQ Form 429.

Note the time you started introducing additional gas and the time you finished introducing gas and record in Block 40 (Remarks) on the PPQ Form 429. Run the fans until you get even gas distribution throughout the enclosure. Turn off the fans, then take a concentration reading 30 minutes after you complete introducing the gas. If all readings are above minimum concentration levels, then proceed as usual with the remainder of the concentration readings. If gas is not evenly distributed (readings not within 4 oz. of each other), then run fans until you get gas evenly distributed.

Step 5—Exhausting the Gas

Exhaust the gas at the completion of the exposure period. The aeration of the structure and the final release to the owner is the responsibility of the commercial fumigator unless under a Section 18 Exemption. Exhausting the fumigant is facilitated by partially removing the tarpaulin and the use of suction fans which are supplied with ducts leading from the enclosure to the outside. The fumigant should be evacuated to the outside, downwind areas of the enclosure. The fumigator must be certain that the removal of the covers and ventilation is done in a manner that minimizes the hazard from the released gas.

Aerating the Enclosure

TABLE 2-7-2: Determine the Responsibility for Monitoring the Aeration

If the treatment schedule is:	Then:
A FIFRA Section 18 Exemption	MONITOR the aeration of the commodity. FOLLOW "Aerating the Enclosure" steps which follow.
A labelled treatment	RELEASE the commodity and RELEASE the fumigation to the fumigator.

Step 1—Securing the Area

Assuming that you've already restricted access and secured the fumigation area, you now must restrict access to the area where the exhaust duct extends beyond the enclosure. During the first 10 minutes of aeration, there should be no people within 200 feet of the exhaust duct outlet. When securing the duct outlet area, consider the direction of the wind. Face the duct outlet toward an open area and away from people. Point the duct outlet upward to aid in dispersing the exhaust gas.

Have the fumigator use a physical barrier such as ropes, barricades, or walls to secure the area.

Placard the secure area near the exhaust outlet with the appropriate DANGER/PELIGRO signs. Make sure the placards meet the appropriate fumigant label or labeling requirements. The skull and crossbones should be present as well as "AREA UNDER FUMIGATION, DO NOT ENTER/NO ENTRE"; date of the fumigation; name of the fumigant used; and the name, address, and telephone number of the fumigator.

Unless you authorize their use, do ***not*** allow motorized vehicles to operate within the secure area.

Step 2—Aerating the Structure

Wearing the SCBA, have the fumigator open slightly the opposite end of the enclosure to allow entry of fresh air. The fumigator may open doors, tarpaulins, and areas to facilitate aeration. Start the exhaust system (minimum 2,500 cfm exhaust fan connected to an exhaust duct) and aerate the structure.

Important

The PPQ officer is not required to be continuously onsite during the entire aeration unless specified by the label, Section 18 Exemption, or State or local regulations. The officer must verify the gas concentration levels before removal of the tarpaulin and final release of the structure.

Step 3—Taking Concentration Readings

Stop the aeration fans. Take a concentration reading with a colorimetric tube in the exhaust duct within 2 feet of the enclosure. If the concentration is above 5 ppm but less than 100 ppm (for MB), the fumigator may remove the tarpaulin while wearing the SCBA. Release the structure when the concentration is 5 ppm or less after taking readings 4 feet from the floor and 1 foot inside the fumigation perimeter at several representative locations (a minimum of two are required). Record the date, concentration reading, and time on PPQ Form 429.

2

Treatment Manual

Chemical Treatments

Fumigants • Methyl Bromide • Special Procedures for Container Fumigations Without a Tarpaulin

Contents

Methods and Procedures **page-2-8-2**
Materials Needed **page-2-8-2**
PPQ Officer Provides **page-2-8-2**
Fumigator Provides **page-2-8-3**
Preparing to Fumigate **page-2-8-3**
Step 1—Selecting a Treatment Schedule **page-2-8-3**
Step 2—Issuing a PPQ Form 523 (Emergency Action Notification) **page-2-8-4**
Step 3—Determining Section 18 Exemptions and Sampling Requirements **page-2-8-4**
Step 4—Selecting a Fumigation Site **page-2-8-4**
Step 5—Arranging the Stack **page-2-8-6**
Step 6—Arranging and Operating Fans **page-2-8-7**
Step 7—Placing the Gas Introduction Lines **page-2-8-8**
Step 8—Placing the Gas Sampling Tubes **page-2-8-8**
Step 9—Measuring the Temperatures **page-2-8-9**
Step 10—Measuring the Volume **page-2-8-10**
Step 11—Calculating the Dosage **page-2-8-11**
Step 12—Making a Final Check **page-2-8-11**
Conducting the Fumigation **page-2-8-12**
Step 1—Introducing the Gas **page-2-8-12**
Step 2—Testing for Leaks **page-2-8-13**
Step 3—Taking Concentration Readings **page-2-8-14**
Step 4—Determining the Need to Add Gas and Adjust Exposure **page-2-8-16**
Special Procedures for Adding Gas and Extending Exposure Period **page-2-8-17**
Special Procedures for Fruits, Vegetables, or Perishable Commodities Using Schedule T101-a-1 or Equivalent **page-2-8-18**
Special Procedures for Adding Gas to Oak Logs and Lumber Using T312 or Equivalent **page-2-8-23**
Exhausting the Gas **page-2-8-23**
Aerating the Enclosure **page-2-8-23**
Responsibility for Aerating the Commodity **page-2-8-24**
Materials Needed **page-2-8-24**
Securing the Area **page-2-8-24**
Wearing Respiratory Protection **page-2-8-25**
Aerating Nonsorptive, Containerized Cargo **page-2-8-25**
Step 1—Installing Exhaust System **page-2-8-25**
Step 2—Aerating the Commodity **page-2-8-26**
Aerating Sorptive Commodities in Containers **page-2-8-27**
Step 1—Installing the Exhaust System **page-2-8-27**
Step 2—Aerating the Commodity **page-2-8-27**

Methods and Procedures

The procedures covered in this section provide PPQ Officers and commercial fumigators with the methods, responsibilities, and precautions for container fumigation without a tarpaulin.

A refrigerated container may be used for fumigations without a tarpaulin provided the following requirements are met:

- The container must be a refrigerated (reefer) container
- The container must have the two drainage holes removed at the doors. If damage will occur to the container by removal of these drains, the fumigator should obtain permission from the container manufacturer
- before proceeding.
- The container must have three gas monitoring leads to be located in the front-high, middle-middle and rear-low of the container. (The "rear" is considered to be at the doors.)
- The container must be packed (in some cases re-packed) so that one circulation fan can be placed in the front and one in the back. This will ensure at least 2’ of air space above the commodity. Use fans which have the capacity to move a volume of air in cubic feet per minute equivalent to the total volume of the container. The rear fan (at the doors) has the gas introduction hose attached to it and is referred to as the gas introduction fan.
- The PPQ officer must visually inspect the container prior to fumigation to identify any possible areas of leakage for the fumigator to repair.
- Air exchange vents must be closed and taped if any openings are visible.

Materials Needed

PPQ Officer Provides

- Calculator (optional)
- Colorimetric tubes (Draeger/Kitagawa)
- Desiccant (Drierite®)
- Forms (PPQ Form 429 and APHIS Form 2061 if necessary)
- Halide leak detector
- Self-contained breathing apparatus (SCBA) or supplied air respirator to be used by PPQ officer

- Tape measure
- Thermal conductivity unit[1], [2]
- Thermometer

Fumigator Provides

- Auxiliary pump for purging long gas sample tubes
- Carbon dioxide filter (Ascarite®)
- Colorimetric tubes (Draeger/Kitagawa)
- Desiccant (Drierite®, anhydrous calcium sulfate)
- Electrical wiring (grounded, permanent type), three prong extension cords
- Fans (circulation, exhaust, and introduction)
- Gas introduction line
- Gas sampling tubes (leads)
- Methyl bromide
- Scales or dispensers
- Self-contained breathing apparatus (SCBA) or supplied air respirator
- Tape
- Thermal conductivity unit[3], [4]
- Volatilizer
- Warning signs

Preparing to Fumigate

Step 1—Selecting a Treatment Schedule

Select a treatment schedule to effectively eliminate the plant pest without damaging the commodity being fumigated.

Turn to the Treatment Schedule Index and look up the available treatment schedule(s) by commodity (example—apples, pears, or citrus) or by pest (example—Mediterranean fruit fly). Some

1 If fumigating oak logs or lumber for export, the unit must be capable of reading 400 oz.
2 T/C unit must be calibrated annually by the Center for Plant Health Science and Technology (CPHST). If requested, CPHST will calibrate a commercial fumigator's T/C unit.
3 If fumigating oak logs or lumber for export, the unit must be capable of reading 400 oz.
4 T/C unit must be calibrated by CPHST. If requested, CPHST will calibrate a commercial fumigator's T/C unit.

commodities may have several treatment schedules. The "Fumigants—Methyl Bromide" section on Residual Effects lists those commodities which may be damaged by MB. Each treatment schedule lists the target pest or pest group (e.g., *Ceratitis capitata*, surface feeders, wood borers...), commodity, or both pest and commodity. If there is no schedule, contact the Center for Plant Health Science and Technology (CPHST) in Raleigh, North Carolina, to see if a schedule is available under a FIFRA Section 18 Exemption. If a treatment is required, go to **Table 2.2.1**.

TABLE 2-8-1: Determine Reporting Requirements

If a treatment is required:	Then:
As a result of a pest interception	GO to Step 2
As a condition of entry	GO to Step 3

Step 2—Issuing a PPQ Form 523 (Emergency Action Notification)

When an intercepted pest is identified and confirmed by a PPQ Area Identifier as requiring action, issue a PPQ Form 523 (Emergency Action Notification) to the owner, broker, or representative. Be sure to list all treatment options when completing the PPQ Form 523 (Emergency Action Notification). Follow instructions in Appendix 1 for completing and distributing the PPQ Form 523 (Emergency Action Notification).

Step 3—Determining Section 18 Exemptions and Sampling Requirements

After selecting the treatment schedule, you will be able to determine which treatment schedules are FIFRA Section 18 Exemptions by the presence of broad, bold, vertical lines on the borders of the treatment schedule table listed in the reference. Some treatment schedules are only FIFRA Section 18 Exemptions at specific temperature ranges. Check the treatment schedule and temperature to determine if the fumigation will be a FIFRA Section 18 Exemption.

Food or Feed Fumigations

Residue monitoring by taking samples of the commodity prior to the start of the fumigation and after aeration is no longer required.

Step 4—Selecting a Fumigation Site

Consider the following factors in selecting a fumigation site:

- A well-ventilated, sheltered area
- Ability to heat area (in colder areas)
- A nonwork area which can be effectively marked and safeguarded or isolated
- Electrical power supply
- Water supply

- A well-lighted area
- Aeration requirements

A Well-Ventilated Area

Select sites which are well-ventilated. A well-ventilated site is required for exhausting gas.

Important

Only open-air fumigations are allowed for non-tarped containers. Non-tarped containerized fumigations may not be conducted in a warehouse.

Some gas will escape from the container even in the best conditions. Ensure that the exhausted gas does not endanger people working outdoors. When treatments are conducted in a particular location on a regular basis, a permanent site should be designated. Select a site that is semi-sheltered such as the leeward side of a warehouse or pier.

A Nonwork Area

Select a secure area where traffic and people are restricted from entering and which is isolated from people working. You want a non-work area to help prevent accidents such as a forklift piercing a container and for other safety reasons. Consider either the entire structure area or an area which extends 30 feet from the container and is separated by a physical barrier such as ropes, barricades, or walls as the fumigation area. Some states, for example California, require a 100-foot perimeter around fumigation sites. If a wall of gas-impervious material is less than 30 feet from the container, the wall may serve as the edge of the secured area. Place placards clearly in sight of all who come near. Placards must meet label requirements regarding specific warnings, information, and language. Placards generally include the name of the fumigant, the fumigation date, time, and the name of the company conducting the fumigation. Restrict access to the fumigation area to the fumigator's employees and PPQ employees monitoring the treatment. Use rope or marker tape to limit access within 30 feet of the enclosure. Do not allow motor vehicles (includes forklifts) to operate within 30 feet of the enclosure during the fumigation and aeration periods.

The area outside the 30-foot perimeter is generally regarded as a safe distance from the container. Gas concentrations exceeding 5.0 ppm (TLV for MB) are seldom recorded by gas monitoring, except during aeration. PPQ Officers that work within the 30-foot primeter must wear (and use) respiratory protection (SCBA), unless the gas levels are safe to breath and validated as safe by gas monitioring. The 30-foot perimeter is not specifically mentioned on the MB label, but is required for PPQ Officers.

When space is tight, it is permissible to overlap two or more adjoining 30-foot perimeters. However, there must be sufficient space for a person wearing SCBA to walk between the containers.

Electrical Power Supply

An adequate electrical source must be available to run the circulation fans and the T/C unit. A separate line should be available for the T/C unit. Electrical outlets must be ground and conveniently located in relation to the fumigation area. Do not use generators as a power source, except under emergency conditions.

Water Supply

A water supply is necessary for safety purposes. Water is necessary for washing off MB if the liquid form is spilled on someone. Water is also used to fill the volatilizer. If no permanent water is present on site, the fumigator must provide a portable, 5-gallon supply of clean water.

Well-Lighted Areas

The area should have adequate lighting for safety purposes and for ease in reading T/C units, thermometers, and for determining whether a container has holes or places where the MB may leak.

Aeration Requirements

Assuming that you've already restricted access and secured the fumigation area, you now must restrict access to the area where the exhaust duct extends beyond the enclosure. Before you start a fumigation, make sure the exhaust duct is located in a safe place. During the first 10 minutes of aeration, there should be no people within 200 feet down wind of the exhaust duct outlet. If it is impossible to restrict people from the area of aeration during regular work hours, consider aeration during another time of the day. When securing the duct outlet area, consider the direction of the wind. Face the duct outlet toward an open area, and away from people. Point the duct outlet upward to aid in dispersing the exhausted gas.

If an exhaust duct is not used, then a perimeter of 30 feet or more from the containers is usually regarded as a safe distance for personnel. However, for personal safety, gas levels should occasionally be monitored at greater distances, especially downwind. Experience provides the best guide.

Step 5—Arranging the Stack

Containerized Cargo

Containers should ordinarily not be loaded beyond 80 percent of their capacity. A space of 20 percent (18 inches) should be provided above the commodity. This allows a crawl space for placing the gas monitoring leads and fans, and to facilitate uniform gas distribution.

(Some restacking of cargo may be necessary to meet this requirement.) The commodity should be on a pallet to allow adequate space (at least 2 inches) below the commodity.

"Due to safety considerations, APHIS recommends that containers to be fumigated should not be stacked

Gas Penetration and Distribution

MB will penetrate most cargo easily; however, cargo may be packaged in an impermeable material.

Some of the more common types of impermeable materials are cellophane, plastic, wax coated materials, laminated, and waterproofed papers. Tight wooden packing cases are also relatively gastight. Impermeable materials will allow some gas to penetrate, but make it difficult to aerate and evacuate the gas. Remove, perforate, or open all impermeable materials.

For impermeable wrappers or containers, open the entire top or side and place the package with the open portion on the side.

Step 6—Arranging and Operating Fans

Containerized Cargo

There must be two circulation fans in the container, both placed on top of the stack. Place one fan at the doors (rear) and one fan in the front. The rear fan is the gas introduction fan and should be pointed into the container. The front fan is pointing in the opposite direction.

The electrical cords for the fans should be inserted through the drainage holes located at the doors. The fumigator must obtain approval from the owner of the container before removing the drains. The drains may be removed by any practical means available. Re-seal the holes using plumber's putty or similar water-proof caulking material to ensure minimal gas loss.

Turn on fans to make sure they work. Operate fans during gas introduction and for 30 minutes after the gas is introduced. If after taking gas concentration readings the fumigant is not evenly distributed, run the fans until the gas is evenly distributed as indicated by concentration readings (within 4 oz. of each other). Operate fans when adding gas, but only long enough to get even gas distribution.

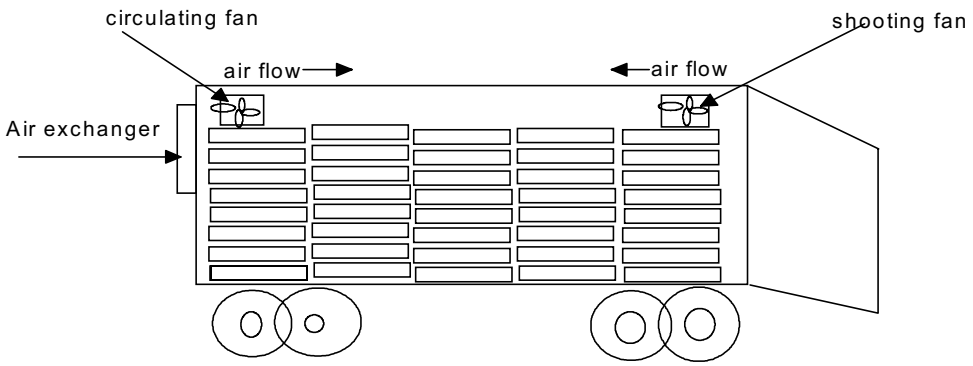


FIGURE 2-8-1 Fan Placement

The refrigeration unit may be run throughout the entire fumigation to enhance gas circulation and maintain pre-selected temperatures.

Important

However, the ½ hour readings are at the minimum required concentration, or if gas has been added twice to the reefer, turn the refrigeration unit off for the remainder of the fumigation.

Step 7—Placing the Gas Introduction Lines

Containerized Cargo

Place the gas introduction line directly above the rear (door) fan. Attach the line to the top of the fan to prevent movement of the hose. The fan should be firmly attached to the cargo or have a base that prevents it from toppling (not a pedestal type). Place a piece of impermeable sheeting (example—plastic or rubberized canvas) over the commodity below and to the front of the gas supply line. The sheet will prevent any liquid MB from coming in contact with the cargo.

Step 8—Placing the Gas Sampling Tubes

Containerized Cargo

Place a minimum of three gas sampling lines in the container. Position the gas sampling tubes in the following locations:

- Rear low - at the doors, 3 inches above the floor
- Middle center—center of the load, midway from bottom to top of load
- Front high - at the extreme top of the load

The gas introduction and sampling lines should be inserted through the drainage holes located at the doors. The fumigator must obtain approval from the owner of the container before removing the drains. The drains may be removed by any practical means available. Re-seal the holes using plumber's putty or similar water-proof caulking material to ensure minimal gas loss.

Use gas sampling tubes of sufficient length to extend from the sampling position inside the container to at least 30 feet up-wind from the container. Have all the gas sampling tubes meet in one area for ease and safety in taking gas concentration readings. Do not splice gas sampling tubes. Before starting the fumigation, test all gas sampling tubes for tightness by connecting each gas sampling tube to the T/C unit and placing a finger over the far end of the gas sampling tube. The ball in the flow meter will fall to zero if the gas sampling tube connections are tight. Replace any defective gas sampling tubes. Before starting the fumigation, check for gas sampling tube blockage or pinching by connecting each tube for a short time. If the tube is blocked, the flow meter will drop sharply. Fix all gas sampling tubes securely in place in the container and label each one at the end where the gas concentration readings will be taken. By labeling each gas sampling tube, you will be able to record concentration readings easily.

Step 9—Measuring the Temperatures

Important

Regardless of the commodity, never fumigate at temperatures below 40 °F.

If the commodity temperature drops below 40 °F after the fumigant has been added, do not include the time below 40 °F as part of the required exposure. Begin counting exposure time only after the temperature increases to at least 40 °F. However, in the case of parishable commodities, you must abort the fumigation immediately, unless it is feasible to add supplemtal heat to bring the commodity temperature back to 40 °F or above. (Do not use an open flame or electric heating elements to increase the temperature.)

Determine the temperature to use in selecting the proper dosage rate:

- For fruits, pulpy vegetables, or logs use only the commodity temperature.
- For all other commodities use both the commodity and air temperature.

To take the temperature readings, use a bimetallic, mercury, or digital long-stem thermometer that has been calibrated. Use TABLE 2-8-2: Determine the Temperature for the Proper Dosage Rate **page-2-8-10** to determine which temperature to use when selecting the proper dosage rate for commodities other than fresh fruits, vegetables, or logs.

TABLE 2-8-2: Determine the Temperature for the Proper Dosage Rate

If the air temperature is:	And:	Then, for commodities other than fresh fruits or pulpy vegetables or logs and lumber:
Higher than the commodity temperature	→	Use the single lowest commodity temperature for determining the dosage rate (Do Not use the average commodity temperature).
Lower than the commodity temperature	By 9 degrees or less	
	By 10 degrees or more	Use the average of the single lowest air and commodity temperatures for determining the dosage rate (Never initiate a fumigation if any commodity temperature reads lower than 40°F.)

EXAMPLE: You are about to fumigate guar gum and the commodity temperature is 82 °F and the air temperature is 69 °F. Average the air and commodity temperatures to determine the dosage rate because the air is 13 degrees lower than the commodity temperature. The average of the two temperatures is 75.5 °F. Use 75 °F to determine the dosage rate.

If the commodity is fruits, pulpy vegetables, or logs, see the specific procedures that follow.

Fresh Fruits and Pulpy Vegetables

For fresh fruit and pulpy vegetables, insert the thermometer into the pulp. (for purposes of this paragraph, peppers are also included in the category of pulpy vegetables.) For commodities which have been refrigerated, probe the fruit that have the lowest pulp temperature. Again, fumigate only when the fruit pulp is at 40 °F or higher. However, if the commodity has no pulp (for example, peas, beans, grains, herbs, spices, etc.), take the temperature of the air space immediately surrounding the commodity as well as the commodity temperature. With these temperatures, use TABLE 2-8-2: Determine the Temperature for the Proper Dosage Rate **page-2-8-10** to determine the correct temperature for use when selecting the proper dosage rate

Step 10—Measuring the Volume

Using a 100-foot tape measure, carefully measure the length, width, and height of the enclosure. *Never* estimate the measurements. An error in measurement of as little as 12 inches can result in miscalculation of the dosage by as much as 15 percent. When measuring, round off to the nearest quarter foot (example—3 inches = .25 feet). In the case of fumigations of edible commodities, an error can result in an unacceptable level of residue on the commodity.

Formula for determining volume:

Length × width × height = volume in cubic feet

Record volume in Block 26 of the PPQ Form 429.

Step 11—Calculating the Dosage

Calculate dosage by doing the following:

1. Refer to the treatment schedule for the correct dosage rate (lbs./1,000 ft^3) based on temperature (°F) (Step 10).
2. Multiply by the dosage (lbs./1,000 ft^3) rate by the volume (ft^3) to get the dosage in pounds.
3. Rules for rounding. Round to nearest ¼ pound.

Formula for calculating dosage:

$$\text{dosage (lbs.)} = \text{volume}(ft^3) \times \text{dosage rate (lbs./1,000 } ft^3)$$

$$= \frac{\text{volume}(ft^3) \times \text{dosage rate (lbs.)}}{1{,}000\ ft^3}$$

Step 12—Making a Final Check

Just prior to introducing the gas, do the following:

- Turn on all fans and T/C unit to make sure they work.
- Warm up T/C unit at least 30 minutes before zeroing in.
- If contaminant, CO_2, is detected, test again with Ascarite®. If you get a zero reading, proceed. If you don't get a zero reading, suspect a leak.
- Start volatilizer and heat water to 200 °F or above. A minimum temperature of 150 °F is required at all times during the introduction process.
- Place fumigant cylinder with gas introduction line on scale and take initial weight reading. Make sure the gas introduction line is attached to the cylinder. After obtaining the correct weight, subtract the dosage to be introduced into the enclosure. After you have introduced the proper amount of gas, the scale will be balanced.
- Check that container is placarded and the area is secured. Only people working on the fumigation may be in the area.
- Check container to make sure it is free from holes where MB might leak.
- Check that all gas sampling tubes are labeled and are not crimped or crushed. Inspect tubes visually, or use an electric or Mityvac hand pump to check tubes. Either a fumiscope or vacuum pump may be used to test leads for unrestricted flow.

Important

When conducting fumigations with methyl bromide, sulfuryl fluoride or phosphine, erroneous readings may occur if the monitoring leads become blocked or crimped. It would be impossible to install a new monitoring lead during a fumigation treatment. Therefore, to avoid an unsuccessful fumigation, you should test monitoring leads before the treatment begins.

The Center for Plant Health Science and Technology (CPHST) has developed the following procedure to detect blocked monitoring leads with the use of a Mityvac hand-held pump (for supplier, see ***Vacuum Pump***, Appendix 8):

1. Prior to fumigant introduction, connect the Mityvac hand-held vacuum pump to a monitoring lead.
2. Squeeze the handle on the Mityvac unit. If the lead is blocked, a vacuum will be indicated on the vacuum gauge of the Mityvac unit. (The handle should be squeezed two or three times for monitoring leads longer than 25 feet. The Mityvac hand-held pump has the capacity to attain and hold 25 inches of Hg vacuum and a minimum of 7 psig pressure.)
3. Disconnect the Mityvac hand-held pump from the monitoring lead, and repeat this procedure for each monitoring lead. (Connect monitoring leads to the gas analyzer prior to fumigant introduction.)

- Check that there is enough gas in the cylinder and if necessary, that other cylinders are available.
- Check the gas introduction line connections to make sure they are tight and free of leaks (wearing the SCBA).
- Check all safety equipment, especially SCBA, is available and in working order.
- Install Drierite® tube on gas sample line attached to the T/C unit and check to make sure granules are blue, if pink—replace Drierite®. If humidity is high, additional Drierite® tubes or frequent changes may be necessary.

Conducting the Fumigation

Step 1—Introducing the Gas

CAUTION

The acceptable air concentration level for methyl bromide (MB) is 5 ppm. A respirator (approved SCBA or MSHA/NIDSH) is required if the MB concentration level in the air is greater than 5 ppm at any time. You and the fumigator must use your SCBA while introducing the gas, checking for leaks, and when taking aeration readings.

Turn on all fans before introducing the gas. When using large cylinders of MB, have the fumigator open the cylinder valve slightly, then close the valve. With a halide detector, check all connections on the gas introduction line for leaks. If leaks are found, advise the fumigator tighten the connections and repeat the test. If no leaks are found, then open the valve to the point where 3 to 4 pounds of MB are being introduced per minute. The water temperature in the volatilizer should never go below 150 °F at any time during gas introduction. The water in the volatilizer may include an antifreeze and should be handled with the appropriate safeguards.

CAUTION

Don't touch the introduction line with your bare hands—you could get burned! Close the cylinder valve once the proper dosage has been introduced.

The fumigation time begins once all the gas has been introduced. Record the time gas introduction was started and completed in Block 32 on the PPQ Form 429. Run the fans for 30 minutes to achieve even gas distribution. Take the initial concentration reading 30 minutes after all the gas has been introduced.

When evacuating large cylinders, getting the final amount of gas out may take a long time. Consider taking a T/C unit reading 30 minutes after the gas was first introduced. If the gas distribution is even (all readings within 4 ounces of each other) and at a significantly high concentration, then turn off the fans. Running the fans longer may contribute to gas leakage. Allow the remainder of the gas to discharge with intermediate running of the fans. Normally, all the gas should be introduced within 30 minutes.

CAUTION

Do not begin counting fumigation time until all the gas has been introduced and valve on the MB tank is closed.

Step 2—Testing for Leaks

Wear the SCBA while checking for leaks. Use a halide detector to test for leaks before the 30 minute reading or anytime when the concentration level is unknown or above 5 ppm. Test around the perimeter of the container, and especially at the plugged drainage holes. When you detect leaks, have them sealed using tape.

If you detect excessive leakage (concentration readings of 50 percent or less of the minimum concentration) in a container which cannot be corrected in a practical way, do not attempt to correct the problem by adding more gas. Quickly evacuate the remaining gas from the enclosure, eliminate the problem, and construct a new enclosure. Aerate as usual following procedures on **page-2-8-14**. Restart the fumigation in the new enclosure.

CAUTION

Commodities used for food or feed may not be re-treated. If commodities fall into this category, the only options are the following:

- Re-exported to another country if they will accept the shipment
- Destroy by incineration

Step 3—Taking Concentration Readings

Important

Before obtaining readings, always purge sampling lines with a mechanical or hand pump. If you're using treatment schedule T101 or T104-a-1 to fumigate fresh fruit or vegetables, see "Special Procedures for Fruits and Vegetables" on **page-2-4-25**.

Take concentration readings with a T/C unit to determine the gas concentration and distribution within the enclosure. Check desiccant tubes before each reading and change Drierite® if its color is pink. Depending upon the length of exposure period, take concentration readings at the following times:

- 30 minutes
- 2 hours
- 4 hours (optional)
- 6 hours (optional)
- 12 hours (optional)
- 24 hours[5]
- 36 hours (optional)
- 48 hours
- 72 hours

Any final concentration reading (see following example)

EXAMPLE: If the treatment schedule lists a 6 hour exposure period, then the 6 hour reading would be required and not optional as shown in Step 3. If the treatment schedule lists a 16 hour exposure period, you must take a 16 hour reading.

CAUTION

Avoid using hand-held two-way radios near the T/C unit. Using two-way radios near the T/C unit will interfere with an accurate concentration reading.

5 If fumigating oak logs or lumber for export, see "Special Procedures for Adding Gas to Oak Logs and Lumber."

Thirty Minute Reading

The 30 minute reading shows the initial concentration and distribution of gas. The 30 minute reading can indicate leakage, sorption, incorrect dosage calculation, or error in fumigant introduction—all of which require immediate attention. Concentration readings should not differ more than 4 ounces among the leads.

Two Hour Reading

In comparison with the 30 minute reading, the 2 hour reading also will indicate if the container is leaking or the commodity is sorbing gas. Readings more than 15 percent lower than the 30 minute reading will require close monitoring and possible corrective action.

EXAMPLE: Your dosage for the fumigation was 4 pounds (64 ounces). The 30 minute reading was 50 ounces (3.125 pounds). The 2 hour reading is 42 ounces (2.625 pounds). The 2 hour reading is more than 15 percent less than the 30 minute reading and would indicate that either a leak or sorption problem may exist. You would need to monitor the fumigation closely until the concentration level stabilizes.

Four, Six, Twelve, or Thirty-Six Hour Reading

Not required if previous readings are satisfactory and experience with similar fumigations indicate successful treatment can be expected. If either the 4, 6, 12, or 36 hour reading is the final reading, then you must take the reading. If you are unfamilar with the treatment schedule, optional concentration readings may be necessary to ensure a successful fumigation.

Final Reading

The final reading is required for all container fumigations in order to determine if the fumigation has been successfully completed. You may start the final reading before the finishing time of the treatment so that aeration commences at the finishing time. Starting the final reading before finishing time is especially critical when fumigating perishables. Do not add gas after the final reading.

Additional Readings

Decide the need to take additional readings based on the following:

- Rate of gas concentration decrease
- Any condition which could change the gas concentration such as severe winds, or rain.

When concentration readings differ by more than 4 ounces, run the fans to equalize the gas and record readings on the APHIS 429. Generally, at the ½ hour reading, gas should be evenly distributed, and you should not have to restart the fans unless you added gas.

Severe winds (30 mph or higher including any amount severe enough to cause damage) are a good reason to take additional readings on an outdoor fumigation. Any sharp or unusual decreases of the readings in relation to previous readings is a clue to take corrective action and supplementary readings. Take additional readings every 30 minutes until problems are rectified. Adverse weather conditions may indicate the need for additional readings.

Sorptive commodities may also require additional concentration readings.

Step 4—Determining the Need to Add Gas and Adjust Exposure

Use the following table to determine when to add gas or extend the exposure period:

TABLE 2-8-3Determine the Need to Add Gas and Adjust Exposure

If the average T/C unit readings are:	And the schedule is:	Then:
Below the required minimum concentration	T101-a--1* or equivalent	ADD gas and extend fumigation. SEE "Special Procedures for Fruits and Vegetables" on **page-2-4-25**
	Other than T101a--1 or equivalent	ADD gas using "Special Procedures for Adding Gas and Extending Exposure" on page **page-2-4-25**
At or above required minimum concentration	T101-a--1* or equivalent	SEE **page-2-4-19** for corrections at 0.5 hour and 2 hour readings
	Other than T101-a-1	No action necessary

Important

* T101-a-1 or equivalent treatment schedules are those schedules that are not greater than 2 hours long (exposure time), and the dosage rate is not greater than 4lbs per 1000ft^3 anywhere on the schedule

Special Procedures for Adding Gas and Extending Exposure Period

Adding Gas to Commodities that are Fumigated Using Treatment Schedules Other Than T101-a-1 or Equivalent (may include perishables)

Important

T101-a-1 or equivalent treatment schedules are those schedules that are ***not*** greater than 2 hours long (exposure time), and the dosage rate is ***not*** greater than 4lbs per 1000ft^3.

NOTICE

To avoid injuring the commodity, add fumigant using the following formula:
1.6 × number of oz. below minimum × vol/1,000 = oz. of gas to add

When adding gas, these procedures must be followed:

1. Heat water in volatilizer.
2. Turn on fans.
3. Take weight of the cylinder.
4. With your SCBA on, open valve on cylinder and introduce the gas.
5. Close valve when the weight of the cylinder indicates that the needed amount of gas has been added.
6. Record quantity of fumigant added in Block 34 and the additional fan time in Block 30 of the PPQ Form 429.

Note the time the fumigator started introducing additional gas and the time the fumigator finished introducing gas and record in Block 40 (Remarks) of the PPQ Form 429. Run the fans until there is even gas distribution throughout the stack. Turn off fans, then take a concentration reading 30 minutes after the gas has been introduced. If all readings are above minimum concentration levels, then proceed as usual with the remaining scheduled concentration readings.

Excessive leakage (concentration readings are less than 50 percent of minimum) in any one container which cannot be eliminated in a practical way must *not* be corrected by the addition of MB. "Quickly evacuate remaining gas from the container, eliminate the problem,and start a new treatment

CAUTION

Commodities used for food or feed may not be re-treated. If commodities fall into this category, the only options are the following:

- Return to the country of origin
- Re-export to another country if they will accept the shipment
- Destroy by incineration

Extending the Exposure Period for Food, Nonfood, Feed, or Nonfeed Commodities

Use the following table to determine how long to extend the exposure period.

TABLE 2-8-4: Determine the Extended Exposure Period

If the exposure time is:	And the reading is below minimum by:*	Then extend exposure:
Less than 12 hours	10 oz. or less	10 percent of the time lapse since the last acceptable reading
	11 oz. or more	30 minutes
12 hours or more	10 oz. or less	10 percent of the time lapse since the last acceptable reading
	11 oz. or more	2 hours or 10 percent of time lapse since last acceptable reading, whichever is greater

*If reading is 50 percent below minimum or less, then abort the treatment. For example, if the minimum reading is 38 ounces then the reading 50 percent below the minimum is 19 ounces
[38 ounces – (38 ounces × .50) = 19 ounces]. (See the following special procedures for fruits and vegetables using T101 or equivalent.)

Special Procedures for Fruits, Vegetables, or Perishable Commodities Using Schedule T101-a-1 or Equivalent

Use these instructions only for fruits and vegetables being fumigated under treatment schedule T101-a-1 or equivalent.

CAUTION

Fresh fruits and vegetables are sensitive to MB so you should double check volume calculations and dosage measurements to avoid accidental overdoses. If any 30 minute readings are 50 percent or more above the minimum concentration, it indicates a miscalculation of the dosage. Include a brief report on the PPQ Form 429 stating possible reasons for the overdose. Exposure periods are decreased for fumigations where concentration readings are much higher than required. See table on the following pages to determine when to reduce exposure periods.

Use Table 2-2-6 and **Table** 2-2-7 on the following pages for fresh fruits and vegetables to determine if you need to add gas or extend or decrease the exposure time. Average your concentration readings before using the tables. Select the proper table based on the time of the T/C unit concentration reading (30 minutes or 2 hours).

Important

These tables apply ***only*** to those T101 schedules lasting 2 hours or less at a dosage rate of 4lbs/1000ft^3 or less. They do not apply to schedules of longer duration.

Adding Gas

NOTICE

To avoid injuring the commodity, add fumigant using the following formula:
1.6 X number of oz. below minimum X vol/1,000 = oz. of gas to add

When adding gas, these procedures must be followed:

1. Heat water in volatilizer.
2. Turn on fans.
3. Take weight of the cylinder.
4. With your SCBA on, open valve on cylinder and introduce the gas.
5. Close valve when the weight of the cylinder indicates that the needed amount of gas has been added.
6. Record quantity of fumigant added in Block 34 and additional fan time in Block 30 of the PPQ Form 429.

Note the time the fumigator started introducing additional gas and the time the fumigator finished introducing gas and record in Block 40 (Remarks) of the PPQ Form 429. Run the fans until there is even gas distribution throughout the stack. Turn off fans, then take a concentration reading 30 minutes after the gas has been introduced. If all readings are above minimum concentration levels, then proceed as usual with the remaining scheduled concentration readings.

TABLE 2-8-5: Determine Gas Concentration Values and Corrections for Fruits and Vegetables at the 30 Minute Reading of T101-a-1 or Equivalent Schedules

If the schedule is:	And the minimum concentration reading (oz.) in the schedule is:	And the average concentration reading (oz.) is:	Then:
40-49 °F 4 lbs for 2 hrs	48	73 or higher[1]	EVACUATE excess gas immediately
		65 or greater*	REDUCE exposure by 15 minutes
		64-48	TAKE 2 hour reading as scheduled
		47 or lower	1. ADD gas, and 2. EXTEND exposure 15 minutes
50-59 °F 3 lbs for 2 hrs	38	58 or higher*	EVACUATE excess gas immediately
		52 or greater	REDUCE exposure by 15 minutes
		51-38	TAKE 2 hour reading as scheduled
		37 or lower	1. ADD gas, and 2. EXTEND exposure 15 minutes
60-69 °F 2.5 lbs for 2 hrs	32	49 or higher*	EVACUATE excess gas immediately
		48 or greater	REDUCE exposure by 15 minutes
		47-32	TAKE 2 hour reading as scheduled
		31 or lower	1. ADD gas, and 2. EXTEND exposure 15 minutes
70-79 °F 2 lbs for 2 hrs	26	40 or higher*	EVACUATE excess gas immediately
		37 or greater	REDUCE exposure by 15 minutes
		36-26	TAKE 2 hour reading as scheduled
		25 or lower	1. ADD gas, and 2. EXTEND exposure 15 minutes

TABLE 2-8-5: Determine Gas Concentration Values and Corrections for Fruits and Vegetables at the 30 Minute Reading of T101-a-1 or Equivalent Schedules (continued)

If the schedule is:	And the minimum concentration reading (oz.) in the schedule is:	And the average concentration reading (oz.) is:	Then:
80-89 °F 1.5 lbs for 2 hrs	19	30 or higher*	EVACUATE excess gas immediately
		27 or greater	REDUCE exposure by 15 minutes
		26-19	TAKE 2 hour reading as scheduled
		18 or lower	1. ADD gas, and 2. EXTEND exposure 15 minutes

1 If concentration reading is more than 50 percent above the minimum concentration reading, it indicates that something is radically wrong and an immediate check should be made to determine the cause and to correct it.

TABLE 2-8-6: Determine Gas Concentration Values and Corrections for Fruits and Vegetables at the 2 Hour Reading of T101-a-1 or Equivalent Schedules

If the schedule is:	And the average concentration reading at 2 hours is:	Then do not add gas, but:
40-49 °F 4 lbs for 2 hours	38 and above	AERATE commodity (see page-2-4-29)
	37-28	EXTEND exposure by 15 minutes
	27-25	EXTEND exposure by 30 minutes
50-59 °F 3 lbs for 2 hrs	29 and above	AERATE commodity (see page-2-4-29)
	28-24	EXTEND exposure by 15 minutes
	23-21	EXTEND exposure by 30 minutes
60-69 °F 2.5 lbs for 2 hrs	24 and above	AERATE commodity (see page-2-4-29)
	23-21	EXTEND exposure by 15 minutes
	20-18	EXTEND exposure by 30 minutes
70-79 °F 2 lbs for 2 hrs	19 and above	AERATE commodity (see page-2-4-29)
	18-16	EXTEND exposure by 15 minutes
	15-13	EXTEND exposure by 30 minutes
80-89 °F 1.5 lbs for 2 hrs	14 and above	AERATE commodity (see page-2-4-29)
	13-12	EXTEND exposure by 15 minutes
	11-10	EXTEND exposure by 30 minutes

Special Procedures for Adding Gas to Oak Logs and Lumber Using T312 or Equivalent

After taking the 24 hour concentration reading, if necessary, add gas to bring the concentration level up to 240 ounces. Subtract the 24 hour concentration reading from 240 to determine how many ounces the concentration is below 240 ounces. Use the following formula in calculating how much gas to add:

$1.6 \times$ number of oz. below 240 $\times$ volume in $ft^3/1{,}000\ ft^3$ = oz. of gas to add or

$$\frac{\text{oz. of gas to add}}{16\frac{\text{oz.}}{\text{lbs.}}} = \text{pounds (lbs.) of gas to add}$$

EXAMPLE: You're fumigating a 10,000 ft^3 enclosure of oak logs for export. At the 24 hour reading, the T/C unit readings indicate a 160 oz. concentration level. To determine how much gas to add, do the following:

240 oz. – 160 oz. = 80 oz. below 240 oz.

1.6×80 oz. $\times$ 10,000 $ft^3/1{,}000\ ft^3$ = 1,280 oz. or

$$\frac{1{,}280\text{oz.}}{16\frac{\text{oz.}}{\text{lbs.}}} = 80 \text{ pounds (lbs.) of gas to add}$$

Take concentration readings 30 minutes after adding gas and record on the PPQ Form 429.

Exhausting the Gas

Exhaust the gas at the completion of the exposure period. If the treatment schedule is a FIFRA Section 18 Exemption, then you must monitor the aeration of the commodity. Use the following table to determine the need to monitor the aeration of the fumigation.

TABLE 2-8-7Determine the Need to Monitor Aeration

If the treatment schedule is:	Then:
A FIFRA Section 18 Exemption	MONITOR the aeration of the commodity. FOLLOW "Aerating the Enclosure" steps which follow.
A labelled treatment	RELEASE the commodity and RELEASE the fumigation to the fumigator for aeration.

Aerating the Enclosure

Aeration procedures are designed to provide safe working conditions during the aeration period and to assure that commodities are safe for handling, storage, and transportation. A fumigant must be aerated in accordance with Environmental Protection Agency (EPA) label requirements, the Occupational Safety and Health Administration (OSHA), and the PPQ Treatment Manual.

Aeration of fumigated structures and ships are covered within those particular sections.

Responsibility for Aerating the Commodity

The label requires that at least two people trained in the use of the fumigant must be present at all times during gas introduction, treatment, and aeration. The PPQ officer, however, is not required to be continuously present at the fumigation site throughout the aeration process unless specified by the label or by State or local regulations.

If the fumigation is performed under a Section 18 Exemption, then a PPQ officer must be present at the initiation of aeration and to verify the final aeration readings.

TABLE 2-8-8: Determine Responsibility for Aerating the Commodity

If the Treatment Schedule is:	Then:
A FIFRA Section 18 Exemption	1. MONITOR the aeration of the enclosure, and 2. USE the table on page-2-4-31 to determine which aeration procedure to follow
A labeled Treatment Schedule	1. RELEASE the fumigation to the fumigator to aerate according to label instructions and the conditions of the compliance agreement. 2. RELEASE the commodity.

Materials Needed

The following materials will be needed to aerate the enclosure:

- SCBA[6]
- Colorimetric tubes* (Draeger or Kitagawa for example)
- Exhaust fan[7]
- Exhaust duct**
- Danger signs**
- Materials for limiting access to area (barricades, rope)**
- PPQ Form 429

The following procedures apply to the aeration of all container fumigations.

Securing the Area

Assuming that you have already restricted access and secured the fumigation area, you now must restrict access to the area where the exhaust duct extends on the ground beyond the enclosure.

6 Materials required for both PPQ and commercial fumigator.
7 Materials to be furnished by the commercial fumigator.

CAUTION

During the first 10 minutes of aeration, it is recommended that no people should be within 200 feet of the exhaust duct outlet.[1]

1 If this buffer zone is regulated by the State or municipality where the fumigation takes place, local regulations must be followed.

If it is impossible to restrict people from the area of aeration during regular work hours, consider aeration during another time of the day. When securing the duct outlet area, consider the direction of the wind. Face the duct outlet toward an open area, and away from people. Point the duct outlet upward to aid in dispersing the exhausted gas.

Advise the fumigator use a physical barrier such as ropes, barricades, or walls to secure the area.

Placard the secure area near the exhaust outlet with the appropriate DANGER/PELIGRO signs. Make sure the placards meet the appropriate fumigant label or labeling requirements. The skull and crossbones should be present as well as “AREA UNDER FUMIGATION, DO NOT ENTER/NO ENTRE”; date of the fumigation; name of the fumigant used; and the name, address, and telephone number of the fumigator.

Unless you authorize their use, do *not* allow motorized vehicles to operate within the secure area.

Wearing Respiratory Protection

The fumigator and the PPQ officer monitoring the aeration must wear approved respiratory protection (SCBA, air supplied respirator, or a combination unit) when:

- Installing the exhaust system
- Opening the container for aeration
- Any time during the aeration process when a risk of exposure to concentrations above 5 ppm exists. This includes any time the concentration is unknown.

TABLE 2-8-9Determine the Aeration Procedure

If:	And:	And:	Then:
Nonsorptive	Containerized	→	GO to page-2-4-32
Sorptive, including yams and chestnuts	Containerized	→	GO to page-2-4-33

Aerating Nonsorptive, Containerized Cargo

Step 1—Installing Exhaust System

Advise the fumigator:

- Install an exhaust fan (minimum of 5,200 cfm capacity) to a 16 inch, or greater, diameter duct located at the floor near rear doors of the container.
- Or, as another option, install an air introduction duct system consisting of a 3,750 cfm, or greater, fan attached to a 12 inch, or larger, duct which reaches two-thirds of the length of the container at the top of the load. Have the ducts installed prior to the start of the fumigation. Extend the exhaust duct at least 30 feet beyond the container.

Important

(1) Volume of enclosure (in cubic feet) divided by the sum of cubic feet per minute (cfm) of the exhaust fan(s) or exhaust blower equals the number of minutes required per complete gas volume exchange. (2) Sixty minutes divided by the number of minutes per gas volume exchange equals the number of complete gas exchanges per hour. The result should be in the range of 4 to 15. The faster the rate of aeration the better, particularly for perishable commodities. If the exhaust flow is connected to a methyl bromide recovery system, this device must not impede the flow rate to less than 4 volumes per hour.

Step 2—Aerating the Commodity

Advise the fumigator:

1. Connect the exhaust duct to the exhaust fan.
2. Start the exhaust fan(s)
3. Aerate for 3 hours.
4. Stop the aeration fans.
5. Use a colorimetric tube to take a concentration reading in the exhaust duct.

After the fumigator takes the concentration reading, you must record the date, concentration reading, and time in Block 39 of PPQ Form 429. Then use the following table to determine when to release the commodity.

TABLE 2-8-10

If the gas concentration level is:	Then:
5 ppm or less	RELEASE the commodity
6 ppm or more	1. CONTINUE aeration until the concentration is 5 ppm or less[1], then 2. RELEASE the commodity

1 Concentration reading must be taken 4 feet from floor and 1 foot inside stack at two locations between the cartons but not inside the cartons.

Aerating Sorptive Commodities in Containers

Step 1—Installing the Exhaust System

Advise the fumigator:

- Install an exhaust fan (minimum of 5,200 cfm capacity) to a 16 inch or greater diameter duct located at the floor near rear doors or the container.
- Or, as another option, install an air introduction duct system consisting of a 3,750 cfm or greater fan attached to a 12 inch or greater duct which reaches two-thirds of the length of the container at the top of the load. Have the ducts installed prior to the start of the fumigation. For outdoor fumigations, extend the exhaust duct 30 feet beyond the container.

Step 2—Aerating the Commodity

Outdoors

Advise the fumigator:

1. Complete installation of exhaust duct and begin exhaust fan.
2. Start the circulation and air introduction fans. Sorptive commodities generally require 12 hours or longer to aerate. Since sorptive commodities vary in their rates of desorption, aeration may be completed in less than 12 hours. Require a minimum of 4 hours aeration for all sorptive commodities.
3. Stop the circulation fans and take concentration readings with colorimetric tubes 4 feet from the ground and 1 foot inside the outer edge of the stack between the cartons but not inside the cartons. One location is sufficient.

After the fumigator takes the concentration reading, you must record the date, concentration reading, and time in Block 39 of PPQ Form 429. If you are not at the fumigation site, have the fumigator call and give you the information. Then use the following table to determine when to release the commodity.

TABLE 2-8-11Determine When to Release the Commodity

If the gas concentration level is:	Then:
5 ppm or less	RELEASE the commodity
6 ppm or more	1. CONTINUE aeration and take concentration readings until the level is 5ppm or less, then 2. RELEASE the commodity

2

Treatment Manual

Chemical Treatments

Fumigants • Sulfuryl Fluoride

Contents

Properties and Use **page-2-9-1**
Leak Detection **page-2-9-2**
Tarpaulin Fumigation **page-2-9-2**
- Sealing **page-2-9-3**
- Circulation **page-2-9-3**
- Prevention of Condensation **page-2-9-3**
- Gas Sampling Lines **page-2-9-3**
- Gas Introduction **page-2-9-4**
- Dosage Rate **page-2-9-5**
- Measure Gas Concentrations **page-2-9-5**
- Replacing Lost Gas **page-2-9-5**
- Aeration **page-2-9-5**

Structural Fumigation **page-2-9-6**
Chamber Fumigation **page-2-9-6**
Shipboard Fumigation **page-2-9-6**
Safety and First Aid **page-2-9-7**
- Protective Clothing **page-2-9-7**
- If SF Is Inhaled **page-2-9-7**
- If Liquid SF Is Spilled on the Skin **page-2-9-7**
- If Liquid SF Is in the Eyes **page-2-9-7**

Consult the Vikane[1] Gas Fumigant label and Structural Fumigation Manual for more detailed instructions and additional supportive information.

Properties and Use

Sulfuryl fluoride (SF) is a compressed-gas fumigant which is used primarily against insects that attack wood. The following characteristics make this fumigant especially desirable:

- High vapor pressure — 13,442 mm Hg @ 770 °F.
- Penetrates wood better than any other commercial fumigants, including methyl bromide.
- Low solubility in water and low sorption by soil or commodity.
- Odorless, colorless, and nonflammable.
- Very low loss through plastic tarpaulins.
- Relatively non-reactive.

1 Trademark of Dow Agro Sciences

- 2.88 times heavier than air.

SF boils at minus 67 °F. SF is not registered for use on foodstuffs or on living plant material.

SF is effective at very low dosages on Drywood termites where control of the adult stage is the only concern (typically 0.5 – 1.0 lbs/1,000^2). Higher dosages are required for control of the egg stage of other insects (typically 3 – 5 lbs/1,000^2). Consult treatment schedules in this manual for specific dosages.

Leak Detection

Interscan (Model GF 1900) or Miran gas analyzers (these units are portable) may be used to detect SF in the range of 0 to 150 ppm respectively. Consult the Vikane Structural Fumigation Manual for further instructions. Colorimetric ("detector") tubes are not available for detecting SF gas leaks around tarpaulins, chambers, and application equipment.

Important

A halide leak detector, which depends upon the color of a flame to indicate the presence and relative concentration of methyl bromide in the atmosphere, cannot be used to detect SF.

Tarpaulin Fumigation

Important

Refer to the section for tarpaulin fumigation with methyl bromide for additional information on the following:

- selecting fumigation sites

- placing gas sampling lines

- sealing tarpaulins

- taking concentration readings

- securing fumigation areas

Important

Refer to the PPQ Treatment Manual section on **Fumigants • Methyl Bromide • Tarpaulin Fumigation** (and aeration), the Vikane label, and Vikane Structural Fumigation Manual for a detailed discussion of proper procedures.

Sealing

The commodity to be fumigated should be placed onto a relatively even and non-porous surface, such as concrete, asphalt, or macadam. Special attention should be given to the seal along the ground or floor. The inspector should have tape, sand, or water snakes properly positioned.

Circulation

Fans are necessary to distribute SF and to help prevent condensation. The number of fans depends upon the cubic volume of the enclosure being treated, and the arrangement of cargo. Axial fans of approximately 5,000 cfm have proven effective. Usually two fans are used, one on either end facing the lower center and upper center of the load. If the enclosure is over 35 feet long, additional fans should be used. It is usually not necessary to run fans longer than 15 minutes after the gas has been introduced.

Prevention of Condensation

In cool weather, moisture may condense under tarpaulins if the sun is shining directly on the load. Continuous air circulation can prevent this from occurring. Do not tarp or seal any item while it is wet.

Gas Sampling Lines

A thermal conductivity unit calibrated for Vikane must be available for readings. Sampling lines should be arranged so that gas samples are drawn from representative parts of the fumigation area and lead to a common point.

A minimum of three sampling lines should be placed in enclosures of up to 10,000 ft^3 at the following locations:

- Front of the load, 3 inches from the floor
- Center of the load, midway from the bottom to the top of the load
- Rear of the load, at the top.

When 10,000 to 15,000 ft^3 are being treated, two additional lines should be appropriately deployed.

Gas Introduction

Unlike methyl bromide, SF does not require the use of a volatilizer to speed up its conversion from a liquid to a gas. The gas introduction tube should be placed directly in the air flow of a fan away from the cargo. Also, place a drip cloth under the tube. The introduction rate is controlled by the introduction line length and diameter. A 1/8 inch inside diameter by 100 ft long hose will allow a flow rate of approximately 2 lbs per minute while a 25 ft long hose will allow approximately 4 lbs per minute.

TABLE 2-0-30: Effect of Hose Inside Diameter on Rate of Gas Introduction through a 25 Foot Hose

Inside Diameter (in inches)	Pounds Vikane Per Minute
1/8	4
1/4	20
1/2	45

Approximate; dependent on pressure in cylinder.

TABLE 2-9-1: Effect of Hose Length on Rate of Gas Introduction through a 1/8 inch Inside Diameter Hose

Hose Length (in feet)	Pounds Vikane Per Minute
25 ft	4.0
50 ft	2.8
100 ft	2.0[1]

1 Where fumigant introduction rates lower than 2 lbs/min are needed, a longer hose can be used, e.g., 200 ft.

It is important not to overshoot the ability of the fan to rapidly disperse the cool air near the fumigant introduction site. Fan capacity should be at least 1,000 cfm for each lb of Vikane introduced per minute. In addition, a volatilizer (heat exchanger) may be used in fumigating containers or small chambers to prevent a “fog-out” (condensation) which could cause corrosion or damage to the contents. The last few pounds of fumigant will turn to gas within the cylinder before moving out, and the flow rate will be reduced. The cylinder and tubing will often become frosted. Be certain that no open flame or glowing hot surfaces above 400 °C are present since corrosive substances (mainly hydrofluoric acid) are formed when SF is exposed to such conditions. To avoid possible damage, do not apply the fumigant directly to any surface.

Dosage Rate

To control a particular pest, locate the proper fumigation schedule to be followed in the Treatment Manual. The three variables in these schedules are temperature, dosage, and exposure duration. Treatment is not recommended below 50 °F. Dosages are in pounds per 1,000 feet^3 of space. To determine the total amount of fumigant required by weight in pounds, divide the total volume of space by 1,000. Then multiply the resulting figure by the dosage rate schedule expressed in pounds (per 1,000 feet^3). The cylinder should be placed on a scale, and the flow of gas is controlled by the valve and introduction line until the desired cylinder end-weight is obtained. The valve should be turned fully open to fill the fumigant introduction hose with liquid SF. Initially, the valve should be opened slightly until flow has begun and then opened about one full turn which should give full flow through the 1/8″ fumigant introduction hose.

Measure Gas Concentrations

During the course of fumigation, minimum concentrations must be maintained according to the schedules used. Readings on the T/C unit (Fumiscope or Gow-Mac) if not calibrated for Vikane must be multiplied by a factor to obtain the actual ounces per 1,000 feet^3 present. The Center for Plant Health Science & Technology (CPHST) in Raleigh, North Carolina, will calibrate these instruments to determine the exact multiplication factor to use. Be certain that the reading without the multiplied factor is also registered on PPQ Form 429, however. Do not use filters containing soda asbestos (Ascarite) with SF. Fresh desiccant (Drierite) should be used with the T/C unit. Desiccant should be changed at appropriate intervals to insure accurate readings.

Replacing Lost Gas

When it appears that additional SF will be needed, the inspector should use his best judgment to determine the amount of gas to add, according to the prevailing conditions of tarpaulin tightness or wind conditions. Usually, 1.6 oz of gas should be added for every ounce of deficiency in the minimum concentration required.

Aeration

For detailed guidelines, consult the “Aeration” discussion elsewhere in this manual, under “Fumigants—Methyl Bromide—Tarpaulin Fumigation—Methods and Procedures,” the Vikane Gas Fumigant label, and Structural Fumigation Manual. The threshold limit value for SF is 5 ppm (20 mg/cubic meter), the same as for MB. Since no colorimetric (“detector”) tubes are available for SF, a suitable instrument must be used, such as the Interscan GF 1900 or Miran (calibrated for SF).

Structural Fumigation

Refer to the section on MB structural fumigation (or aeration) in this manual, the Vikane label, and Vikane Structural Fumigation Manual for a detailed discussion of proper procedures.

When preparing a structure for fumigation with SF, the surrounding soil should be watered thoroughly at the base of trees, shrubs, and other ornamental plants around the perimeter of the structure to prevent loss of fumigant into the soil. Watering around the plants will protect the roots; however, plants and grass closer than 1 ft may die even if this precaution is taken.

Before placing the tarpaulin over the structure, be sure to remove items for which the use of SF is not registered. These include food, feed, drugs, and medicines. Extinguish all flames (including pilot lights), unplug all heating elements, and turn off all lights. Open all internal doors.

Chamber Fumigation

Refer to the section on MB chamber fumigation (and aeration) in this manual, the Vikane label, and Vikane Structural Fumigation Manual for a detailed discussion of proper procedures.

CAUTION

Trying to measure out a small quantity of SF in a graduated glass tube (sight gauge)—which is common practice with MB chamber fumigations—should never be attempted with SF because the cylinder pressure is much greater, and the glass gauge may explode and shatter.

The gas will generally be introduced through a volatilizer or heat exchanger in order to prevent a “fog-out” which could damage the contents. Introducing a very small amount of gas into a small chamber, however, is difficult to do with precise accuracy because the amount introduced must be calculated by weight loss from the cylinder. The scale used beneath the cylinder must be readable in ounces or grams, not just in pounds or kilograms.

Shipboard Fumigation

Refer to the section on MB ship fumigation (and aeration) in this manual, the Vikane label, and Vikane Structural Fumigation Manual for a detailed discussion of proper procedures. Surface ships (only those in port) must be fumigated at dock side, and not when the vessels are underway. Shipboard fumigation is also regulated by the U.S. Coast Guard (Department of Transportation). That regulation appears as 46CFR 147A.

Safety and First Aid

Read and understand all directions and safety precautions on Vikane label before applying. Additional information is presented in Vikane Structural Fumigation Manual. There is no known antidote for SF. Vikane is odorless. However, the chance of lethal exposure is not probable unless an individual actually enters the fumigation space. An SCBA must be worn by anyone in the fumigated areas when the level exceeds 5 ppm.

Protective Clothing

Wear goggles or full face shield for eye protection during introduction of the fumigant. Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with liquid SF until thoroughly aerated and cleaned.

If SF Is Inhaled

An individual who has inhaled high concentrations of SF may exhibit the following symptoms:

- Slowed or garbled speech
- Slowed body movements
- Dulled awareness
- Nausea
- Difficulty in breathing
- Numbness of the extremities

If any of the above symptoms appear, then immediately do the following:

- Remove the victim to fresh air.
- Put victim at complete rest.
- Keep the victim warm and see that breathing is normal and unhampered. If breathing has stopped, give artificial respiration.
- Do not give anything by mouth to an unconscious person.
- Obtain medical assistance.

If Liquid SF Is Spilled on the Skin

Immediately apply water to the contaminated area of clothing before removing. Wash contaminated skin thoroughly or shower.

If Liquid SF Is in the Eyes

Flush with plenty of water for at least 20 minutes, and get medical attention. Damage to the eye may result from cold or freezing temperatures.

2

Treatment Manual

Chemical Treatments

Fumigants • Phosphine • Tarpaulin (NAP Chamber or Container)

Contents

Properties and Use **page-2-10-1**
Leak Detection—Gas Analysis **page-2-10-2**
Dosage **page-2-10-2**
Safety Precautions **page-2-10-3**
Storage and Handling **page-2-10-3**
Protective Clothing **page-2-10-4**
Respiratory Protection **page-2-10-4**
Use of SCBA (Self-Contained Breathing Apparatus) **page-2-10-4**
Safety **page-2-10-5**
Disposal of Residue **page-2-10-6**
First Aid Treatment **page-2-10-6**
Bulk Fumigations **page-2-10-6**
Sealing **page-2-10-6**
Probing **page-2-10-6**
Aeration **page-2-10-7**
Container Fumigation **page-2-10-8**
Concentration Readings **page-2-10-9**

Properties and Use

Phosphine (generally abbreviated as PH) may be generated from either aluminum phosphide (AP) or magnesium phosphide (MP).

Aluminum phosphide and magnesium phosphide are available under various trade names (see **page-5-4-28**) as tablets, pellets, prepacs, bags, or plates. For example, each pellet of Phostoxin weighs 0.6 grams and yields approximately 0.2 grams of PH and each tablet weighs 3 g and yields approximately 1 g of PH. Each 34 g bag or sachet of Detia yields 11.4 g of PH. Each plate of Fumi-Cel weighs 117 g, contains 32.3 percent MP and liberates 33 g of PH. A high humidity (40 percent or more) is needed to generate the gas, and temperatures above 40 °F are needed to produce satisfactory results.

In the presence of moisture, phosphine (hydrogen phosphide, PH_3), a colorless gas, is emitted. PH boils at -87.8 °C (-126 °F), is slightly soluble in water, has excellent penetrative power, and has approximately the same density as air. The lower level of flammability is 1.79 percent in air.

Flashpoint is 212 °F. Direct contact with a liquid could cause spontaneous combustion. In case of fire, a CO_2 dry chemical fire extinguisher should be used. *Never use water.* PH has an odor somewhat like garlic, which enables the gas to serve as its own warning agent. However, under some conditions, the odor may be lost, even at high toxic concentrations. Ammonia and carbon dioxide are also produced, which act as fire retardants.

Copper, brass, gold, and silver are severely damaged by PH. Other metals react to some extent, especially in high humidity. Normally, only electrical or electronic equipment (especially the contact points) and some household effects would be affected.

PH is used to control insects found with both plant and animal commodities, especially stored products, throughout the world. The program use of PH for commodities other than cotton, tobacco, and wood products may be limited because of the long exposure periods required compared to other fumigants. For some insects, long exposure to low concentrations is more effective than short exposure to high concentrations. The germination of most seeds does not seem to be affected, even with schedules higher than normally recommended for insecticidal use. Phosphine should not be used for fumigating growing plants, cut flowers and greenery, fresh fruits, or vegetables due to poor tolerance of these commodities. Phosphine is effective against most wood, cotton, tobacco, and grain insects in all stages of development. Phosphine leaves little or no residue. Baking and brewing qualities of treated commodities are unaffected.

Leak Detection—Gas Analysis

Phosphine levels can be detected using either detector tubes or any electronic instrument such as the “Porta-Sens” detector. (See Equipment Section for instructions on how to use the Porta-Sens.) This equipment is used for determining both the high (fumigation concentration) and low (personnel safety) levels of PH. Halide or any flame detectors *are not* to be used for PH. T/C units (e.g., Gow-Mac or fumiscope) cannot be used for this fumigant.

PH is poisonous to man and animals. The threshold limit value for an 8-hour per day exposure is 0.3 ppm. The maximum concentration for a single exposure for animals should not exceed 50 ppm.

Dosage

The dosage rate is usually measured in grams (g) per 1,000 cubic feet or grams per cubic meter and varies with the commodity, treatment temperature, and type of enclosure. However, some schedules may be

based on the weight of grain. Schedules for use against specific pests by commodity are listed in the Domestic Program Manuals or in this manual.

Always follow manufacturer's instructions on the number of pellets, tablets, bags, prepacs, or plates to be placed at one spot. (See **Table 2-10-1**: Amount of Phosphine Liberated by Various Products.)

TABLE 2-10-1: Amount of Phosphine Liberated by Various Products

Calculate amount of product needed by using the amount of phosphine released as shown in the right column.

Product	Type	Unit and weight in grams	Grams of phosphine*
Degesch Fumi-Cel[1]	MP	1 plate; 117.0	33.0
Degesch Fumi-Strip[1]	MP	16 plates; 1872.0	528.0
Degesch Phostoxin[1]	AP	1 tablet; 3.0	1.0
Degesch Phostoxin[1] Tablet Prepac Rope	AP	1 prepac; 99.0 (strip or rope of 33 tablets)	33.0
Detia	AP	1 tablet; 3.0	1.0
Detia Rotox AP	AP	1 pellet; 0.6	0.2
Detia Gas EX-B	AP	1 bag or sachet; 34.0	11.4
Fumiphos tablets	AP	1 tablet; 3.0	1.0
Fumiphos pellets	AP	1 pellet; 0.6	0.2
Fumiphos bags	AP	1 bag; 34.0	11.0
Fumitoxin	AP	1 tablet; 3.0	1.0
Fumitoxin	AP	1 pellet; 0.6	0.2
Fumitoxin	AP	1 bag; 34.0	11.0
Gastoxin	AP	1 tablet; 3.0	1.0
Gastoxin	AP	1 pellet; 0.6	0.2
"L" Fume	AP AP	1 pellet; 0.5 1 pellet; 0.6	0.18 0.22
Phos-Kill	AP	1 tablet; 3.0	1.1
Phos-Kill	AP	1 pellet; 0.6	0.22
Phos-Kill	AP	1 bag; 34.0	12.0

Safety Precautions

Storage and Handling

Although PH is flammable and may ignite when exposed to excessive moisture, the commercial precautions of AP and MP are considered fire-safe and explosion-safe when used in accordance with the

manufacturer's instruction. No more than ten pellets of Phostoxin should be placed in a single envelope which is supplied by the manufacturer. A Fumi-Cel plate should not contact another or the commodity.

Protective Clothing

No protective clothing is necessary when handling prepacs or strips. Use dry cloth gloves when handling tablets, pellets, or dust. Be sure to aerate gloves and contaminated clothing in well-ventilated area prior to laundering. Particularly useful are surgical or disposable thin rubber or polyethylene gloves. Wash hands thoroughly after each use.

Containers of AP and MP should be stored in a cool, dry, locked, ventilated protected area not subject to extremes of temperature. Water must never be allowed to come in contact with AP or MP. Shelf life of unopened containers is virtually unlimited. When a tube or container is first opened, the odor of PH (garlic) and ammonia will be noticeable and a blue flame sometimes occurs. However, the quantity of free PH present within that container should not be considered dangerous.

Respiratory Protection

Use of SCBA (Self-Contained Breathing Apparatus)

The slow evolution of PH from the AP or MP enables the operator to dispense the tablets, pellets, packets, or plates, or pre-pack ropes safely, usually without the need for wearing an SCBA. However, an SCBA unit must be available at all times. The individual opening the chamber or container doors, or initially raising the tarpaulin following fumigation should wear an SCBA. Do not eat or smoke while dispensing AP, MP, or any pesticide, and not until after washing. Wash thoroughly after handling any pesticide. SCBA must be immediately available and must be used by persons who may be exposed to phosphine concentration above the threshold limit value (TLV). Respiratory protection will be worn by the PPQ Officer when within 30 feet of the enclosure under treatment

Threshold limit values for phosphine are as follows:

- Single exposure for continuous daily 8-hour exposure = 0.3 ppm.
- Short term exposure limit (STEL) = 1 ppm or 1 mg/m^3.
- The threshold level of odor to the human nose is considered to range from 0.005 to 0.5 ppm.

Safety

In addition to instructions and precautions found on the label, be certain to:

- Study and follow the recommended application procedure.
- Comply with all regulations.
- Allow only personnel properly trained in the use of phosphine products to conduct fumigations under the monitoring of a certified pesticide applicator.
- Ensure that first aid equipment and information are readily available.
- Check that approved respiratory protection (SCBA) is readily available for each applicator.
- Placard the area to be fumigated and an area extending 30 feet from the fumigation enclosure (or the entire building if less than 30 feet to the walls). Placards must include the name of the chemical, date of the fumigation, and name, address, and telephone number of applicator. See fumigant label for proper wording.
- Always work in pairs, never alone. At least two people trained in the use of the fumigant must be present during the introduction of the fumigant, and the testing and aeration periods.
- Never smoke, eat, or drink while handling phosphine producing materials.
- Always wash hands after handling phosphine materials.
- Never save excess or partially used packets, plates, etc. It cannot and must not be done. Phosphine gas will evolve and constitute a serious safety hazard. Dispose of all opened material following label instructions.
- Remove placards when aeration is complete and concentrations are below the TLV. Only certified pesticide applicators should be used to remove placards.
- Mechanically unload grain treated with phosphine. Dust from the residue may release a small amount of phosphine when particles land on the moist mucous membrane of the nose or mouth.
- Never use phosphine in vacuum fumigation, and never pull a vacuum during chamber aeration. This compound is unstable at reduced pressure that can occur during aeration.

Disposal of Residue

Following treatment with AP, a powdery residue, essentially aluminum hydroxide, will remain in the envelope. This material should be collected and mixed in a container of water to which liquid detergent has been added (2 tablespoons of detergent per gallon of water). The liquid should then be buried or deposited in an approved pesticide disposal landfill.

Following treatment with MP, the plates may be disposed of by burial in an approved landfill or by burning where approved by local ordinances.

First Aid Treatment

Immediate warning signs resulting from exposure to high concentration of PH include nausea, vomiting, and diarrhea. Progressive signs include vertigo, chest pains, dry cough, choking, intense thirst, enlarged pupils, and possible coma. Get the victim to fresh air, treat for shock, and ***call a physician.***

Bulk Fumigations

Important

Refer to the section for tarpaulin fumigation with methyl bromide for additional information on the following:

- selecting fumigation sites
- placing gas sampling tubes
- sealing tarpaulins
- taking concentration readings
- securing fumigation areas

Sealing

Make the fumigation enclosure as gas tight as possible. Phosphine can penetrate polyethylene tarpaulins at a very low rate; 4-mil tarpaulins can be used only once; 6-mil tarpaulins should be used whenever possible.

Probing

When large quantities of grain or other commodity in bulk are to be treated, it will be necessary to “probe” tablets or pellets into the mass of the commodity for adequate distribution. Specially constructed probes made of steel tubing 1 1/4 inch in diameter are generally available as described below:

- **Head Piece—**Dosing device and numerical counter to indicate number of tablets used.
- **Tubing—**Usually in 3-foot sections, which can be added to one another to provide the desired length.
- **End Piece—**Cut obliquely and provided with a hinged flap, closing the entrance to the tube. When the tube is inserted into the commodity, the flap is closed and prevents the commodity from entering. When the probe is withdrawn, the flap opens due to the slightly larger diameter on the flap. The tablets or pellets are then released one at a time as the probe is withdrawn.

Grain or other bulk or loose commodities up to 30 feet deep can be probed. Best results are obtained by probing twice every square foot and as regularly as possible. Penetration of phosphine is up to 10 feet below the area in which the tablets are placed. When large bulk grain stores are treated, many probes may be placed prior to treatment. One head piece can be moved from probe to probe, or pellets or tablets can be placed in the tubes by hand (use surgical or disposable thin rubber or polyethylene gloves).

Gas generation starts within 4 hours of placement of the pellets or tablets (depending on relative humidity). Therefore, the whole procedure of pellet or tablet placement or tarpaulin covering must be accomplished within this time frame. It is possible to work in a probed area if the area is covered with a gas-proof tarpaulin. Special care should be taken to monitor gas concentrations to determine if toxic levels are approached and corrective action taken to prevent exposure.

If it is known ahead of time that grain or cottonseed will require treatment prior to placement in a means of conveyance or storage, the space should be sealed properly before loading. Tarpaulins of at least 6-mil thickness should be used if walls are permeable since lighter tarpaulins may tear. As the material is loaded, tablets or pellets can be metered into the bulk stream for even distribution of fumigant.

If a bulk shipment is in a large storage facility which has a high roof, it may be better to tarp on top of the grain rather than seal the roof. When side walls of the facility are not gas-impervious, tarpaulins can be placed around the outside of the facility to the height of the commodity. Again, 6-mil tarpaulins are preferred, since windy conditions can easily tear lighter gauge tarpaulins off the building.

Aeration

Phosphine treated commodities must be aerated using either electric exhaust fans or by passive aeration in the open air following completion of treatment. Personnel must not be allowed to reenter

fumigated areas until gas concentrations are determined to be below the Threshold Limit Value's (TLV's) measured with a sensitive gas detection device.

Boxcars require little or no aeration after a 5-day treatment, but phosphine concentration must be measured and personnel not allowed entry until readings are below the TLV.

Container Fumigation

In all container fumigations, it is recommended that the container be covered with a gas impervious tarpaulin following the usual tarpaulin fumigation procedures.

For new containers (5 years old or less), the use of a tarpaulin is not an absolute requirement if all vents can be sealed off. The age of the container is usually shown in a metal decal on one of the rear doors. Any container with obvious dents, punctures, nail holes, or parallel floor boards will require a tarpaulin. Any untarped containers, at the very least, must have their rear doors thoroughly taped at all four edges.

Important

A relative humidity of at least 40% and an air temperature above 40 °F will produce satisfactory results for a phosphine fumigation.

If a gas tight enclosure can be assured for the fumigation, the following procedures may be used:

- Close and secure one of the doors. Seal all openings and joints. If possible, caulk all joints and drape entire doorway with polyethylene sheeting, securing the edges to the inner walls, floor, and ceiling with masking tape.
- Inspect the roof, floor, and walls for holes and/or cracks. Seal all openings with either masking tape or caulking compound. Containers require close inspection and a great deal of sealing to insure against leakage.
- Place half of the required packets or plates on each of two pieces of heavy cardboard, spacing them at least 1 inch apart with no overlap. Tape packets to board across both ends of the packet. *Do not* tape across middle of the packet. *Do not* exceed label dosage. Plates and packets must never be subdivided to reduce the amount of phosphine. Plates must never touch each other.

- Take prepared boards into the container and secure one board in each end, bag side up to the load. If load is covered with paper, secure cardboard to paper. As an alternative, boards may be securely nailed to the wall.
- If possible, drape remaining doorway with polyethylene film before door is closed. Secure edges to door jams and floor. Close door and secure. If doorway is draped with polyethylene, it may not be necessary to seal the door from the outside. If doorway is not draped, seal all cracks, openings, and joints with masking tape and/or caulking compound from outside.
- Placard all doors of the container with the appropriate warnings.

Concentration Readings

The officer will take readings at the time indicated in the particular fumigation schedule using sampling tubes appropriate for the phosphine levels to be measured, or by using an electrochemical device approved by the Center for Plant Health & Technology (CPHST) in Raleigh, North Carolina.

Refer to the section for tarpaulin fumigation with methyl bromide for additional information on the following:

- selected fumigation sites
- placing gas sampling tubes
- sealing tarpaulins
- taking concentration readings
- securing fumigation areas

2

Treatment Manual

Chemical Treatments

Aerosols and Micronized Dusts

Contents

Introduction **page-2-11-1**
Aerosols **page-2-11-1**
Micronized Dusts **page-2-11-2**
Cartridges **page-2-11-2**
Equipment **page-2-11-2**
Methods and Procedures for Application **page-2-11-2**
Treatment of Passenger Compartments and Cargo Aircraft **page-2-11-2**
Treatment of Separate Cargo Compartments and Containerized or Palletized Cargo **page-2-11-3**
Precautions for Both Aerosols and Micronized Dusts **page-2-11-4**
Precautions in Use of CO_2 Fire Extinguishers **page-2-11-4**

Introduction

This section includes information about aerosols and micronized dusts. Use this information with the T409 series of treatments, and with Table 5-5-1: Determine the Amount of Aerosol, to conduct a safe and effective aerosol disinfestation.

Aerosols

When applying an aerosol, the dispenser nozzle(s) should be directed upward at an angle of 45 ° and moved from side to side in order to get uniform distribution of the material. During discharge, the dispensing valve should be depressed fully, and the nozzle held 45 cm (18 inches) or more from all surfaces. Devices are available for depressing the valve and expending all the aerosol in the can or a trigger mechanism for ease in dispensing the material. Aerosol dosages are based on a dispensing rate of 1 g per second, unless otherwise noted. The applicator should use a dust mask, or face mask (with filter) for personal protection. The PPQ quarantine dosage shall not be applied in the presence of passengers, crew, or animals, except as noted in the schedules.

Micronized Dusts

Both domestic and foreign quarantine programs use dust to kill pests such as the Japanese beetle and pests of foreign origin. This method may be used in treating aircraft, railroad cars, trucks, and palletized or containerized cargo. Specific instructions for domestic quarantine use are included in Program Manuals.

Cartridges

Prefilled cartridges are used (available as follows: green–1 g; yellow–3 g; red–5 g; and blue–13 g). Combinations of these sizes will give the correct amount and the dust may be combined into a single cartridge to reduce the number of individual “shots” required. Care must be taken in combining the material to insure no exposure to the dust occurs through dermal contact or inhalation.

Store filled pesticide cartridges in a cool, dry, protected location. Damaged cartridges and empty cartridges should be disposed of by placing them in refuse containers in accordance with recommendations for the safe disposal of pesticide containers. When treating aircraft, refer to T409 of this manual which lists the cubic capacity and application schedules for most commercial and military aircraft. Do not deduct the space occupied by cargo in computing the required treatment rate.

Equipment

Compressed CO_2 or compressed air is used to expel the dust. A modified CO_2 fire extinguisher with a standard release valve may be used. The 10-pound CO_2 capacity extinguisher, which weighs 35 to 40 pounds when full, is convenient and safe for use. Sufficient gas for 25 to 30 releases is contained in this size. Smaller modified extinguishers are also satisfactory. Compressed air units must be specifically designed for expelling dust and are not readily available.

Specifically developed micronized dust guns with proper connections may be available through the Program Support Staff in Riverdale, MD.

Methods and Procedures for Application

Treatment of Passenger Compartments and Cargo Aircraft

All entry doors and other openings should be closed and all ventilation systems stopped before discharge of dust. The door to the pilot’s compartment must be closed. On aircraft with a baggage compartment immediately behind the pilot’s and no door to separate these compartments, place a screen of plastic or other suitable material

between the baggage compartment and the pilot's compartment. Galleys shall be closed off by means of doors or a screen of plastic, etc., which will prevent the entry of the pesticide.

The single nozzle gun recoils or kicks back when discharged. Therefore, it must be held firmly with one hand while the other hand is used to trigger the release of the CO_2. Keep the host between the extinguisher and the gun as straight as possible to reduce kickback. A position should be taken much like that used when firing a large caliber pistol. Rest the bottom of the gun on a solid object if possible. Kneeling on one knee may be necessary if the host to gun is short. A 1-second blast is sufficient. The discharge nozzle should be directed above the top of the seats or cargo to assure unimpeded flow of the dust cloud from the release point.

On smaller types of aircraft, stand behind the first seat to discharge the dust. Leave the aircraft immediately after release; close the door quickly to avoid disturbing proper dust distribution.

In larger aircraft, discharge the dust from the front behind the pilot's compartment or from the rear depending on location of exit doors. Remain in the craft only long enough for the dust cloud to appear to have reached the other end of the craft—about 1 minute. The dust cloud may not return from the opposite end of the large aircraft. Judgment should be used by the inspector as to the best location for firing if partitions are present.

A recently designed gun has two nozzles facing in opposite directions. Since the gas and dust are expelled from both nozzles, no "kick" results. The operator should stand in the middle of the large compartment when firing the charge.

After dust has been discharged, the officer will leave the aircraft, close the door, and hold the aircraft closed for 10 minutes.

Unless responsible personnel remain near the craft to prevent inadvertent entry by others, place a treatment notice, PPQ Form 468, on the entry door. Cargo or passenger area ventilation systems shall not be in operation during the application and settling periods. After a 15-minute aeration period, the aircraft may be reentered.

Treatment of Separate Cargo Compartments and Containerized or Palletized Cargo

Cargo compartments in bellies of aircraft will be treated by opening the doors sufficiently to insert the applicator nozzle. After firing, close the door quickly and do not open for at least 10 minutes. Treatment of such compartments may require two people, one to operate the doors

and the other to operate the gun. Containerized cargo is treated by lifting the cover or otherwise inserting the nozzle in the container. After discharge, the cover should be quickly closed.

Precautions for Both Aerosols and Micronized Dusts

1. Treatment shall not be applied when animals or people are present.
2. Food should be removed or covered prior to treatment.
3. Food preparation surfaces and equipment shall be covered to prevent contamination.
4. A suitable respirator, approved by the National Institute of Safety and Health shall be worn by the person applying the pesticide. **EXCEPTION:** A respirator is not required when the pesticide label or this manual specifies that use in the presence of people is acceptable.
5. Goggles are optional equipment and should be worn if the person applying the pesticide experiences any eye irritation.
6. Do not smoke or eat during application and not until after washing. Wash as soon as possible after application of pesticides.
7. Any pesticide residue noted on smooth surfaces after treatment should be wiped away using a clean damp cloth. (If a deposit of dust is noted on the floor immediately after discharge, a blast of compressed air or CO_2 will usually clear the area.)

Precautions in Use of CO_2 Fire Extinguishers

1. Discharging CO_2 chills metal and can cause freezing injury to bare hands. Do not touch the nozzle immediately after discharge. It may be advantageous to wear a glove on the gun hand if several discharges are to be made in close succession. Do not hold the release valve open longer than necessary to expel the dust (about a second).
2. Replace the safety pin in the CO_2 tank valve after each use and secure with wire or tape. Accidental release could result in severe injury.
3. Keep the face away from openings when applying material in a luggage compartment or to containerized cargo to avoid dust backlash.

4. Check the flexible hose between the CO_2 tank and dust gun. Pay particular attention to the areas near the connections. Replace the host when it shows wear.

2

Treatment Manual

Chemical Treatments

Dips

Contents

Overview **page-2-12-1**
Safety and Dip Treatment Equipment and Materials **page-2-12-1**
Dip Treatment Procedures **page-2-12-3**
- Step 1—Plan for the Dip Treatment **page-2-12-3**
- Step 2—Designate Restricted Use Areas **page-2-12-3**
- Step 3—Prepare Plant Material **page-2-12-3**
- Step 4—Prepare the Pesticide Solution **page-2-12-3**
- Step 5—Dip the Plants in the Pesticide Solution **page-2-12-4**
- Step 6—Remove the Plants from the Pesticide Solution **page-2-12-4**
- Step 7—Dry the Plants **page-2-12-4**
- Step 8—Disinfect Original Shipping Containers **page-2-12-4**
- Step 9—Clean Up the Treatment Area and Equipment **page-2-12-5**
- Step 10—Release the Cargo **page-2-12-5**

Safety Responsibilities **page-2-12-5**

Overview

As with other treatments, chemical dips require careful planning and preparation. Make sure you have all the necessary safety and treatment equipment and materials ready before you start the dip treatment procedure. When you handle pesticides, always comply with the pesticide Label instructions, and State and local regulations.

Safety and Dip Treatment Equipment and Materials

The following lists include safety equipment (Personal Protective Equipment, PPE) and basic material that you will need for dip treatments. However, other materials may be required by additional Label requirements that are specific to chemical being used.

Personal Protective Equipment (PPE)

Always check the Label and Material Safety and Data Sheet (MSDS) for additional requirements of personal protective equipment. The following is a basic list of PPE that you will need for dip treatments:

- protective eye wear (goggles)
- chemical resistant headgear for overhead exposure
- chemical resistant rain suit with hood
- chemical resistant footwear (rubber or neoprene boots)

- chemical resistant gloves (neoprene)
- respirator (per Label and MSDS requirements)

Dip Treatment Equipment and Materials

Always check the Label for additional requirements for equipment and materials. The following is a basic list of equipment and materials you will need for dip treatments:

- Newspaper or any other absorbent paper

Important

Place plastic backed paper on pallets prior to covering with paper and/or absorbent paper to preclude the pesticide being absorbed onto the wood.

- Pesticides

Important

Pesticides should be fresh (not over 1 year old). Labels and MSDS must be attached to the pesticide container and all instructions must be followed.

- Mixing containers and dipping containers must be provided with lids to prevent spills during transportation and storage.
- New boxes (when reconditioning or excess contamination of original boxes is not possible)
- Fans[1]

Important

A mechanical exhaust is the preferred method of aeration when it is specifically installed to remove chemical fumes from the treatment area. Fans may be used if they do not cause airborne pesticides to contaminate the treatment facility or the breathable air. The flow of air should be across the dip vat/container and away from people in the treatment area.

- Pallets[1]

Important

Place plastic backed paper on pallets prior to covering with paper and/or absorbent paper to preclude the pesticide being absorbed onto the wood.

- Plastic bags (4 to 6 mil plastic)[1]
- Shear scissors
- Sponges
- Liquid soap[2]

1 This equipment will be provided by USDA when available.

- Packing material[1]

Dip Treatment Procedures

Step 1—Plan for the Dip Treatment

Before you start the dip treatment, inform the customer (Broker/ Importer) of the specific material and personal protective equipment (PPE) that will be needed to perform the dip treatment procedure. All required materials and equipment must be available at the time of treatment.

Step 2—Designate Restricted Use Areas

Designate the following restricted use areas:

- **Measuring and mixing area-** The measuring and mixing area for the specific pesticide(s) must be in a well ventilated area away from food preparation, eating areas, and offices. Areas that contain mechanical exhaust systems are preferred.
- **Plant Material Dipping Area-** The plant material dipping area must be an area where access is limited by a barricade or warning signs. Areas that contain mechanical exhaust systems are preferred.
- **Plant Material Drying Area-** The plant material drying area must have proper air circulation and exhaust ventilation. These areas should be closed to the dipping area. The route from the plant dripping area to the drying area should be lined with plastic backed absorbent paper or plastic and paper to catch excess pesticide solution.

Step 3—Prepare Plant Material

Prepare the plant material for the dip treatment according to the PPQ Treatment Manual and pesticide Label requirements.

Step 4—Prepare the Pesticide Solution

CAUTION

Wear personal protective equipment (PPQ) and keep the exhaust system running when you are preparing pesticide solutions. To minimize your exposure to the pesticide dust or airborne particles, keep the pesticide between you and the exhaust.

1. Measure the amount of water required for the treatment

2 This equipment will be provided by USDA when available.

2. Measure the amount of pesticide required for the treatment

Important

It is important to use fresh chemicals for every solution. If questions arise during this procedure, stop and seek assistance from the Center for Plant Health Science & Technology (CPHST) (Tel: 919-513-2496)

3. Prepare a pesticide paste as follows:
   - **A.** Add the previously measured amount of water into a clean and empty container, for example, an empty can or plastic container.
   - **B.** Form a paste (with dry pesticides) by adding the measured pesticide to the small amount of water and mix gently
   - **C.** Dilute the paste by slowly adding more water from the previously measured water
   - **D.** Slowly add the concentrated solution(s) to the rest of the measured water
4. Add some drops of liquid soap to the solution (soap is used as a sticking agent)
5. Mix the final solution by stirring it gently

Step 5—Dip the Plants in the Pesticide Solution

Dip the plants in the solution for the time required by the PPQ Treatment Manual.

Step 6—Remove the Plants from the Pesticide Solution

Remove the plants from the solution and allow excess solution to drip into the dipping container.

Step 7—Dry the Plants

Place the plants on newspaper covered pallets and allow them to dry (make sure to space the plants out for maximum drying).

CAUTION

Plants should be dried thoroughly before releasing them to the customer.

Step 8—Disinfect Original Shipping Containers

Disinfect the original shipping containers with a sponge containing the pesticide solution. The plant material may be packed with new packing material in a previously used container that has been disinfected.

Step 9—Clean Up the Treatment Area and Equipment

Discard all empty containers, excess pesticides, packing materials, plastic bags/backing materials, and newspaper/absorbent paper in compliance with instructions on the Label and State/Local regulations. Decontaminate all treatment areas and equipment while you are wearing your PPE.

Step 10—Release the Cargo

After the plant material is dry, release it to the customer or broker if agreed to by the airline and if it has been released by Customs.

Safety Responsibilities

The PPQ Officer is responsible for the following safety issues:

- Make the broker/importer aware of their responsibilities as it pertains to:
  - materials
  - Personal Protective Equipment (PPE)
  - health hazard and safety concerns when performing the dip treatment process
- All personnel involved in the dip treatment process are required to wear the appropriate and Label required PPE while performing the treatment. PPQ Officers may need to wear PPE if the dip treatment process area prevents them from observing the process from outside the restricted area.
- Designated dip treatment process areas must be located away from food preparation, eating areas, and offices. Al efforts should be made to place dip treatment processes in an area containing a mechanical exhaust.
- The broker/importer personnel involved with treatments must be aware and briefed on the location of the emergency eyewash and all other required safety equipment. They also need ti be aware of the areas that they will be limited to working within and any other specific restrictions determined by the PPQ Officer in charge of the process. The PPQ Officer monitoring the process should be aware of procedures to be followed in the event of an accidental release of the pesticide or an injury to one of the broker/importer's personnel.
- The broker/importer's personnel should shower as soon as possible after performing a dip treatment. The PPQ Officer should ensure that personnel are aware of the location and route to the shower. Guidance should also include instruction on how to disrobe and dispose of clothing used during dip treatment

processes. All contaminated clothing and PPE must be removed before entering the shower room. Contaminated clothing should be placed in plastic bags and PPE in Separate plastic bags.

- Broker/importer personnel should be informed that clothes wore during treatment must be washed in hot water with detergent and that they should be washed separately from other clothes
- The plant material should be released to the Broker/importer only if they are using/provide a vehicle that has a compartment physically separated from the cab, for example, a pick-up truck of tractor trailer.

2

Treatment Manual

Chemical Treatments

Dusts

Contents

This Section for Future Development.

2

Treatment Manual

Chemical Treatments

Sprays

Contents

This Section for Future Development.

3

Treatment Manual

Nonchemical Treatments

Overview

Contents

Overview **page-3-1-1**
Heat **page-3-2-1**
Cold Treatment (CT) **page-3-7-1**
Irradiation **page-3-8-1**

The Nonchemical Treatment section of this manual is organized by the following nonchemical categories:

- Heat
- Cold
- Irradiation

Use the Table of Contents that follows each tab to quickly find the information you need. If the Table of Contents is not specific enough, then turn to the Index to find the topic and its page number.

3

Treatment Manual

Nonchemical Treatments

Heat

Contents

Introduction **page-3-2-1**
Heat • Hot Water Immersion Treatment **page-3-3-1**
Heat • Steam Treatments **page-3-4-1**
Heat • Vapor Heat Treatment **page-3-5-1**
Heat • Forced Hot Air **page-3-6-1**

Introduction

Heat treatments are generally based on maintaining the plant material at a specific temperature for a specified time. Heat treatments, as other quarantine treatments, are designed to kill plant pests without destroying or appreciably devaluing the infested commodity. The following heat treatments are described in this section:

- Hot Water Immersion Treatment
- Steam Treatments
- Vapor Heat Treatment
- Forced Hot Air

3

Treatment Manual

Nonchemical Treatments

Heat • Hot Water Immersion Treatment

Contents

Hot Water Immersion Treatment (in General) **page-3-3-2**
- Principle **page-3-3-2**
- Schedules **page-3-3-2**
- Procedures **page-3-3-2**

Checklist Of USDA-APHIS Minimum Requirements for Hot Water Immersion Treatment Facilities: General Requirements **page-3-3-3**
- Submission of proposals **page-3-3-3**
- On site inspection option **page-3-3-3**
- Design of the facility **page-3-3-3**

Electrical and Electronic Components **page-3-3-5**
- Wiring **page-3-3-5**
- Computers and microprocessors **page-3-3-5**
- Commercial line conditioner (surge protector) **page-3-3-5**
- Electrical generator **page-3-3-5**

Boilers and Thermostatic Controls **page-3-3-6**
- Adequate water heating capacity **page-3-3-6**
- Thermostatic controls (set point) **page-3-3-6**
- Multiple set point option **page-3-3-6**

Water Circulation **page-3-3-7**

Temperature Sensors **page-3-3-7**
- Type of sensor **page-3-3-7**
- Number of sensors required, and their placement **page-3-3-7**
- Tank access for temporary placement of portable sensors **page-3-3-8**
- Certified glass-mercury thermometer **page-3-3-8**

Temperature Recorder **page-3-3-8**
- Automatic operation **page-3-3-8**
- Long-term recording **page-3-3-8**
- Recording frequency **page-3-3-8**
- Accuracy **page-3-3-9**
- Repeatability **page-3-3-9**
- Calibration **page-3-3-9**
- Range **page-3-3-9**
- APHIS-approved recorder models **page-3-3-9**
- Approved strip chart (pen) recorder models **page-3-3-10**
- Approved data logger recorder models **page-3-3-10**
- Chart paper specifications: **page-3-3-11**

Alarm System **page-3-3-12**

Safeguarding the Treated Fruit **page-3-3-12**
- Layout and flow pattern **page-3-3-12**
- Garbage disposal **page-3-3-12**
- Quarantine area **page-3-3-12**

Pre-treatment Warming Options **page-3-3-13**
- Treatment Tank **page-3-3-13**

Separate tank **page-3-3-13**
Heated air **page-3-3-14**
Heated room **page-3-3-14**
Direct sunlight **page-3-3-14**
Post-treatment Cooling Options **page-3-3-14**
Refrigerated room **page-3-3-14**
Fans **page-3-3-14**
Hydrocooling **page-3-3-14**
Changes **page-3-3-15**
Safety and Health Checklist **page-3-3-15**
Work Plan **page-3-3-16**
Start-up Costs and Resources **page-3-3-16**

Hot Water Immersion Treatment (in General)

Principle

Hot water immersion treatment (also called hydrothermal treatment) uses heated water to raise the temperature of the commodity to the required temperature for a specified period of time. This is used primarily for certain fruits that are hosts of fruit flies, but may also be used for nursery stock for a variety of pests.

Schedules

Refer to the appropriate section in the Treatment Manual for treatment schedules. The time-temperature relationship varies with the commodity and pest. Typically, the pulp temperature is raised using water heated to between 115 and 118 °F for a prescribed period of time.

Procedures

All treatments will be conducted in an approved tank.

The facility will be checked for proper operation of the heating, circulation, and recording equipment before the start of each treatment. Continuous flow equipment (submerged conveyor belt) will be checked at the start of each day or run.

Commodity will not be refrigerated before treatment, and must be at or above the prescribed minimum temperature if specified in the treatment schedule.

Commodities subject to size restrictions require a preliminary culling procedure to eliminate oversized items prior to treatment.

Immersion tanks will be loaded in a manner approved by the U.S. Department of Agriculture (USDA), usually using baskets with perforations that allow adequate water circulation and heat exchange.

Each treatment container or lot shall be given an identifying number before bring placed in the immersion tank.

An automatic temperature recording system shall record the temperature and duration of each hot water dip. A responsible employee of the packing company shall indicate on the printed temperature record the starting time, lot number, duration of each treatment and initial each entry. An alternative recording system may be used only with prior APHIS approval.

All boxes of hot water treated fruit will be stamped *Treated with Hot Water, APHIS-USDA,* together with the numerical designation that APHIS has assigned to the particular treatment facility.

Commodities treated at origin will be moved to an insect free enclosure promptly after treatment and maintained insect-free throughout the shipping process. This may be accomplished by using insect-proof containers, screened or enclosed rooms, doors with air-curtains, or some combination of these.

The entire treatment shall be under the general monitoring of APHIS, and may be further governed by a signed Work Plan (for foreign facilities) or Compliance Agreement (for domestic facilities).

Checklist Of USDA-APHIS Minimum Requirements for Hot Water Immersion Treatment Facilities: General Requirements

Submission of proposals

In submitting proposals for new hot water facilities, the accepted protocol must be followed. (Under Certifying Facilities," see the discussion under "Certification of How Water Immersion Facilities - Protocols for Foreign Treatment Facilities.")

On site inspection option

When the construction is 75% completed, the firm may request APHIS to make an on-site inspection. This interim inspection is optional. However, a final inspection is required as well as performance tests of the equipment. All costs involved must be prepaid by the requesting firm.

Design of the facility

APHIS does not provide construction details, but only this checklist of minimum requirements. Design and construction of the hot water facility is the responsibility of the owner, in consultation with an engineering firm. (Engineering firms and sources of supply are

provided in Appendix B.) APHIS allows a wide range of design flexibility, to take into account variations in facility size, availability of materials, economic feasibility, and individual preference.

There are two basic designs for hot water facilities, although each facility is somewhat unique. The two types are referred to as the *batch system* and the *continuous flow system.*

Batch system (sometimes called "Jacuzzi system")

Most hot water immersion treatment facilities are of this type. In this system, baskets of fruit are loaded onto a platform, which is then lowered into the hot water immersion tank, where the fruit remain at the prescribed temperature for a certain length of time, then are taken out, usually by means of an overhead hoist. In this system, the treatment chart must indicate (by an identifiable marking) when a fruit basket is prematurely removed from the tank. Other alternatives include a solenoid switch, sensor or similar device that disengages whenever a basket is removed from the treatment tank, or a locking device to make it physically impossible to remove the fruit until the treatment is fully completed.

Continuous flow system

In this type of system, the fruit are submerged (either loosely or in wire or plastic mesh baskets) on a conveyor belt, which moves slowly from one end of the hot water tank to the other. Belt speed is set to insure that the fruits are submerged for the required length of time. This system requires an instrument to monitor the speed of the conveyor belt. This can be accomplished by attaching a speed indicator (encoder) to the gear mechanism. The belt speed is recorded on the same chart as the time and temperature, and also indicates whether the belt is moving or stopped during the treatment cycle. Smaller fruits require less treatment time than larger fruits. Therefore, conveyor belt speed should be adjustable to accommodate treatments of different lengths of time. As an alternative, the belt speed may remain constant, but the length of the submerged portion of the belt is adjusted according to the length of treatment time required for the particular size of fruit. The conveyor must prohibit either forward or backward movement of the fruit during treatment (due to flotation).

Some operators believe that treating fruit while it passes through the system on a conveyor belt is an advantage. Few new systems of this type were built after 1990, presumably because mechanical fruit damage (scratching of the peel) often occurs. if the fruit are not in baskets. The system also occupies much more floor space in the plant than a batch system.

Water Quality

Prevention of microbial contamination of fruit at the plant is expected. Any water used for washing, dipping, or showering the fruit should be chlorinated, and maintained at a level of 50 to 200 ppm parts per million. Also, hydrocooling tanks must be chlorinated to the same level. This level is easier to maintain if the water is first filtered and run through a flocculation process to remove organic material which

would otherwise bind with the chlorine. Water should be sampled regularly for microbial contamination. Water should be changed, as necessary, to maintain sanitary conditions. Standard operating procedures should be implemented to include water change schedules for all processes that use water. In addition, surfaces that come into contact with water, such as wash tanks, hot water tanks, and hydro cooling tanks should be cleaned and sanitized as often as necessary to ensure the safety of the produce. Equipment designed to assist in maintaining water quality, such as chlorine injectors, filtration systems and back flow device's, should be routinely inspected and maintained to ensure efficient operation.

CAUTION

Periodic monitoring is critical, because chlorine levels above 300 ppm may result in metal corrosion

Electrical and Electronic Components

Wiring

Electrical wiring throughout the facility must meet both international as well as local safety code requirements. Earth grounding is required for all electrical wiring located in the vicinity of water, to eliminate shock hazard. Wires must be shielded inside metal or PVC conduit to prevent damage.

Computers and microprocessors

These shall be located in a climate-controlled (air-conditioned) room, to maintain accuracy and reliability. This room shall be raised above tank level, and provide a clear view of the treatment tank(s), and be capable of being locked. This room may also serve as an office for the inspector.

Commercial line conditioner (surge protector)

This is recommended for use with computers and microprocessors, to provide protection from voltage irregularity (power surges), noise reduction, and harmonic distortion.

Electrical generator

This is recommended for use as a back-up power supply, in the event of a power outage, to provide a secondary source of electricity to enable continued operation of the plant.

Fruit Sizing Equipment

In the treatment schedule, the duration of hot water immersion depends upon the particular weight class of the fruit being processed. It is very important to have accurate sizing equipment that sorts the

fruit into groups, either by diameter or by weight. (Weight sorting is the preferred method.) Not more than 10% of the fruit in any batch are allowed to weigh more than the maximum weight for their particular weight class. Of these, none are allowed to be more than 25 grams over weight. The APHIS inspector shall periodically record the weights of 100 fruits in a particular batch that has been sorted prior to treatment to be sure that the accuracy of the sizing equipment stays within these parameters. If the weight range is too broad, some calibration adjustment will be required on the equipment. Since it is possible for the immature stages of fruit flies to survive in fruit that are under-treated for their weight, it is especially important to assure that all fruits are sorted accurately into precise weight classes, as required by the treatment.

Boilers and Thermostatic Controls

Adequate water heating capacity

The hot water facility must have adequate water heating capacity (i.e., a boiler powerful enough), and thermostatic controls accurate enough to hold the water temperature at or above the temperatures prescribed in the treatment schedule for the given duration of time. A boiler used for the purpose of heating the water in a two-tank batch system typically needs an output rating of approximately 1,000,00 BTU, or 30 horsepower.

Thermostatic controls (set point)

APHIS requires that the thermostatic controls should be automatic. The temperature set point(s) will be determined and approved during the official performance test, and shall be high enough to ensure that the water in the treatment tank will meet or exceed minimum treatment temperature prescribed for the fruit. Once approved, the temperature set points may not be tampered with. Temperature set points shall remain constant for the entire shipping season. However, if the operator of the facility requests a change in set points, the inspector shall conduct a new performance test. If this test is unsuccessful, then the tanks shall revert to using their prior set points.

Multiple set point option

Managers of some facilities prefer to use two set points for each tank. In this type of system the initial dip temperature (set point no. 1) is set slightly higher for the first 5 minutes. The second set point is the temperature to be maintained for the remainder of the treatment. This must be verified during the official performance test, and the same procedure must be repeated on each subsequent commercial treatment. The use of two set points is not required. However, this

arrangement makes it makes it easier for the tank to pass its performance test. This system works only for tanks that treat only one cage (basket) of fruit (basket) of fruit at a time.

Important

Tanks are not allowed to have any set point that is lower than the standard treatment temperature for the commodity being treated (115 °F in the case of mangoes).

Water Circulation

A water circulation system shall be installed in the tank, to provide uniform water temperatures throughout the treatment process and avoid the formation of cool pockets during treatment. The controls for the circulation pumps or propellers shall be tamper-resistant, to guarantee that the equipment is not turned off during the treatment process. Pulleys on all pumps located within 6 feet of the floor shall be shielded for the safety of personnel working in the area.

Temperatures recorded from the various sensors shall not vary by more than 1.8 °F (1 °C) at any given time after the fruit have been immersed for the first 5 minutes of treatment.

The fruit must be kept at least 4 inches (10.2 cm) below the water surface during the treatment, by use of a flotation barrier.

Temperature Sensors

Type of sensor

Platinum 100-ohm resistive thermal detectors (RTD sensors) are to be installed permanently in the lower third of the tank. The resistance of an RTD sensor changes linearly with temperature, whereas thermisters and thermocouples are non-linear, and less stable. Major advantages of RTD's include long-term stability, high signal levels, and overall accuracy of the system. The sensor unit shall be located within the distal one inch (2.54 cm) of the sensor rod. The sensor shall have an outer sheath of 0.25 inch (6.4 mm) in diameter or less.

Number of sensors required, and their placement

The minimum number required shall at least 10 per tank for continuous flow systems, which must be spaced throughout the length of the conveyor. For batch systems, the requirement is at least two sensors per tank. However, in tanks that treat multiple baskets (cages) of fruit there must be at least one sensor per basket position.

(A tank with 4 basket positions, for example, would require at least 4 sensors). In both the batch and continuous flow systems, sensors shall be installed in the lower third of the tank.

Tank access for temporary placement of portable sensors

The hot water tank must be designed to accommodate the temporary placement of numerous portable sensors or probes to be used during the performance testing procedure required for certification or re-certification. During the testing procedure, the temporary sensors shall be positioned throughout the load of fruit, at the direction of the inspector who conducts the performance test. The facility is required to purchase and have available, 24 portable thermistor or thermocouple sensors (each with its own flexible cord at least 10 ft. in length), and a portable temperature monitor which reads to the nearest one tenth of a degree.

Certified glass-mercury thermometer

The treatment facility is required to have at least one high-accuracy, water-immersible, certified glass-mercury stick thermometer on the premises at all times. This thermometer shall be accurate to 0.1 °F (or C), and will cover the range between 113 °F and 118 °F. It will be used as the standard against which all sensors are calibrated. Normally, one glass thermometer is left hanging in each tank during the performance testing procedure.

Temperature Recorder

An automatic temperature recorder (strip chart or data logger) shall be used to record the time and temperature during each treatment.

Automatic operation

The instrument used for recording the time and temperature must be capable of automatic operation whenever the hot water treatment system is activated.

Long-term recording

The recording equipment must be capable of non-stop recording for an extended period of time. Continuous flow systems require recording equipment capable of operating for up to twelve consecutive hours.

Recording frequency

The time interval between prints will be no less than once every two minutes. Alternatively, a strip chart system may be used which gives continuous color pen lines. The numerical print or pen line

representing each temperature channel (sensor) must be uniquely identified by color, number, or symbol. It is not necessary to record temperatures from sensors located in portions of the tank not in use.

Accuracy

The combined accuracy of the entire temperature recording system (i.e., sensors, controllers and recorders) must be within 0.5 °F (0.3 °C) of the true temperature (as verified by a certified glass mercury thermometer).

Repeatability

The recording equipment must be capable of repeatability to within 0.1 °F of the true calibrated readings when used under field conditions over an extended period of time. Failure to maintain reliability, accuracy and readability in a previously approved instrument will result in cancellation of approval. The design construction and materials used shall be such that the typical environmental conditions (including vibration) will not affect performance.

Calibration

Channels (sensors) must be individually calibrated against a certified glass mercury thermometer reading in tenths of a degree F or C, within the range of 113 °F to 118 °F, (45 °to 47.8 °C). The engineering firm that installs the recording equipment shall also calibrate it. (Calibration equipment often used for this purpose includes, for example, a Decade instrument and relay range cards.) The calibration procedure should be done at or near the fruit-treatment temperature (around115 °F), but not at 32 °F.

Range

The recorder must be programmed to cover the entire range between 113 °F to 118 °F (45 ° to 47.8 °C), with a resolution of one-tenth of a degree. The range should not extend below 100 °F (37.8 °C) nor above 130 °F (54.4 °C). If the range band of the recorder is wider than this, it must be restricted (narrowed) by proper programming.

APHIS-approved recorder models

Some recorder models currently on the market are not approved by APHIS for various reasons. For example, they only display the sensor numbers and temperatures without making a print-out on paper; or they print out the temperature data only after the treatment has been completed. (These are known as “memory loggers.”). These two types of instruments do not provide an adequate level of monitoring during treatment, and are therefore not approved. *Also, revolving circular charts are not acceptable, because of the difficulty in reading fractions of one degree.*

Temperature recorder models presently approved by APHIS are listed below. They may be either of the strip chart or data logger type. Some have adjustable chart speeds. Additional temperature recorder models may be added to this list upon petition to the Center for Plant Health & Technology (CPHST) in Raleigh, North Carolina. To seek APHIS approval for recorder models not listed, the manufacturer's technical brochure shall be submitted to CPHST for evaluation.

Approved strip chart (pen) recorder models

- Chessel 346
- Honeywell DPR 100A (3 channel capability)
- Honeywell DPR 100B (6 channel capability)
- Honeywell DPR 100C (3 channel capability)
- Honeywell DPR 100D (6 channel capability)
- Honeywell DPR 180 (36 channel capability)
- Honeywell DPR 1000 (6 channel capability) [1]
- Honeywell DPR-3000, version D4 (32 channel capability) [2]
- Honeywell Versaprint-131 (12 channel capability)
- Molytek 2702
- Neuberger P1Y
- Toshiba AR201
- Tracor 3000
- Yokogawa Micro-R l80

Approved data logger recorder models

- ASICS Systems B & C
- Chino AA Series
- Cole Parmer (32 channel capability)
- Contech (10 channel capability) [3]
- Flotek (must be attached to a printer)
- HACCP Warrior PTR- 4 (4 channel capability)
- HAACP Warrior PTR- 10 (10 channel capability)
- Honeywell DPR I00B (6 channel capability)[4]

1 The Honeywell DPR-3000 must be the high-accuracy version, with model number beginning with D4. It has the versatility of being used either as a strip chart or data logger.
2 The Honeywell Versaprint-131 was no longer manufactured after 1996.
3 The Flotek Company went out of business in 1991. However, used instruments occasionally become available, and a few new instruments may still be stocked by companies such as ASICS.
4 The Honeywell DPR-1500 was no longer manufactured after 1990.

- Honeywell DPR-1500 (30 channel capability) [5]
- Honeywell DPR-3000, version D4 (32 channel capability) [6]
- Flotek (must be attached to a printer)
- IBM-PC (must be attached to a printer)
- National Instruments (hardware + software) (64 channel capability)
- Nanmac H30-1
- Omega OM-205
- Omega OM-503
- Ryan Data Mentor (12 channel capability)
- Tracor Westronics DDR10

Chart paper specifications:

C or F scale

Temperature may be recorded either in Fahrenheit or Centigrade, although Fahrenheit is preferred by APHIS.

Scale deflection

Scale deflection on the strip chart paper shall be at least 0.10 inches for each degree Fahrenheit, or at least 5 mm for each degree Centigrade. Greater width between whole degrees, however, is preferred. Between each line representing one degree, there shall also be finer lines, each representing subdivisions of one-tenth, or two-tenths of a degree, in the range of 113 °F to 118 °F (45 °C to 47.8 °C).

Sample required

A sample of the strip chart or numerical printout made by the recording equipment must be submitted to CPHST. It should be in the exact format to be used at the facility during the treatment cycle. Each symbol on the print wheel (or ink color, in the case of strip charts) must correspond to, and identify, the particular sensor that it represents.

Chart speed

Chart speed for strip chart recorders shall be no less than one inch for every ten minutes of treatment time. (One inch for every 5 minutes is preferred). Thus, for a typical 90 minutes of treatment the total length of the chart will be at least 9 inches long (preferably 18 inches).

Chart length

The chart paper shall be of sufficient length to display at least one entire treatment. Continuous flow systems must contain enough chart paper to continuously record temperatures for up to 12 consecutive hours.

5 The Honeywell DPR-3000 must be the high-accuracy version, with model number beginning with D4. It has the versatility of being used either as a strip chart or data logger.

6 The Flotek Company went out of business in 1991. However, used instruments occasionally become available, and a few new instruments may still be stocked by companies such as ASICS.

Alarm System

An alarm is required for all batch (Jacuzzi) systems. In order to notify packinghouse employees that a treatment has been completed for a particular basket (cage), an alarm system must be installed. This system may be an audible noise (such as a horn, buzzer, or bell), or a highly visible light, attached to a timing device located on the equipment that indicates time and temperature. Some facilities use both a noise and a light. The alarm system alerts the operator of the hoist to remove a basket from the tank at the end of treatment, to avoid "over-cooking."

Safeguarding the Treated Fruit

Layout and flow pattern

The flow pattern of the fruit moving through the hot water treatment process should be so designed that fruit waiting to be loaded into the hot water immersion tank cannot become mixed with fruit that has already completed treatment. A drawing that shows the proposed layout of the packinghouse shall be submitted to CPHST for approval.

Garbage disposal

Cut fruit, culled fruit, rotting fruit, and miscellaneous garbage shall be placed into covered containers and removed form the premises daily, in order not to attract fruit flies.

Quarantine area

Treated fruit must be brought to an insect-free enclosure immediately after treatment, and must remain there until loading into insect-proof shipping containers. The designated enclosure is usually a screened room. Packing line equipment, hydro cooling equipment, and a cool storage room (if any), should be located in this area, but this equipment is not a requirement. Effective procedures shall be enforced to prevent the movement of untreated fruit (accidentally or intentionally) into the insect-free quarantine area.

Screening and other materials

Ordinary window screen or mosquito netting (at least 100 mesh per square inch) is sufficient to exclude fruit flies. It must be inspected regularly and repaired as often as needed. Solid glass, concrete, drywall, or wooden walls are also acceptable.

Air curtain

Apparatus that generate a high-velocity wind barrier or air curtain (such as fans or blowers and associated air-directing chambers or enclosures such as baffles, boxes, etc.) shall be located on the wall or ceiling prior to entering any quarantine area. This device shall exclude the possible entry of fruit flies into the insect-free enclosure. (On

facilities approved prior to July 1, 1997, vertically hanging, clear plastic flaps are required at the doors to the insect-free enclosure, as a minimum.)

Loading of treated fruit

Doors leading from the quarantine area to the loading dock shall be kept closed when not in use. When loading, truck vans and containers shall form a fly-proof seal with the exterior wall. Truck vans and containers shall be inspected and disinfected prior to loading. If wooden pallets are used, they must be completely free from weed-infesting insects and bark. A numbered APHIS seal shall be applied to each container before its departure.

Pre-treatment Warming Options

Pre-warming the fruit is sometimes desirable in order to meet the APHIS requirement that all fruit pulp temperatures must be at least 70 °F before the commencement of treatment. (This usually insures that the required minimum treatment temperature of 115 °F shall be achieved within the first 5 minutes of treatment.) The requirement of having fruit at or above 70 °F (in the case of mangoes) prior to hot water treatment may not be met (a) when the fruit have come directly from a refrigerated room, (b) when the weather is rainy or cloudy, or (c) in the early morning hours. These conditions may cause a treatment facility to close temporarily until the fruit pulp temperature has warmed sufficiently to allow treatment.

It is the usual practice at many facilities to use the hoist to hang a basket of fruit a few inches above the surface of the hot water tank prior to submerging it. However, except for the bottom layer of fruit in the basket, the fruit do not absorb a sufficient amount of heat to make this a practical means of pre-warming the entire basket load. To accelerate the pre-warming process, several viable options are available. APHIS suggests the following methods for pre-treatment warning:

Treatment Tank

In tanks that treat a single basket (cage) of fruit at a time, pre-heating may be accomplished within the tank itself, by use of a timer or delay switch. (The extra time in the water is not considered as part of the treatment, but is in addition to the treatment.) This approach, however, is not feasible to use in a multi-basket tank (in which the baskets enter the tank at different times), and is not an approved option in this instance.

Separate tank

A separate hot water tank may be used for pre-heating purposes.

Heated air

Hot air may be blown onto the fruit.

Heated room

The fruit may be placed in a heated room.

Direct sunlight

The fruit may be exposed to direct sunlight (which may be magnified through glass).

Post-treatment Cooling Options

Cooling the fruit after hot water treatment is not an APHIS requirement. However, from the standpoint of fruit quality, many facilities choose to install a system to cool the fruit after removal from the hot water.

Refrigerated room

Hot water-treated mangoes may not be moved directly to a refrigerated room until at least 30 minutes following treatment. Allowing the fruit to simply stand for at least 30 minutes after removed from the hot water tank is thought to be helpful in killing immature stages of fruit flies, because the mangoes complete their “cooking” process during that time. The recommended storage temperature for mangoes is 55 °F to 57 °F (12.8 °C) at 85 to 90% relative humidity. This delays softening and prolongs storage life to approximately 2 to 3 weeks.

Fans

APHIS allows the use of fans in the screen room to blow air over the fruit as soon as they are removed from the hot water tank (if desired). However, the ambient air must not be less than 70 °F.

Hydrocooling

APHIS allows the use of a cool water tank or shower system, but with the following provisions:

Hydrocooling (either by showering or water immersion) is optional. However, it *may not be done* until a waiting period of at least 30 minutes has elapsed, after the fruit have been removed from the hot water tanks. During the waiting period and hydrocooling period, the mangoes must be safeguarded in a room or tunnel, separate from the hot water tanks. Water temperature used during hydrocooling is not regulated. However, if it is too cool (below 65 0 F), it may cause some of the fruit to split their skins, making them unmarketable. Water

used for hydrocooling should be chlorinated (50 to 150 ppm). Any other chemicals, such as fungicides, are optional, but must be approved in advance by FDA.

Changes

Hot water immersion treatment facilities whose construction was approved under earlier guidelines may continue to operate with APHIS approval. Newer facilities, however, are required to meet the current requirements outlined in this Checklist, which in most cases are more strict.

Once CPHST has formally approved the plans and drawings for a hot water immersion treatment facility, the facility may make no further changes in the equipment without APHIS approval. Any proposed changes or improvements must be described in writing (with accompanying drawings, if necessary), and must be approved by APHIS in writing. Examples of proposed changes include adding additional treatment tanks, adding a cold storage room, and changing the model of the temperature recorder.

Safety and Health Checklist

- An adequate lavatory.
- Fire extinguisher, located near the boiler.
- First-aid kit, located near moving machinery.
- Hard hats for use by workers and visitors in the treatment and loading areas. (This is optional if not required by local regulations.)
- Approved safety ladders or walkways (catwalks, etc.) for use in observing treatment tank operations.
- Electric power must meet safety code requirements. Electrical wiring, including switches and other connections, shall be contained in metal or PVC conduit, and grounded to prevent electrical shock.
- Steam and hot water pipes shall be insulated or otherwise protected.
- Sufficient lighting shall be provided in working areas.
- Engines, pulleys, drive belts, and other hazardous moving parts, if located within 6 feet of floor level, shall be guarded with a safety shield or barrier.

- The admission of children or unauthorized persons into the treatment and packing areas shall be prohibited, if not accompanied by a responsible employee.

Dirty water in the tanks is a health concern, as well as an embarrassment to the operator. The APHIS inspector can provide advice on how often the water should be changed. In addition, APHIS recommends that operators should install a light sensor in each tank, to monitor the turbidity of the water.

Work Plan

A Work Plan is a formal agreement, signed by a representative of each treatment facility in a particular country, the Agriculture Ministry of the host government, and by USDA-APHIS. Work Plans govern the day-to-day operations of each facility, and may be improved from one year to the next. Work Plans usually contain additional provisions not included in this Checklist.

Fruit exporters are required to operate under general APHIS monitoring, and to be in full compliance with all APHIS regulations, as outlined in detail in the current Work Plan. The operator of the facility, as well as the inspector assigned to the facility should each keep a copy available, to resolve any disputes.

Start-up Costs and Resources

Currently, a modern two-tank system typically costs from $100,000 to $200,000 to build. Additional funds, about $40,000 to $50,000, are needed for installation. These costs do not include the land, building, and the various infrastructure that may be needed, such as fruit sizing equipment, packing tables, and cooling rooms. APHIS requires the exporter to sign a cooperative service agreement and to make an advance cash deposit into a trust fund, which will be used to pay for transportation, lodging, meals, incidental expenses, and salaries of inspectors sent on temporary duty to the facility, to conduct the official performance tests, and to monitor treatments. If several treatment facilities are located near one another, they may sometimes be allowed to share the cost of services provided by one inspector. APHIS is a regulatory agency of the U.S. Department of Agriculture, and cannot become involved in financing commercial enterprises.

See **Appendix H** for manufacturers, suppliers, engineering firms, and consultants for hot water immersion treatment facilities. These resources are found under the following categories:

- Balances, Portable
- Batch Systems (Completes Installations)
- Temperature Recorders (Including Installation)
- Temperature Sensors (RTD, 100 ohm)
- Thermometers, Glass-Mercury, Certified Precision (used as a calibration standard)
- Digital Thermistor Instrument (hand-held) and Portable Sensors (used in Performance Test)
- Continuous Flow Systems (Complete instrumentations)
- Steam Boilers
- Chain Hoist (Electronic)
- Fruit Crates, (Plastic)
- Fruit Sizing Equipment (Automatic)
- Screening and Netting (Fly-Proof)
- Safety Equipment
- Consultants

3

Treatment Manual

Nonchemical Treatments

Heat • Steam Treatments

Contents

Principle **page-3-4-1**
Steam Pressure Sterilization **page-3-4-1**
Loose Masses of Material **page-3-4-2**
Closely Packed Material **page-3-4-2**
Steam Jet Method **page-3-4-2**

Important

This section includes information from the old Treatment Manual and is for future development.

Principle

Steam at a temperature of 212 °F will destroy most pathogenic microorganisms of the common vegetative forms or the spore types when in the growing or vegetative state in a short period of exposure. Some spores, however, are much more resistant and will withstand prolonged periods of exposure to steam at atmospheric pressure. Saturated steam at temperatures of 240 °F to 248 °F (10 to 15 pounds pure steam pressure) will destroy the most resistant spores in a brief interval of exposure. However, near-complete air discharge from the autoclave or steam chamber is necessary. When steam is admitted to a chamber from which the air is completely evacuated, the temperature of the steam throughout the chamber will advance at once to the maximum range that can be attained for the pressure carried. If air remains in the chamber, the ultimate temperature will be reduced dependent upon the quantity of air remaining. Refer to a recording or indicating thermometer for correct chamber temperature-pressure relationships.

Steam Pressure Sterilization

Live steam is introduced into a closed chamber containing the material to be treated until the required temperature and pressure are indicated. The temperature/pressure relationship is maintained at or above this point for the required exposure period. The exposure period will depend on the nature of the material, quantity, and its penetrable condition.

Loose Masses of Material

For loose masses of material, which permit rapid and complete penetration of steam to all parts of the mass, no initial vacuum is needed, but air must be released until steam vapor escapes, and exposure at 20 pounds pressure for 10 minutes, 15 pounds for 15 minutes, or 10 pounds for 20 minutes is sufficient.

Closely Packed Material

For closely packed material, such as soil or baled straw, special measures are needed to ensure rapid heat penetration to all parts of the material. Baled rice straw, for example, is required to have a density of less than 30 pounds per cubic foot since penetration at higher densities is too slow to be practical. Soil, if in large containers, will not allow adequate treatment under normal sterilization exposure periods. Quicker penetration of the steam is obtained by first exhausting the air in the chamber to a high vacuum and then introducing live steam until the required positive pressure is reached.

Examples of the pressure-temperature relationships are listed below. The gauge pressure in pounds per square inch corresponds to the temperature of saturated steam in degrees Fahrenheit. Zero gauge pressure corresponds to an absolute pressure of 14.7 pounds per square inch. The figures are based upon the complete replacement of air by steam. If air replacement is not complete the temperature for any given pressure will be less than the corresponding temperature.

Gauge Pressure (lbs. per sq. in.)	Temperature °F
10	239.4
15	249.8
20	258.8
30	274.1
40	286.7
50	297.7
60	307.4

Steam Jet Method

Live steam from a jet or nozzle is forced into or through a more or less loose and open mass of material in such amount and for such period required to raise the temperature of all parts of the mass to approximately 212 °F. This method takes advantage of the considerable latent heat liberated when steam condenses into water. This process does not effect complete sterilization since spore-forming bacteria are not always destroyed. Since no spore-forming bacteria are known that cause plant diseases, however, and fungi are readily killed

by the temperatures reached, this process is effective for quarantine purposes if the necessary degree of heat is generated in all parts of the material.

3

Treatment Manual

Nonchemical Treatments

Heat • Vapor Heat Treatment

Contents

Principle **page-3-5-1**
Schedules **page-3-5-1**
Procedures **page-3-5-2**
Safeguards **page-3-5-3**

Principle

This treatment uses heated air which is saturated with water vapor to raise the temperature of the commodity to a required point and holds the temperature for a specified period. The latent heat released by the condensation of the vapor on the commodity raises the pulp temperature quickly and evenly and thus prevents damage. In application, a fine mist and air under forced circulation is present with the saturated vapor. VH treatment is used primarily for fruits and vegetables that are hosts of fruit flies.

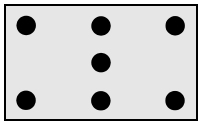
Schedules

The time-temperature relationship varies with the commodity and the pest involved. Typically, the pulp temperature of the commodity is raised by the saturated water vapor to 110 °F–112 °F (43.3 °C–44.4 °C) during a period of 6 or 8 hours and then held at the required temperature for an additional 6 or 8 hours. The fruits and vegetables are cooled immediately after treatment. An option with the shipper includes a pretreatment conditioning, usually at a relative humidity of less than 100 percent. The officer is expected to inform the shipper of current practices and recommendations on the subject. See T106 for approved VH schedules.

Procedures

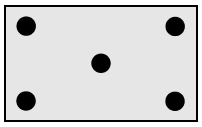
1. Temperature sensors are used to determine the pulp temperature of the commodity under treatment, psychrometers are used to determine the existing relative humidity. The tips of the sensors are inserted in the centers of individual fruits and vegetables, a typical sensor placement in the crates is shown below:

One layer only—7 sensors



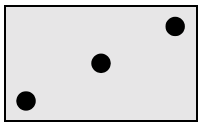
Multiple layers

Bottom layer—5 sensors



Middle layers—4 sensors

Top layers—3 sensors



Hot air duct—2 leads
(1 wet, 1 dry = psychrometer)

2. Professionally engineered vapor heat processors employing a duct system, which delivers the vapor directly to each individual stack of commodity and which channels the air flow directly through the stack, may utilize the following sensor placement:

   Bottom, Middle, and Top Layers (A total of 9 sensors)

   Hot air duct—2 sensors (1 wet, 1 dry = psychrometer)

   When several commodities are being treated simultaneously, temperatures must be determined for each commodity.

   The stacking of the loaded crates in the treatment chamber must insure uniform circulation of the vapor. The floor must be completely covered, unused portions of the floor being covered with empty crates, heavy paper, or cardboard. This paragraph is not applicable if 2. above applies.

Vapor heat processors must be approved prior to use for APHIS treatments. Plans and specifications showing dimensions, air circulation, and other specifications of the heating and temperature recording systems should be sent to USDA-APHIS-PPQ-CPHST, Treatment Support & Certification, 1017 Main Campus Drive, Suite 2500, Raleigh, NC 27606. After preliminary acceptance of the plans and specifications, an on-site survey will be conducted which will do the following:

3. Compare the installation to the approved plans,
4. Check the air and water vapor circulation system, and
5. Check the calibration of the temperature monitoring system.

Upon successful completion of the performance survey and PPQ Form 480 (Treatment Facility), a Certificate of Approval (PPQ Form 482) should be issued. Vapor heat chamber equipment should be tested for correct functioning before each treatment. The accuracy of each temperature sensing element should be checked once a month during regular use with water at temperatures near the normal treatment temperatures.

All sensors, after calibration corrections, must register the required temperature or above at the beginning of treatment. A 0.3 °C (0.5 °F) deviation is considered within the range of acceptable tolerance thereafter. This tolerance applies to the humidity check sensors as well as those for host temperature recordings. Extend the treatment time by an amount equal to any periods when specifications are not met. Chambers must be equipped with recording temperature and humidity indicators. Detailed records of each treatment must be kept. Final calibration values for each temperature sensor must be recorded for the port files.

Safeguards

Adequate safeguards must be maintained to prevent reinfestation or contamination of the treated commodities or their containers. Packing rooms must be fly-proof and only treated host material permitted therein.

3

Treatment Manual

Nonchemical Treatments

Heat • Forced Hot Air

Contents

Pre-Treatment Procedures **page-3-6-1**
- Sizing the Fruit **page-3-6-2**
- Placement of permanent temperature sensors (probes): **page-3-6-2**
- Loading the fruit into the FHA chamber: **page-3-6-2**[1]

Procedures for Performing the FHA Treatment **page-3-6-2**
- Monitoring the temperature: **page-3-6-2**
- Control of air delivery temperature and blower speed: **page-3-6-3**

Post-Treatment Procedures and Safeguards **page-3-6-3**
- Post-Treatment requirements **page-3-6-3**
- Exporter compliance with prescribed safeguarding and safety measures: **page-3-6-4**

APPENDIX: EQUIPMENT AND MATERIALS PROVIDED BY THE EXPORTER **page-3-6-4**

Dry Heat Treatment Facilities for Niger (Guizotia abyssinica) **page-3-6-7**
- Introduction **page-3-6-7**
- Location of Treatment Facilities in the US **page-3-6-7**
- Checklist of USDA-APHIS Minimum Requirements for Dry Heat Treatment Facilities for Niger Seed Treatment **page-3-6-8**
- Requirements for a valid treatment **page-3-6-9**
- Sanitation and Pest Control **page-3-6-9**

Forced Hot Air Treatment for Fruit

Pre-Treatment Procedures

The target pests of these treatments are fruit flies. An APHIS Inspector shall monitor all treatments done for quarantine purposes. Maintaining the dew point temperature of the chamber 2 ° C cooler than the temperature of the fruit surface avoids condensation on the fruit surface and improves fruit quality. However, for regulatory purposes, APHIS shall base the validity of treatment solely upon the center pulp temperature of the fruit. Control of blower speed and relative humidity in the chamber are the sole responsibility of the operator.

NOTICE

Any preconditioning treatments (such as degreening) shall not be conducted in the FHA chamber.

1 Forced hot air (FHA) is also referred to as high-temperature forced air (HTFA).

Sizing the Fruit

Fruits must be sorted by size before treatment. For some fruits, a size and weight limit has been established. After sizing, fruits that exceed the permitted size classes are not eligible for shipment. There is no minimum size requirement. The various sizes of fruits may be treated either *separately or together at the same time*, in their own respective trays or bins. For best results, however, only fruits similar in size and variety should be treated during the same run.

Placement of permanent temperature sensors (probes):

Placement of sensors (at least one per column) shall be monitored by an APHIS Inspector, and done in a certain, precise manner. Insert the sensors into the *center* of the *largest* fruits of the lot, at the *top* of the load of fruit located closest to air that exits the chamber. (Research has shown that these fruits, in this location, require the longest time to heat.) Be careful not to pinch the sensor cables.

In a FHA chamber that has *bottom air delivery*, place all sensors in large fruit in the *top layer* of trays or bins.

In a FHA chamber that has *top air delivery*, place all sensors in large fruits at the *bottom layer* of trays or bins.

In a FHA chamber that has *both bottom and top air delivery, side delivery*, or that has air delivery with a *reversible direction of flow*, place all sensors in large fruits in the *middle layers* of trays or bins.

Loading the fruit into the FHA chamber:

Under monitoring of the APHIS Inspector, bins or trays containing fruit shall be loaded directly over the delivery air source, leaving no uncovered space around the edges of the air supply ducts. The intention is to force the heated air through the slatted sides or bottoms of the bins or trays, not around them.

NOTICE

There is no minimum or maximum fruit pulp temperature required prior to beginning the treatment.

Procedures for Performing the FHA Treatment

Monitoring the temperature:

After the fruit has been loaded into the chamber, the door is closed, and the FHA generating equipment is turned on. The temperature recorder shall then begin making numerical recordings of temperatures from each sensor at least once every five (5) minutes, or make continuous pen-line recordings, color-coded for each sensor, on a graph paper readable in tenths of a degree (F or C). After the *warm-up period* [see below], the frequency of temperature recordings shall be increased to once every two (2) minutes.

The fruit pulp temperature (on all sensors) must be increased to the *target temperature* stated in the treatment schedule. This shall be done gradually, during a *warm-up period*. If the fruit are cool initially, the target temperature will require a longer approach time to achieve. The temperature of the delivery air should be slightly hotter than the target temperature. When all the fruits with sensors have reached their target temperature, and their minimum warm up time has been completed, the fruit center temperature (on all sensors) must then remain at or above treatment temperature for the amount of *dwell time* specified in the schedule. The APHIS Inspector shall review and approve the temperature records (by initialing them) when the entire treatment (warm-up period + dwell time) has been completed.

NOTICE

A faulty sensor, giving erroneous readings, does not necessarily negate a treatment. The suspected faulty sensor, after the load of fruit has been treated, must be tested by running a calibration check, to determine if it is accurate or faulty. If the sensor is found to be accurate, the treatment is negated. If the sensor is found to be faulty, the treatment is validated; however, this sensor must be replaced before the next treatment. In the case of repeated treatment failures, it may be necessary to change certain treatment parameters, then recertify the chamber. The same load of fruit may be retreated, at the option of the operator. However, APHIS assumes no liability for possible damage.

Control of air delivery temperature and blower speed:

The delivery air must be warmer than the target fruit pulp temperature, but this matter is left to the discretion of the operator. APHIS shall not require any particular temperature set point, because the treatment is based upon pulp temperature, not air delivery temperature. The operator is also given the flexibility to change the temperature of the delivery air at various times during treatment. Also, the delivery air temperature and/or blower speed may be varied according to the height (length) of the columns of fruit in the FHA chamber, based upon operator experience.

NOTICE

The APHIS Inspector monitoring the treatment may void (negate) a FHA treatment for failure of the operator to follow any treatment requirements.

Post-Treatment Procedures and Safeguards

Post-Treatment requirements

After treatment, the bins or trays of citrus must be moved immediately to a secured holding room or area (quarantine zone). After a 30-minute waiting period, the fruit may be cooled to enhance their quality (optional), and placed into commercial cartons. Other procedures, such as degreening and application of fungicides, are done at the option of the operator of the facility.

Each carton shall be stamped APHIS-USDA TREATED WITH FORCED HOT AIR, together with the APHIS stamp number assigned to the facility. Cartons must not be preprinted or prestamped with this information. Official rubber stamps shall be controlled by the APHIS Inspector.

Exporter compliance with prescribed safeguarding and safety measures:

The exporter shall be responsible for:

Providing adequate safeguards to prevent treated fruit from becoming exposed to the risk of reinfestation.

Performing each FHA treatment in a manner that conforms with APHIS requirements and sound safety procedures.

Maintaining the FHA chamber and packing house in a safe and sanitary condition at all times. This shall include providing industrial first-aid kits and approved safety equipment at the facility, and training in their use. He shall also ensure that local authorities and hospitals are aware of treatment activities, and are prepared to handle emergencies such as burns.

Designing an operator to be present throughout the entire treatment period (warm-up time + dwell time), who shall be trained and thoroughly familiar with treatment procedures and operation of the FHA chamber.

APPENDIX: EQUIPMENT AND MATERIALS PROVIDED BY THE EXPORTER

Forced hot air chamber:

Delivery of heated air is by means of high-speed blowers or fans, at a recommended air speed of 2 meters/second or higher. The air is forced to pass vertically or horizontally through the load of fruit being treated. It then passes out of the chamber through a heating system, and is returned to the chamber at the opposite end. The chamber must be constructed so as to accommodate the placement of several portable sensors during the yearly performance test. For this purpose, temporary access through an opening or openings in the chamber walls is required.

Trays or bins:

Fruit are to be treated in containers providing solid sides perpendicular to the direction of air flow, and vented or open sides in the direction of air flow, to facilitate movement of heated, moist air through the column(s) of fruit.

Permanent temperature sensors:

These may be high-performance RTD, thermistor, or thermocouple sensors (probes), installed at the ends of insulated wire cables long enough that all areas of the load can be reached. Fruit pulp sensors must be at least 2 inches in length. The operator of the facility shall maintain a supply of extra sensors to use as replacements.

The minimum number of sensors required shall be in proportion to the size of the load of fruit. In no case shall the number of permanent sensors be less than ten (10). However, each stack (column) of fruit must contain at least one fruit pulp sensor. For Example: A chamber with 5 stacks must have at least 10 sensors. A chamber with 20 stacks must have at least 20 sensors. It is recommended, however, that several extra sensors be installed.

In addition, it is recommended that additional sensors be installed to monitor supply air, return air, fruit surface temperature, and relative humidity. (For required placement of pulp sensors, refer to the earlier discussion.) Sensors shall be numbered, corresponding to a particular printout or pen line shown on the recorder. Accuracy must be to within plus or minus 0.5 ° F (0.3 °) of the true temperature.

Automatic temperature recorder:

This is a computerized device, which may be either a data logger or a continuous strip chart pen recorder. The combined accuracy of the entire temperature recording system must be to within plus or minus 0.5 ° F (0.3 ° C) of the true temperature, and the recording must be readable in whole degrees and tenths. This equipment is very sensitive, and must be kept inside an air-conditioned control room. An electrical surge protector is also recommended, to provide protection from voltage irregularities (power surges). For data loggers, one print shall be required for each sensor, at least once every five (5) minutes during warm-up, and every 2 (two) minutes during dwell time. The recorded model must be approved in advance by APHIS. Circular graph temperature recorders are not acceptable.

Portable temperature sensors:

These will be used by the APHIS Inspector during the yearly performance test. For every two permanent pulp sensors installed, at least one portable sensor must be available when needed for performance testing. As an option, additional permanent sensors may be used, if the automatic temperature recorder is capable of handling the additional capacity. Portable sensors can also serve as emergency back-ups in case of malfunctioning of permanent sensors.

For example: For a FHA chamber using 20 permanent pulp sensors, at least 10 portable sensors (or 10 additional permanent sensors) are required for the purpose of conducting the performance test for certification.

Portable temperature monitor:

This will be used by the APHIS Inspector during the yearly official performance test. It must be capable of reading in whole degrees and tenths. This instrument may be either a simple, hand-held thermistor devise that can be quickly connected to individual portable sensors in sequence, or it may be a more complex device that is capable of monitoring several sensors at once.

As a second option, in the absence of a portable temperature monitor, the chamber's permanent temperature recorder may be used during an official performance test, if it is capable of monitoring the minimum number of additional sensors required for the test (in addition to the normal number of permanent sensors).

As a third option, the APHIS Inspector may use cordless sensors during the yearly official performance test, if available. Readings from these sensors must be downloaded onto a computer after the treatment is completed.

NOTICE

The exporter shall not be required to purchase cordless sensors, because of high cost.

Certified thermometer:

A certified glass-mercury, water-immersible stick thermometer, readable in tenths of a degree, shall be kept on the premises at all times. This thermometer shall be certified by the factory to be accurate to within plus or minus 0.5 ° F (0.3 ° C) of the true temperature, and shall cover the range between 104 and 122 ° F (40 to 50 ° C). This thermometer shall be used as the standard against which all sensors are calibrated. It must be recalibrated by the manufacturer, or by an independent testing laboratory, at least once every five years.

Portable calibrator:

This is usually a small, swirling heated water bath, which provides a constant water temperature during the calibration of sensors.

Fruit sizing equipment:

This equipment shall be located in an area of the plant that is outside the quarantine zone, because sizing of fruit is required to be done *before treatment*.

Air curtain and/or double doors:

Air curtain generating apparatus (if used) shall be located on the wall or ceiling at the entrance to the quarantine zone, and shall blow air in an outward direction from the quarantine zone whenever the door is opened. A second option is to install a double door system (with a short walkway between the doors) at the entrance. Only one of the two doors may be open at a time.

Quarantine Zone:

Treated fruit must be brought to an insect-free encloser (usually a screened room), immediately after treatment. Packing line, palletizing, and banding equipment shall be located within this zone. A cooling system is optional. Fruit for markets other than the United States is not allowed to be present in the quarantine zone. Detection of live insects in the zone may be used as grounds for refusal to allow shipment of treated fruit that may be present. Untreated fruit is not allowed in this zone at any time.

Cooling equipment for treated fruit:

Thirty minutes after completion of FHA treatment, the fruit may be cooled. Forced air cooling may be done inside or outside the FHA chamber. Air temperature is optional. The fruit may also be brought to a refrigerated room within the quarantine zone. Cooling the fruit is not mandatory, but may be done to preserve fruit quality. It is not an integral part of the quarantine treatment.

Dry Heat Treatment Facilities for Niger (Guizotia abyssinica)

Introduction

Niger is grown as a marginal crop mainly in India, Ethiopia and Burma. Its black seeds are imported into the US for bird feed. Since niger is frequently contaminated with Federal Noxious Weed seeds, the seeds from any foreign place, at or before the time of arrival at the port of first arrival, are required to be heat treated in accordance with the applicable schedule of the PPQ's Treatment Manual.

Location of Treatment Facilities in the US

The proposed niger treatment facility should be constructed near the port environs; not exceeding 10 miles from the port.

Checklist of USDA-APHIS Minimum Requirements for Dry Heat Treatment Facilities for Niger Seed Treatment

Minimum Requirements for Dry Heat Treatment

- A minimum of two temperature probes must be situated in the heat treating equipment in such a way as to determine that all niger seed being treated reaches the target temperature.
- The temperature recording chart must show changes in temperature in increments of not less than 0.1 inch for each degree Fahrenheit (°F) or 5 mm for each degree Celsius (°C).
- Temperature readings must be recorded on the chart at time intervals not to exceed 4 minutes between each reading.
- Accuracy of the total temperature recording system must be within plus or minus 0.5 °F. (0.3 °C) of actual temperatures as recorded by a certified calibrated thermometer.
- A speed indicator must be present for continuous flow systems.
- All the valves and controls that affect heat flow to the treatment system must be secured to avoid manipulation by unauthorized personnel during the treatment process.
- Heating controls must be automatic and run continuously throughout the treatment process. Manual adjustments are allowed, if necessary.
- Gear systems used to control the niger seed conveyor (if applicable) must be capable of being adjusted as necessary to meet treatment requirements.
- An audible alarm or highly visible light must be installed on burners or other equipment to indicate system failure and/or when not operating properly.
- An action plan must be established to address any pests that may be associated with the storage, treatment, or shipment of niger seed.
- Proper sanitation measures must be implemented to ensure that there are no potential breeding grounds for pests on the premises, and therfore, little risk of reinfestation or cross-contamination.
- Treated seeds must be stored in a location separate from nontreated seeds. The treated and nontreated seeds must be handled in a manner to prevent cross-contamination.
- Seed processing equipment must have the capability to divert for retreatment any nontreated or treated seeds that do not meet treatment standards.

Requirements for a valid treatment

Facility Requirements

- Treatment must be in a niger seed facility maintaining current valid approval in good operating order so as to be capable of providing an acceptable treatment.
- The minimum number of temperature recording elements is two (2) fixed temperature probes. Accurate time/temperature records will also be maintained for any additional probes.
- Facility operators or managers must record the following information on each treatment chart:
  - date
  - lot number
  - Signature of operator

Treatment Requirements

The niger seed heat treatment schedule will be for at least 15 minutes at 120 ° C (248 ° F) and the following procedures will be used by operators to determine if treatment standards are met.

- Examine treatment records for completion of treatment
- Verify that the niger seed was kept at the target temperature for the required time.
- If for any reason records indicate that the niger seed was not held at the target temperature for the required time, the niger seed must be retreated and the reason for the faulty treatment corrected before any niger seed treatment may be continued.
- If any temperature reading falls below 120 ° C (248 ° F), the treatment for that specific lot of seed will be nullified and the seed will be retreated.

Documentation Requirements

- log book of all niger seed treatments
- records of equipment breakdowns and repairs and changes or modifications to the treatment process.

Sanitation and Pest Control

The Plant and Warehouse premises

The premises shall have a cleaning and control program. The facility manager will ensure that there are no potential breeding grounds for pests in the premises, and therefore little risk of re-infestation or cross contamination.

Containers and Packaging

The facility manager will ensure that packaging, whether used or new, shall be checked and cleaned for pests so that they are not a source of pests and contamination.

Waste Disposal

A regular waste program for waste, as well as nonconforming or infested produce will be implemented to ensure minimum risk of contamination and elimination of breeding sites of pests.

Post Treatment Requirements

- After treatment and cooling, the niger seed must be immediately placed in new bags. The old bags must be treated or disposed of in a manner that will eliminate regulated pests.
- PPQ will monitor (by sampling the treated seeds periodically) for actionable contaminants. Every 25th lot after treatment is to be sampled sometime in the middle of the bagging process. Random inspections and viability tests shall be performed, as needed by PPQ at the Port of Entry.

Each sample should be labeled with the following information:

- Origin of seed
- Vessel name and nationality
- Bill of lading number
- Container and lot number
- Date the seeds were treated
- Date the sample was taken

Laboratory results with the above information shall be sent to USDA-APHIS-PPQ-CPHST, Treatment Support & Certification, 1017 Main Campus Drive, Suite 2500, Raleigh, NC 27606.

3

Treatment Manual

Nonchemical Treatments

Cold Treatment (CT)

Contents

Intransit Cold Treatment Procedure of Ships: Introduction **page-3-7-1**
Intransit Cold Treatment Procedure of Ships: Introduction **page-3-7-1**
Performance Survey of Vessels for Approval **page-3-7-2**
Meeting With Ship's Officers **page-3-7-2**
Operation Check of Temperature Recording Instrument **page-3-7-3**
Identification Check of Temperature Sensors **page-3-7-3**
Calibration Check of Temperature Sensors **page-3-7-4**
Survey of Refrigerated Compartments **page-3-7-5**
Reporting **page-3-7-5**
Initiating Intransit Cold Treatments **page-3-7-6**
Conventional Refrigerated Vessel **page-3-7-6**
Container Vessel **page-3-7-8**
Fruit in Shipboard-Cooled Containers **page-3-7-9**
Clearance of Shipments Cold Treated in Transit **page-3-7-10**
Conventional Vessel **page-3-7-10**
page-3-7-15
Progressive Cold Treatment Clearance **page-3-7-16**
Intransit Cold Treatment Procedure—Self-Refrigerated (Integral) Containers: Introduction **page-3-7-16**
Intransit Cold Treatment Procedure—Self-Refrigerated (Integral) Containers: Introduction **page-3-7-16**
Initiating Intransit Cold Treatments **page-3-7-17**
Check Container **page-3-7-17**
Calibration of Temperature Recorders and Sensors **page-3-7-17**
Check Fruit **page-3-7-17**
Loading the Fruit **page-3-7-18**
Monitor Loading and Placement of Temperature Sensors **page-3-7-18**
Prepare Documents **page-3-7-19**
Distribute Documents **page-3-7-19**
Clearance of Intransit Cold Treatments **page-3-7-20**
Cold Treatment—Warehouses **page-3-7-21**
Initiating the Cold Treatment **page-3-7-22**
Clearance of the Cold Treated Fruit **page-3-7-22**

Intransit Cold Treatment Procedure of Ships: Introduction

The use of sustained cold temperatures as a means of insect control has been employed for many years. Rigid adherence to specified temperatures and time periods effectively eliminates certain insect infestations. Treatments may be conducted in refrigerated compartments of transporting vessels or in containers cooled by the ship's refrigeration system or by individually refrigerated containers.

Owners of vessels seeking approval to conduct intransit CT should apply in writing to:

USDA-APHIS-PPQ-CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606

The vessels and/or containers must be capable of maintaining fruit pulp temperatures within the specified CT schedules. To monitor these treatments, the vessels and/or containers must be equipped with a temperature recording device which meets the approval of PPQ. Specifications for temperature recording installations and other requirements for approval are supplied upon request (see Certifying Facilities, Cold Treatment (CT)).

PPQ officers conduct vessel and/or container approval tests under the general guidance of CPHST. CPHST will provide the officers with the necessary information for the testing of specific vessels and/or containers. The information will include plans of the refrigerated compartments with the number and location of the temperature sensors and other data as may be required.

The vessel must be docked prior to testing. Also, vessel's hold must be empty before it can be tested and certified by PPQ. Vessel approval tests can be performed at ports in the United States or most overseas ports. Fifteen working days, excluding weekends and holidays, will be required for PPQ to make travel arrangements to overseas ports.

Prior to the approval tests, a representative of the instrument company should have checked the temperature recorders. This representative should be available during the test to advise on the operation of the instrument and to correct deficiencies.

Performance Survey of Vessels for Approval

Meeting With Ship's Officers

The ship's officers in most instances will have received instructions on the Agency's requirements from their owners. However, a discussion by the PPQ officer with these officers will provide for better understanding and cooperation. The discussion should include procedures used for the approval survey and the general treatment procedures in accordance with Quarantine 56 (7CFR 319.56-2d). A communication system should be made available to facilitate communication between personnel in the compartments and the recording room.

Operation Check of Temperature Recording Instrument

Strip Chart Recorder

The instrument should be in operation for at least 30 minutes prior to the calibration test. During this time a check should be made of the print interval, the chart speed, the print wheel, and the indicating wheel.

The print interval is determined by measuring the time lapse between each printing on the chart using the second hand of a watch.

The chart speed can be measured by noting the distance the chart advances in 1 hour or can be determined by using the print interval and the number of prints per inch or centimeter of chart. (For sequence of clearance procedure, see Clearance of Shipments Cold Treated in Transit, Conventional Vessel.)

The print wheel should be checked for the proper symbols and calibration point. The indicating wheel must correspond with the symbol on the print wheel. The printing on the temperature chart must be fully legible.

Data Logger

The instrument should be in operation for at least 30 minutes prior to calibration tests. During this time the functioning of the visual scanner, the printer, and the high limit setting should be observed. The log sheets should be checked for proper format and serialization.

Important

Data logger installations are utilized to record various components of the vessel's operating systems. Temperature recording is only a part of the record which is produced. Under our approval requirements, the log sheets upon which the intransit cold treatment is recorded are generally more detailed in design than the standard commercial log sheet. They are prepared and serialized to facilitate scanning and to provide a level of security against fraudulent records. The USDA log should be printed on separate sheets with no other ship data interspersed. Data loggers are programmed to print out those temperatures above a set limit in a contrasting color. Some instruments print a symbol to indicate this. The limit is set at the time of loading to a temperature level which coincides with the projected treatment schedule.

Identification Check of Temperature Sensors

Conventional Vessels

Individual sensors must be checked to verify that they are properly labeled and correctly connected to the temperature recorder. This may be accomplished by hand warming each sensor when its number appears on the indicating wheel or visual display panel of the recording instrument. A temperature change, which can be observed at the instrument, should occur. If the instrument fails to react, the sensor is incorrectly connected or the print wheel is out of sequence. Correction by the instrument representative will be required.

Container Vessels

To determine if the cables are correctly labeled as to position, resistor plugs of specified sequential values (e.g., 29.5 °, 30.0 °, 30.5 °, 3l. °F) are coupled to the cables. The temperature value assigned to each cable should register on the temperature chart in the proper sequential order.

Calibration Check of Temperature Sensors

Conventional Vessels

Compartment temperatures are to be lowered to near 0 °C (32 °F), for the calibration tests. This requirement may be waived if insulated containers (i.e., styrofoam) are provided for the ice/water test standard.

NOTICE

It is APHIS policy to use the standard "rounding rule" to deal with this issue. In determining calibration factors, if the reading is.05 or higher, then round to the next higher number in tenths. If it is .04 or lower, then go to the lower number. For example: If the calibration factor was .15, then round to .2. If it was .32, then round to .3. Similar rounding can be used in actual treatment readings. If an actual reading was 34.04, then round to 34.0, then add or subtract the calibration factor, if necessary. If it was 34.07, then round to 34.1, then add or subtract the calibration factor, if necessary.

The following is the process for developing ice/water standards:

- A mixture of ice and fresh water is prepared in clean containers. The ice must be crushed and completely fill the container. Just enough water should be added to stir the mixture. The percentage of ice is estimated at 80-85 percent while the water fills the air voids (15-20 percent). As the ice melts, additional ice is added to the water level is reduced. The ice water mixture must be carefully prepared and stirred to maintain a temperature of 32F °.
- The sensors must be submerged in the ice water mixture without touching the sides or bottom of the container on each side.
- The mixture must be constantly stirred during the entire testing process.
- Testing of each sensor in the ice water continues until the reading is stabilized at the lowest temperature obtainable. Two consecutive readings of the lowest temperature obtainable must be recorded on the temperature chart or log sheet before calibrations are certified. There should be at least a 60 second interval between two consecutive readings for any one sensor; however, the interval should not exceed 5 minutes. Also, the recorder used with the sensors must be capable of printing on demand and not just at hourly intervals.
- Any sensor which reads more than plus or minus 0.3 °C (0.5 °F), from the standard 0 °C (32 °F) must either be corrected by calibration adjustments or replaced.

- Every effort should be made to determine the calibrations to the nearest tenth of one degree.

Container Vessels

In contrast to conventional vessels, the temperature sensors are not a permanent part of the temperature recording equipment aboard the container vessel. They are fitted with a connector and are calibrated using shoreside facilities equivalent to the recording equipment aboard the vessel. The temperature recorder is equipped with cables which terminate in the ship's hold. The ends of these cables are fitted with a connector to which the temperature sensors are coupled when the container is positioned in the hold.

To calibrate the temperature recorder, a resistor plug, equivalent to a 0 °C (32 °F) reading, is coupled to the cable end. The calibration error for each cable will be noted on the temperature chart in the same manner as the standard ice water test.

Survey of Refrigerated Compartments

An examination of each empty compartment should be conducted to determine its condition. Obvious faults, such as damaged doors or bulkheads, should be reported. For new constructions, details of the general layout of the compartments and their air distribution scheme should also be reported.

The sensors and storage compartments for conventional vessels and the sensor connectors for container vessels should also be checked to determine if they have been numbered according to the approved diagram for USDA sensors.

Reporting

Complete details of the testing of the recording equipment and temperature sensors should be reported on PPQ Form 449 and forwarded to the following address:

USDA-APHIS-PPQ-CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606

The temperature charts or log sheets which contain the results of the calibration checks should be attached.

In the event there are circumstances or pertinent facts which are noteworthy but which cannot be included on the reporting form, a narrative report listing such information should be submitted with the PPQ Form 449.

General results of the test may be made known to the responsible ship's officers and representatives of the shipping line or instrument company. After review by CPHST, a certificate of approval, valid for a 3-year period, will be issued. The address of the party to which the certificate is to be sent should be included in the narrative report or on PPQ Form 449.

Initiating Intransit Cold Treatments

Conventional Refrigerated Vessel

The PPQ officer boards the vessel to discuss calibration tests, refrigeration requirements, and loading and discharge procedures with the responsible ship's officers. Inspection and calibration of the temperature recording system follow. All materials and labor for this activity, except the calibration thermometer, should be supplied by the vessel or vessel's agent. The officer acts in a supervisory capacity, advising on proper procedure. As loading commences the officer must take fruit temperature readings, advise on proper stowage, and place temperature sensors into the fruit at appropriate intervals and locations. When loading operations are completed, the appropriate documents should be distributed as required.

Important

In countries with which USDA-APHIS has a cooperative agreement, these activities can be conducted by qualified officials from that country. Contact the Preclearance Program Office in Riverdale, MD, for a list of qualified officials.

Meet With the Ship's Officers

On most vessels approved for intransit cold treatment the ship's officers will have had some instructions from their owners, regarding requirements. However, a personal discussion with these officers will provide for better understanding and cooperation. Such a discussion should include (1) temperature sensor and instrument calibration testing (for which the vessel or vessel's agent must supply a mixture of fresh water and ice in clean containers), (2) stowage arrangement, and (3) treatment conditions. When loading is completed, the form letter of instruction listing the treatment schedule must be issued to the captain, along with the appropriate documents for presentation to the clearance official at the port of destination.

Check Instrument Operation

Strip Chart Recorder. Prior to any testing, a full-length chart should be installed by ship personnel so that all the required information will be part of a continuous record. The instrument should be in operation for a period of at least one-half hour prior to calibration tests. During this time, a check is made of the chart speed and print interval. The printing must be legible. The ink pads should be freshly inked and print wheels clean.

Data Logger. A sufficient supply of log sheets must be available to provide a continuous record of calibration and treatment temperatures. The data logging system should be in operation at least one-half hour prior to the calibration tests. During this time a completed log sheet printout should be examined. The temperature set-point for an alarm printout should be activated to verify that this function is operational.

Calibrate Temperature Recording System

Only the compartments that will be carrying fruit under USDA-APHIS regulations should be calibrated. Refer to Intransit Cold Treatments, Performance Survey of Vessels for Approval (Operation Check of Temperature Recording Instrument, Identification Check of Temperature Sensors, and Calibrate Check of Temperature Sensors) for complete instructions on calibration.

Monitor Loading and Placement of Temperature Sensors

Experience with intransit cold treatments shows that the fruit should be precooled before loading which enables the fruit to reach the treatment temperature sooner. When precooled fruit is loaded, manual fruit pulp temperatures should be taken to insure temperature uniformity. If warm fruit is to be loaded in the same compartment as precooled fruit, it should be identified so that a sensor can be inserted in this fruit.

Sensors are to be placed throughout the load in locations representing all areas of the compartment and from midway to the top of the load. When more than two pulp sensors are available, one sensor should be placed in the fruit carton nearest the air-sensor which is located furthest from the cooler room.

If possible, the cartons in which the sensors will be located must be opened and the sensor inserted well into the fruit. The tip of the sensor must not extend beyond the fruit. In the case of small fruit, two or more fruit should be used. The cartons are to be properly closed following insertion of the sensors. If the fruit is palletized, it is sometimes necessary to insert the sensor into the fruit from the side of the carton. The pallet should be securely stowed to prevent shifting and possible damage to the sensor.

Confirm Completion of Loading

When the loading is completed, the compartments are to be secured. This information should be noted on the temperature chart or log sheet by recording the date and time of completion of each compartment and the officer's signature. Fruit is not to be added to the compartment after this has been completed.

Prepare Documents

A "Calibration of Temperature Sensors" record will be issued for each shipment. It must show the temperature readings as taken from the temperature chart or log sheet during the calibration testing. Readings should be given to the nearest tenth of one degree. When the loading of

each compartment has been completed, the temperature reading of each fruit probe should be obtained from the temperature recorder and recorded on this form.

A "Location of Temperature Sensors" record will be prepared showing the actual position of each fruit temperature sensor. (See sample form in Appendix A.) This can be done either by a written description or by a diagrammatic sketch. Compartment loading start and end times and dates should be included on the form.

The "Instructions to Captain" form letter will be prepared and signed. (See sample form in Appendix A.)

A PPQ Form 203 (for APHIS pre-inspected fruit) and a shipper's manifest containing the quantity and kind of commodity completes the documentation of each shipment. (See sample form in Appendix A.)

Distribution of Documents

The original "Calibration of Temperature Sensors," "Location of Portable Sensors," a copy of the "Instructions to Captain," and the documents identifying the fruit will be placed in a sealed envelope and given to the captain for presentation to the clearance official at the port of destination. The original "Instructions to Captain" and one copy of the "Calibration" and "Location of Sensors" documents will be given to the Captain for his reference. Copies of all documents should be sent to CHPHST and to the clearance official at the port of arrival.

Container Vessel

During intransit cold treatment on container vessels, the containers of fruit are refrigerated using shipboard refrigeration equipment. The containers are placed in cells. Each cell is outfitted with a closed refrigeration system with air distribution ducts. Each container is individually connected to the air distribution ducts by pneumatically controlled retractable supply and return air couplings. The group of containers in any one cell (6 to 24) constitutes a unit shipment for intransit cold treatment clearance.

The temperature recorders are generally located in the control room. Each recorder has connecting cables which terminate at specific locations within the cell. For 40-foot containers, each container requires its own sensor. For 20-foot containers, if there are fewer than 5 containers in a cell, each requires its own sensor; if there are 5 or more containers in the cell, then 1 of every 2 containers will be equipped with a pulp temperature recording sensor.

When the containers have been positioned in the cell, the sensors are connected to the available cables. Temperature records from these containers are automatically recorded from this point to the time of discharge. In addition to the vessel's pulp recorder sensors, which are present in the containers, each container must be equipped with one

"Type T" thermocouple wire sensor. This wire sensor is inserted into the fruit during the loading of the container. Thermocouple wire sensors provide the means to measure fruit temperatures in each container by use of a compatible, portable temperature indicating instrument. Temperature measurements are made during the precooling period at the terminal and at the time of discharge.

Testing of Recorder Sensors at Shoreside

Recorder sensors are tested under the monitoring of the designated certifying official using testing equipment equivalent to the recorders on board the vessel. The sensors are tested in a standard ice water bath at 0 °C (32 °F). Sensors may be tested at a central point prior to use provided the calibration errors are documented by the certifying official, and the sensors remain in the custody of the certifying official or person designated by that office.

Testing of Temperature Recorders Aboard the Vessel

Prior to loading fruit, the temperature recording system is tested under the monitoring of the certifying official using resistor plugs of known calibration (0 °C) attached to the recorder's connecting cables. Calibration error (which is the total of the combined error of the sensor and connecting cable) for each position on the recorder is documented by the certifying official.

Fruit in Shipboard-Cooled Containers

The following instructions outline the standard operating procedures for the intransit movement of fruit in containers under USDA-APHIS intransit cold treatment regulations.

Testing Recorder Sensors and Temperature Recorders

Officials approved by USDA-APHIS are the designated certifying officers (CO). The procedures for testing the temperature sensors and recorders are followed as outlined above under Container Vessel, Testing of Recorder Sensors at Shoreside and Testing of Temperature Recorders Aboard the Vessel.

Loading of Containers

Each container is loaded under the direct monitoring of the CO. Specific standard fruit packages approved by USDA-APHIS are to be used in all containers.

Maximum loading temperature for pears and apples is 4.4 °C (40 °F). Standard stowage is used in all containers and only one type of fruit and one type of package.

Temperature sensors are inserted into fruit at predesignated positions by the CO in all containers.

A seal is applied by the CO following the completion of loading of each container. The seal number is documented by the CO.

Precooling Fruit

Refrigeration is applied immediately upon the container's arrival at the terminal.

Fruit is precooled at the terminal to 2.2 °C (36 °F) or below, prior to loading on the vessel.

Just prior to loading on the vessel, fruit pulp temperatures in containers are measured and documented.

Stowing Containers on the Vessel

Containers are placed in the cells in a random fashion. At least one container equipped with a recorder sensor must be placed on each of the levels.

Documentation by Certifying Officer

Documentation of containerized shipments are more extensive than the documentation that is normally associated with shipments in a conventional vessel. The following information is recorded for each container in the shipment:

- container identification number
- container seal number
- quantity of fruit in container
- type of fruit in container
- pulp temperature at loading fruit in container
- pulp temperature at placing of container on vessel
- container position in cell
- recorder sensor calibration
- recorder cable calibration
- total calibration correction
- sensor and cable
- recorder sensor position in container
- random temperatures sampled at dockside during loading

Treatment

A continuous record of treatment temperatures is kept throughout the voyage. A responsible ship's officer must endorse the temperature chart during every 24-hour period. Treatment is not completed until so designated by a PPQ officer.

Clearance of Shipments Cold Treated in Transit

Conventional Vessel

Preliminary Planning

Prior to the arrival of the carrying vessel, the calibration and sensor location documents from the country of origin should have been received at the port of entry. Two additional copies are also placed on board the vessel, one of which is to be given to the PPQ officer.

A certificate of calibration is required for all shipments. This includes information as to the loading date and location of temperature sensors within the commodity, as well as calibration correction factors for every sensor.

The documents, and any accompanying correspondence, should be checked for comments relating to deficiencies noted at origin. They must bear the signature of a PPQ officer or of an authorized official of the exporting country. A list of such names and signatures for each country is on file at CPHST. The list of names and signatures by country is available upon request from CPHST.

Shipping line officials and pier supervisors should be informed of the quarantine safeguards to be observed pending clearance. The officer boarding the vessel should have several accurate thermometers. A scroll winding device should be used when reviewing records from a strip chart recorder.

The entries made on the intransit CT clearance report (PPQ Form 556) should be completed during the actual performance of each step of the clearance procedure. The instructions provide for a progressive clearance in the event that treatments are not completed before a vessel sails for a second U.S. port.

Locate Responsible Ship's Officer

U.S. Vessel: Usually the Chief Engineer or Reefer Engineer.

Foreign Flag: Usually the Chief Officer or Captain.

Inform the officer to withhold discharging the treated commodity until clearance has been completed.

Obtain the clearance officer's copy of the calibration documents from ship's officer (complete items 1-6, and 10).

Determine Recorder Type

Vessel with Strip Chart Recorders: Proceed to recorders with ship's officer. Determine if recorder is locked. Open recorder and check serial number (complete items 11 and 12).

Determine print interval by measuring time period, in seconds, between successive printing (complete item 13).

Stop recorder. Write name of vessel, date, time, and sign the temperature chart. Request ship's officer also to sign the chart. Remove the chart and restart the recorder.

Return to quarters to review the temperature chart with the ship's officer.

Assemble the chart in scroll winding device. Using an appropriate section of the chart, calculate the chart speed (complete item 14).

NOTICE

To calculate chart speed, divide the print interval in seconds into 3600: divide answer obtained by the number of prints per 1 inch or 1 centimeter of chart; multiply answer by 24 to obtain inches or centimeters per day. A sufficient length of chart should be studied to obtain an accurate determination of the number of prints per inch or centimeter.

Rewind the chart until the beginning of the chart roll is reached. Check the calibration record; compare actual calibration readings on the chart with the calibration data on the calibration document (complete item 23).

NOTICE

When reading the recorded temperature values on the chart, use the calibration factor for each sensor. Check the sprocket holes for possible misalignment of the chart. From the start of the precooling period, mark the chart at regular intervals (i.e., every 24 inches or 144 cm) in numerical sequence so the actual length of the chart can be determined.

Review the chart to the point where the loading of the compartment was completed. Determine the maximum and minimum fruit temperatures at the time when sensors were inserted (complete items 24, 25, and 26).

Continue reviewing the chart through the precooling period to the time when treatment commenced. Note abnormalities in the temperature readings which might indicate an irregularity in the treatment process (complete item 27).

Review the treatment portion of the chart for irregularities and excessive temperatures (complete item 28).

NOTICE

If the initial treatment period is broken because of excessive temperatures, failure of the recorder, or improper procedure, and the treatment is later restarted, enter the date and time of restart on the second line of item 28. Air temperatures may occasionally exceed treatment temperatures during defrost cycles; however, fruit temperatures should not rise appreciably during this time. During non-defrost times, the temperatures of the air sensors should never exceed the maximum allowable treatment temperature. For each compartment of a hold, the hourly sensor printouts will be examined by a PPQ Officer at the port of entry. Based upon these records, the officer shall make a determination as to whether to accept the treatment as satisfactory. **In case of dispute, the ultimate decision shall be made by the Port Director**, who shall take all factors into consideration. Occasionally, for example, there are cases in which one or two sensors in a compartment mechanically malfunctioned during the voyage, due to factors beyond the ship's control (e.g., rough seas). This is generally excusable, as long as the other sensors in the same compartment showed no readings higher than the cold treatment schedule allows. If, however, the ship stopped at another port while in route to the discharge destination in the US, but failed to have the facility sensor(s) repaired and recalibrated, this may be considered negligence on the part of the shipping line. The fruit from such refrigerated compartments would have to be retreated (in a cold warehouse) to be eligible for entry.

If a sensor is reading consistently high, it should be tested by use of the ice-water bath technique. If this sensor proves to be accurate (i.e, readings within plus or minus 0.3C from zero, then it must be assumed that the high readings obtained in the fruit were indeed accurate, which would be sufficient grounds for rejection. For additional evidence, the officer may also obtain independent fruit pulp readings from a hand-held portable temperature-sensing instrument, in the area of the load where high readings were obtained form the ship's sensor(s).

Compare actual chart length with calculated chart length. If not approximately the same, determine the cause and likely effects (complete items 15 and 16).

NOTICE

To obtain actual chart length, multiply the last number in the numerical sequence by 24 inches or 144 cm. To obtain the calculated chart length, multiply the chart speed in item 14 by the actual number of days and fraction thereof from the start of precooling.

Review the engineer's log for any irregularities which may have occurred during the treatment period. Proceed to refrigerated compartments with the ship's officer.

Check pulp temperatures with an accurate hand thermometer at high, low, and central areas (i.e., reefer door, hatch opening, fan room). Record maximum and minimum readings (complete item 29).

While taking hand thermometer temperatures, observe the stacking pattern (complete item 31). Return to the recording instrument and retrieve the remaining section of chart upon which the temperatures were being recorded during the clearance operation. These readings should approximate the readings taken with the hand thermometer. If

not, determine the cause and likely effect on treatment (complete item 30). (Proceed to Clearance Action by Officer, Importation of Load and Compartments, and Distribution of Clearance Documents.)

Vessel With Data Logger

Proceed to the data logger with the ship's officer. Request a temperature printout and observe performance of the instrument. Determine if the present time and date are correct (be sure to allow for time zone changes).

The vessel is permitted to store logged temperatures on magnetic media instead of printed on paper. However, the stored date must be printed in the presence of the PPQ Officer.

Collect all previous log sheets and return to quarters to review the temperature records with the ship's officer (complete items 11 and 13).

Assemble log sheets so that a review may be made starting at the beginning of the temperature record. Check the calibration record; compare the actual calibration readings on log sheets with the calibration data on the calibration document (complete item 23).

NOTICE

Many data logger installations are programmed to record temperature variations to one-hundredth of a degree centigrade (0.01 °C). With this high resolution of temperature readings, a deviation of up to three-hundredths of a degree can be expected from consecutive readings in a standard ice water test. Accordingly, calibration certifications which are acceptable under our accuracy requirements show either the average of two consecutive calibration readings or two consecutive readings which are within three-hundredths of a degree centigrade of each other. Deviations beyond this standard should be reported.

Review the log sheets to the point where the loading of the compartment was completed. Determine the maximum and minimum fruit temperature at the time the sensors were inserted (complete items 24, 25, and 26).

Continue reviewing the log sheets through the precooling period to the time when treatment commenced. Note abnormalities in the temperature readings which might indicate an irregularity in the treatment process (complete item 27).

Review the treatment portion of the log sheets for irregularities and excessive temperatures (complete item 28).

NOTICE

If the initial treatment period is broken because of excessive temperatures, failure of the data logger, or improper procedure, and the treatment is later restarted, enter the date and time of restart on the second line of item 28.

Air temperatures may occasionally exceed treatment temperatures during defrost cycles; however, fruit temperatures should not rise appreciably during this time, and should never exceed the maximum allowable treatment temperature.

Review the engineer's log for any irregularities which may have occurred during the treatment period. Proceed to refrigerated compartments with the ship's officer.

Check pulp temperatures with an accurate hand thermometer at high, low, and central areas (i.e., reefer door, hatch opening, fan room). Record maximum and minimum readings (complete item 29).

While taking hand thermometer temperatures, observe stacking pattern (complete item 31). Return to recording instrument to obtain printout of temperatures. These readings should approximate the readings taken with the hand thermometer. If not, determine the cause and likely effect on treatment (complete item 30). Proceed to the following: Clearance Action by Officer, Inspecting of Load and Compartments, and Distribution of Clearance Documents.

Clearance Action by Officer

The officer will: (1) record all exceptions in narrative form and attach to the clearance report; (2) release shipment for discharge if all requirements have been met and notify ship's officers, pier superintendents, and Customs; (3) hold shipment pending further evaluation if total effects of irregularities are not consistent with treatment requirements.

Inspection of Load and Compartments

Time permitting, a general examination should be made of the load and compartments during and after unloading is completed. Sensor locations, labeling, and physical condition should be observed and irregularities reported.

Distribution of Clearance Documents

See M390.210/556 for distribution information.

Container Vessel

Prior to discharge, temperature charts are reviewed by the PPQ officer. The procedures for clearance of intransit cold treatment aboard container vessels are similar to general procedures outlined for conventional vessels in Intransit Cold Treatment—Ships, Clearance of Shipments Cold Treated in Transit, Conventional Vessel, except as noted herein.

Every container is equipped with one "Type T" thermocouple sensor which is inserted into the fruit during the loading of the container. These sensors provide the means for checking the fruit temperature during the clearance operation without having to open the container.

The standard procedure in making this temperature check is to proceed to the refrigerated hold with the ship's officer. The officer will: (1) locate the thermocouple wires which should be extending from each container, (2) record the number of the container, (3) attach the thermocouple wire to the potentiometer, and (4) record the temperature reading.

Manual pulp temperatures may be taken using an electronic, bimetal or liquid hand thermometer when necessary to check abnormal sensor readings.

Progressive Cold Treatment Clearance

Progressive clearance is a special procedure requiring advance authorization and planning before it can be accomplished. The CPHST is responsible for authorizing and coordinating progressive CT clearance.

When two ports are involved in the CT clearance of a vessel, the first port removes the initial portion of the temperature chart for review. Items 1 through 27 of PPQ Form 556 are completed. The first port must forward the removed portion of the temperature chart along with the Treatment Clearance Report (PPQ Form 556), with observations and comments attached, and calibration documents to the final clearance port. Discrepancies which are noted by the first port should be reported by phone (and recorded on the PPQ Form 556) to the second port in advance of the ship's arrival. All documents must be forwarded with the vessel under the Captain's care.

The second port, after reviewing the remainder of the treatment record, completes the PPQ Form 556 for distribution. The initial portion of the temperature chart need not be reviewed unless a discrepancy is noted.

Intransit Cold Treatment Procedure—Self-Refrigerated (Integral) Containers: Introduction

Self-refrigerated containers can be used successfully to satisfy cold treatment requirements; however, factors such as commodity type, packing, loading patterns, load, ambient temperature, container handling practices, and shipboard monitoring can affect the outcome of the treatment. All aspects of this type of cold treatment must be monitored very closely to insure success.

Initiating Intransit Cold Treatments

Check Container

Type and series must be USDA-approved (see Appendix F).

The container must be sound, in good working order, and the doors must have a tight seal. Also must be precooled prior to loading. Precooling may be done in the container but must have prior approval from CPHST.

Calibration of Temperature Recorders and Sensors

Recorder must be USDA-approved. See a list of approved temperature recording instruments in Appendix H, Temperature Recorders for Self-refrigerated Containers.

Calibration is conducted using a mixture of crushed ice and fresh water in clean, insulated containers. The ice must nearly fill the container; then water is added to the level of the ice. As the ice melts, additional ice is to be added or the water level reduced. The ice water mixture must be carefully prepared and maintained.

The sensors must be submerged in the ice water mixture without touching the sides or bottom of the container. It is important that the mixture be constantly stirred while testing. Testing of each sensor in the ice water must continue until the reading is stabilized at the lowest temperature obtainable. Two consecutive readings of the lowest temperature obtainable must be recorded. There should be at least a 60-second interval between the two consecutive readings for any one sensor; however, the interval should not exceed 5 minutes. Any sensor which records more than plus or minus 0.3°C (0.5°F) from the standard of 0°C (32°F) must be replaced. Every effort should be made to determine the calibrations to the nearest tenth of one degree. Also, the recorder used with the sensors must be capable of printing on demand and not just at hourly intervals.

Check Fruit

Prior to loading, fruit should be precooled to a treatment temperature or to a uniform temperature not to exceed 4.5 °C.

Fruit temperature must be checked manually before loading, and the warmest fruit placed in the last quarter of the load.

Fruit must be loaded directly from the precooling storage area to the container so the fruit temperature does not rise.

Loading the Fruit

Each container must contain only one type of fruit loaded in one type of carton. Fruit must be loaded so that the floor is completely covered, and the load is of uniform height throughout the container.

Bottom air delivery units must be loaded using “solid block” stowage. Top air delivery units must be loaded using “horizontal air flow” stowage.

A numbered seal must be placed on the loaded container. This must not be removed until the load has been cleared at the port of destination.

Fruit temperatures must not be allowed to rise after loading and during the transfer of the container to the vessel.

Monitor Loading and Placement of Temperature Sensors

Records of temperature are required from at least three locations. One fruit sensor (previously called an air sensor) must be placed in the fruit in the top of the center box located at the front of the load next to the air return intake. If, for example, the fruit is grapes, this sensor would be placed in the cluster of grapes in the top layer of fruit in the top of the box. The two remaining fruit sensors must be placed approximately 5 feet from the end of the load for 40-ft containers and approximately 3 feet from the end of the load for 20-ft or 24-ft containers (see Figure 3.3.1 showing placement of sensors).

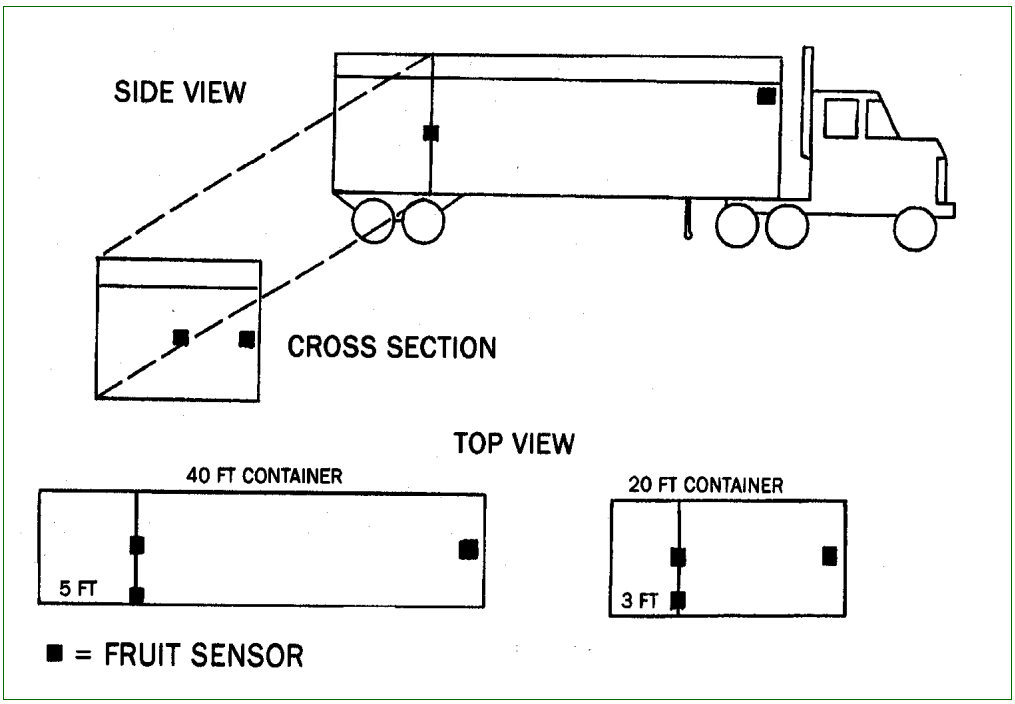


FIGURE 3-7-1: Position of Temperature Sensors in Containers

One sensor must be placed in a center carton and one in a carton at a side wall, both at one-half the height of the load. Placement of sensors must be under the direction of a PPQ officer or a certified official in the country of origin. The tip of the sensor must not extend beyond the fruit. With small fruit it may be necessary to penetrate two or more fruit.

If the recorder is to be carried inside of the container, the temperature data should be obtainable without opening the container doors.

Recordings of all temperature sensors must be made every hour, and printouts must be made available to the PPQ officer at the port of destination for final clearance of the container.

In addition to the recorder sensors in the container, each container should be equipped with a "Type T" thermocouple wire sensor. This wire sensor is inserted into the fruit near one of the recorder sensors.

The wire ends must be available on the outside of the container. The wire sensor provides the means to measure fruit temperature by use of a compatible, portable temperature-indicating instrument.

Off-loading of self-refrigerated containerized fruit that is under treatment must be accomplished rapidly. Containers must be off-loaded and treatment reconvened within 2 or 3 hours from the time the container was disconnected from the refrigerating unit. The pulp sensors should never exceed the maximum allowable treatment temperature.

NOTICE

The thermocouple requirement may be waived, with approval from CPHST; however, the container door must be opened and manual fruit pulp temperature must be taken after the cold treatment is complete.

Prepare Documents

A "Certificate of Loading and Calibration for Cold Treatment in Self-Refrigerated Containers" document must be prepared for each container and signed by an approved official in the country of origin.

"Instructions to the Captain" and "Location of Temperature Sensors" documents must be prepared and signed. Only one of each of these is needed for each group of containers providing they are loaded in the same manner.

Distribute Documents

The original "Calibration" document and a copy of the "Instructions to the Captain" document will be placed in a sealed envelope and given to the captain for presentation to the PPQ officer at the port of arrival.

The original “Instructions to the Captain” document and one copy of the “Calibration” document will be given to the captain for his reference. Copies of all documents must be sent to the PPQ officer at the first port of arrival and to the following address:

USDA-APHIS-PPQ-CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606
Attention: Allison or Laura

Clearance of Intransit Cold Treatments

Obtain the temperature printout and match it with the corresponding “Certificate of Loading” and “Calibration” documents by using the container or recorder number. The documents, and any accompanying correspondence, should be checked for comments relating to deficiencies noted at origin. They must bear the signature of a PPQ officer or of an authorized official of the exporting country. A list of such names and signatures for each country should be on file at each approved port of entry, and signatures must be checked against this to verify authenticity. If the recorder has to be removed from the container to obtain the temperature printout, the recorder should be restarted and replaced as soon as possible so that the temperature record is not interrupted when additional time is needed for completion of the treatment. **This may only be done under USDA monitoring**.

Gaps in the print-out shall be allowed on a case-by-case basis, taking into account the number of gaps, length of each gap, and the temperature before and after. Gaps not exceeding one continuous hour in the print-out of a particular sensor are generally not considered significant, provided the temperatures were within range immediately before and immediately after the gap. Longer gaps in the print-out may be grounds for treatment failure, unless the crew has kept a detailed written log of hand-recorded pulp temperatures, all within acceptable range. In this case, a sworn statement from the ship's captain shall also be required.

Compare printout with loading document to be sure the calibration factors, recorder start time, and recorder start date are the same.

Using PPQ Form 556 (Intransit Cold Treatment Clearance Report) fill in items 1-6 and 10. Write the container number in item 24. Six containers can be cleared per form.

Record the maximum and minimum fruit temperatures from the printout at time of loading (complete items 25 and 26).

Review the temperatures and mark the printout where treatment commences at each temperature according to the appropriate treatment schedule. Determine date and time each treatment commenced (complete item 27).

Review the treatment portion of the printout for irregularities and excessive temperatures (complete item 28). Air temperatures may occasionally exceed treatment temperatures due to defrost cycles; however, fruit temperatures should not rise appreciably during this time. During non-defrost times the temperatures of the air sensors should never exceed the maximum allowable treatment temperature. If necessary, be sure to subtract or add correction factors to obtain the true temperature. (In some cases the computer used to download the data will perform this task.)

NOTICE

If the initial treatment period is broken because of excessive temperatures, failure of the data logger, or improper procedure, and the treatment is restarted, enter the date and time of restart on the second line of item 28.

After determining that cold treatment requirements have been satisfied, pulp temperatures of the fruit should be determined with an accurate hand thermometer (complete item 29) or by means of the thermocouple wire. In some cases this step can be performed when removing the recorder for downloading of data. Verification of the container seal number should also be done at this time.

Record the last readings of the printout in item 30. These readings should approximate the readings taken with the hand thermometer. Discrepancies should be further investigated.

If the treatment has not been completed, determine the amount of time needed to complete the treatment, and report this to the persons responsible for the container. At the end of the predicted completion period, check the temperature recordings to determine if the treatment has been completed.

Submit printout, copy of PPQ Form 556, and calibration documents to the CPHST. See M390.210/556 for distribution information. These documents should be submitted even if the treatment was negated.

Cold Treatment—Warehouses

Requirements for the Movement of Enterable Fruit to Approved Cold Treatment Facilities

The warehouse must be approved by PPQ (see Certifying Facilities).

The shipment must move directly from the port of entry to the cold storage warehouse with no diversion or delay.

The warehouse must provide the necessary security for safeguarding each shipment.

The unloading of carriers which arrive at the warehouse under seal must be conducted under PPQ monitoring.

Initiating the Cold Treatment

The procedures for the operational check of recording equipment and calibration of temperature sensors are similar to those outlined for vessels in Intransit Cold Treatment, Initiating Intransit Cold Treatments, Conventional Refrigerated Vessel, Check Instrument Operation and Calibrate Temperature Recording System. This must be performed under the direction of a PPQ officer.

Stowage must be arranged to provide for adequate air distribution throughout the shipment, and to allow for the sampling of pulp temperatures in any desired location. To accomplish this, aisles must be left between rows of pallets with the aisles parallel to the air flow. Space should also be allowed between pallets.

After loading is completed, manual fruit temperatures must be taken at various locations throughout the load to determine the location of the warmest fruit. Temperature sensors should then be placed randomly throughout the load, being sure to place sensors in the warmest areas. Under some conditions, additional air circulation will be required to cool the shipment uniformly. The use of additional fans or blowers will depend on the particular circumstances at the time of treatment.

Placement of sensors should be under the direction of a PPQ officer. The sensor must be well inserted into the fruit. The tip of the sensor must not extend beyond the fruit. If necessary (in the case of small fruit), the sensor should penetrate two or more fruit.

Clearance of the Cold Treated Fruit

Clearance is similar to the procedure used to clear cold treated fruit on vessels (see Intransit Cold Treatment Procedure of Ships, Clearance of Shipments Cold Treated in Transit, Conventional Vessel).

3

Treatment Manual

Nonchemical Treatments

Irradiation

Contents

Introduction **page-3-8-1**
- General Information **page-3-8-1**
- Approved Sources of Irradiation **page-3-8-3**
- Location of the Irradiation Facility **page-3-8-4**
- Actions Taken at the Port of Entry **page-3-8-4**

Permits **page-3-8-4**

Standard Operating Procedures and the Compliance Agreement **page-3-8-5**
- General Information **page-3-8-5**
- Components of the Compliance Agreement **page-3-8-6**

SAFEGUARDING IRRADIATION TREATMENT FACILITIES **page-3-8-10**
- General Information **page-3-8-10**
- Safeguards **page-3-8-10**

Three Scenarios **page-3-8-14**

Introduction

General Information

This guide provides basic information concerning USDA policy, standards, and use of irradiation as a treatment process to eradicate invasive species of insects, diseases and plants, that may contaminate and be vectored by commodities and other transported items. These harmful invaders are holistically referred to as pests, or pests of plants. This guide also discusses procedures for the approval of facilities that use irradiation energy to mitigate pest to facilitate authorized movement of commodities in commerce. The use of irradiation or the approval of irradiation facilities for other purposes is outside of our scope.

This guide does not establish new regulatory requirements for conducting irradiation treatments, or moving articles treated by irradiation. Instead, it explains certain requirements already established in various APHIS regulations in the CFR; it describes actions that APHIS employees will take, at ports, irradiation facilities, and elsewhere, to enforce those regulations; and it describes a number of safeguards or best practices to comply with the regulatory requirements. A company may devise a facility design or procedure that complies with irradiation regulatory requirements but does not precisely match the options described in this guide. Such innovation may be acceptable. However, issuing a permit or certifying a facility might take somewhat longer in such cases. When the procedures do

not follow those described in this guide, APHIS employees will have to independently verify that they comply with regulatory requirements before issuing the permit or certifying the facility.

To be authorized to apply approved phytosanitary irradiation treatments, an irradiation facility shall first obtain a Certificate of Approval from USDA. (For details, see the section entitled "Certification of Irradiation Treatment Facilities," beginning on **page-6-8-1**.)

The regulatory framework that covers the use of irradiation against plant pests was originally published in the *Federal Register*, and later incorporated into the *Code of Federal Regulations*. Detailed citations are listed below:

- Irradiation phytosanitary treatment of imported fruits and vegetables. (Proposed rule; supplemental) 66 FR *in press* [Docket No. 98-030-3]. To be incorporated into the Code of Federal Regulations at 7CFR and 305 and 319.56.
- Fruit from Hawaii (Final rule). 63 FR 65645-65649, Nov. 30, 1998[Docket No. 97-005-2]. Incorporated into the Code of Federal Regulations at 7CFR 318.13-4f.
- Irradiation in the production, processing and handling of food. (Final rule). 62 FR 64107-64121, Dec. 3, 1997 [Docket No. 94F-0289]; *also*, 51 FR 13376-13399, Apr. 18, 1986 [Docket No. 81N-004]; *also*, 50 FR 15415-15417, Apr. 18, 1985 [Docket No. 84F-0287]. Incorporated into the Code of Federal Regulations at 21CFR 179.
- Irradiation in the production, processing, and handling of animal food and pet food (Final rules). 60 FR 50099, Sept. 28, 1995. *also* 58 FR 18148, Apr. 8, 1993. also 51 FR 8315, Mar. 11, 1896; *also*, 51 FR 5993, Feb. 19, 1986. Incorporated into the Code of Federal Regulations at 21CFR 579.
- Mediterranean fruit fly; additions to quarantined areas and treatments. (Interim rule). 62 FR 47553-47558, Sept. 10, 1997 [Docket No. 97-056-5]. Incorporated into the Code of Federal Regulations at 7CFR 301.78-10.
- Papaya, carambola, and litchi from Hawaii. (Final rule). 62 FR 36967-36976, July 10, 1997 [Docket No. 95-069-2]. Incorporated into the Code of Federal Regulations at 7CFR 318.13-4f.
- The application of irradiation to phytosanitary problems. (Notice of policy). 61 FR 24433-24439, May 15, 1996 [Docket No. 95-088-1].

- The use of irradiation as a quarantine treatment for fresh fruits of papaya from Hawaii. (Final rule). 54 FR 387-393, Jan. 6, 1989 [Docket No. 87-040]. Incorporated into the Code of Federal Regulations at 7CFR 318.13-4f.

Irradiation has been demonstrated to be effective in killing or devitalizing organisms that may contaminate and do harm to commodities or the ecosystems to which the commodities move. This energy source can thus be authorized for use in the treatment of regulated pests. Treatment may be mandatory, as a condition for the entry or movement of consignments, or it may be prescribed, based on the detection of regulated pests in commodities intended for transport. Alternatively, importers or exporters may voluntarily subject commodities to irradiation treatments in order to prolong their acceptability and desirability. Irradiation may thus be a treatment option, or it may be the only treatment which is approved for the pest and commodity in question.

As with all pest mitigation treatments, the objective is to minimize the risk of pest introduction through the use of exclusionary measures. The minimization of pest risk may be achieved through the use of treatments that have an acceptable level of efficacy. Treatments are approved that minimize the impact on the commodity and its ultimate use. The approval of irradiation, or any other technology as a pest mitigation treatment, does not favor that particular methodology. The purpose of these treatments is to minimize the pest risk and to maximize the safety associated with the movement and use of the commodity. Treatments and associated procedures are based upon science, and are no more restrictive than necessary to protect agricultural health.

For the purpose of this guide, the Animal and Plant Heath Inspection Service (APHIS) will usually function as the USDA representative in the use of irradiation for mitigating pests. Information concerning the use of irradiation and other pest mitigation treatments may be obtained from:

Important

USDA-APHIS-PPQ-CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606

Approved Sources of Irradiation

The sources for energy commonly used in irradiation come from gamma-emitting isotopes (radio nuclides) of cobalt-60 or cesium-137; or from machine-generated sources which include (x-rays [bremsstrahlung] operated at or below an energy level of 5.0 MeV, or

electron beams operated at or below an energy level of 10 MeV). Any of these sources can be effectively used to devitalize pests that may be contaminants, thus eliminating the risk of relocating alien invasive species that pose a threat to agriculture or other ecosystems. The source and equipment used for pest mitigation treatments must be capable of safely and effectively irradiating the commodities to the specifications which are required for the targeted pests.

Location of the Irradiation Facility

Facilities approved by USDA for pest mitigation treatments may be located in the United States or outside the United States. Treatment facilities may be identified as being located within or outside an area where pests of concern are known to occur.

Actions Taken at the Port of Entry

In the case of commodities irradiated at a foreign or United States offshore facility. the USDA Plant Protection and Quarantine Officer at the port of entry will review the bill of lading, phytosanitary certificate, or other documentation accompanying the shipment, determine whether or not the shipment is precleared, and decide whether to inspect the commodity for actionable pests that might not have been mitigated by the treatment and might be vectored be the shipment. If non-target pests are encountered, the inspector shall make inquiry to irradiated, a perishable commodity cannot be re-irradiated. In the case of commodities arriving untreated (to be irradiated in the United States), the officer shall:

- review the documentation accompanying the shipment
- ensure compliance with biologically sound safeguards
- facilitate the planned movement of the shipment to an approved treatment facility

Permits

Importers must have, and present (to a USDA Plant Protection and Quarantine Officer at the port of entry) a valid permit before offering for entry of irradiated commodities or commodities intended for irradiation treatment in the USA. Permits may be obtained from:

Important

United States Department of Agriculture (USDA),
Animal and Plant Health Inspection Service (APHIS),
Plant Protection and Quarantine (PPQ),
Permit Unit,
4700 River Road, Unit 133,
Riverdale, MD 20737-1236

For detailed information on permits, applicants may contact the APHIS web site at http://www.aphis.usda.gov/ppq/ss/permits.html. These permits give the conditions of entry requirements, procedures to be followed, commodities covered, accountability and other pertinent information. Permits should be secured at least 30 days in advance of arrival to ensure that ports can be contacted, provisions can be developed, and permits can be transmitted to permittees and ports in advance of arriving shipments. Permits will be provided only to a person or firm able to accept liability and exercise responsibility for the shipment while in the United States. Brokers, agents, and other second-party permittees must be able to demonstrate direct authority concerning the handling of transit shipments under their permit.

Standard Operating Procedures and the Compliance Agreement

General Information

Standard Operating Procedures (SOP) shall be developed and documented by each facility that address irradiation of commodities for mitigation of pests of plants. This document must be in place before the facility is offered for certification. It must include the “how to” for all facets of handling, safeguarding and treating the commodities. Critical control points are dose, dosimetry, and safeguards. Critical control points are points where errors will definitely reduce the long-term effectiveness of the treatment. (On the other hand, effort to ensure correct procedure at these points will result in substantially more effective treatments.) The SOP will be reviewed and scrutinized along with the facility and personnel qualifications in determining the acceptability for certification. Any required changes in this document shall be made before a Compliance Agreement can be issued. This document will be referenced as a part of a formal, written agreement between USDA and the facility. Such agreements shall be reviewed periodically, modified as needed, and treated as confidential.

Before operating as an approved irradiation plant pest treatment facility, a formal, written agreement shall be developed between the irradiation facility and USDA. This document is called a Compliance Agreement when applied to facilities in the United States. **PPQ Form 519 (Compliance Agreement)** may be used as a cover sheet for this document, with attachments as needed.

For foreign facilities, this document may be called a Cooperative Agreement or Work Plan. The signatories to a binational agreement with foreign facilities will include a representative of the irradiation facility, the national plant protection organization, and the USDA (i.e., the Administrator of APHIS, who may delegate this responsibility to

the Regional or Area Director of APHIS International Services who has responsibility for a particular country.) In the case of facilities applying regulatory treatments in Canada or Mexico, that country's delegate to the North American Plant Protection Organization may also be requested to sign. Regulatory officials shall have a Cooperative Agreement or Work Plan on hand, plus a copy of the treatment schedule for the particular pest and commodity being treated, in order to perform their duties as a regulatory official.

Importers also need to sign a separate Compliance Agreement with APHIS, to ensure that they move articles safely to the irradiation facility.

A Compliance Agreement (or equivalent) shall be valid until terminated by a request from the facility. USDA, however, shall suspend or terminate the agreement when any provision is not being met, or is being willfully violated. USDA also has statutory authority to impose civil penalties on facilities in the United States or at the port of entry for foreign facilities for significant noncompliance.

Components of the Compliance Agreement

Safeguarding

The Compliance Agreement, Cooperative Agreement or Work Plan shall describe the pertinent safeguards applicable to the particular facility. Safeguarding topics fall into three general categories:

1. Pretreatment
   - receiving
   - separation of treated from untreated commodities
   - packaging
   - marking/labeling
2. Processing
   - general sanitation
3. 3. Post-treatment
   - wrapping
   - loading of containers

The section for Safeguards (beginning on **page-3-8-10**) addresses the topic of safeguarding in greater depth.

Notifying the regulatory authority

USDA (or the host country's NPPO counterpart agency) shall be notified by the irradiation facility at least 24 hours before irradiating regulated domestic agricultural commodities, or 30 days for regulated foreign agricultural commodities, except if the treatments are ongoing or scheduled.

Treatments shall be subject to scrutiny by an approved inspector. During the initial phase, it is considered important for an inspector to be on site. Phase out of the inspector's presence can be accomplished over a period of time, after the level of confidence is built up that proper procedures are in place, and are working to achieve their goal. Thereafter, an inspector will usually not be physically present to monitor individual treatment procedures. Inspector visits may be announced or unannounced, and shall include an examination of treatment records, and spot-checks to verify that biological safeguards are being conducted.

Treatment verification

Dosimetry system - Use ASTM Standard E1261, Guide for Selection and Calibration of Dosimetry Systems for Radiation Processing (or an equivalent international standard) as a guide for selection and calibration of an appropriate routine dosimetry system that matches the dosimeter requirements for the specific application criteria. Other individual ASTM standards (E 1204 and E 1431) provide detailed procedures for using specific dosimetry systems. (ASTM standards on dosimetry for radiation processing are published in the Annual Book of ASTM Standards, Volume 12.02, American Society for Testing and Materials, West Conshohocken, Pennsylvania.) Prior to use, the dosimetry system shall be calibrated in accordance with the user's documented procedure that specifies details of the calibration process and quality assurance requirements. This calibration shall be repeated when appropriate to ensure that the minimum dose is given to the targeted pest(s). Calibration of dosimeters shall be traceable to a national standard.

Dose mapping- The irradiation facility shall perform sufficient validation studies (dose mappings) to fully characterize the distribution of dose in the irradiation container to determine the zones of minimum and maximum dose. Dose mapping activities shall be conducted with consideration of the density ranges of product categories to be processed. Product loading patterns and pathways used for irradiation processing shall also be addressed. The information from the dose mapping validation is used in the selection of dose monitoring locations for routine processing. Additional dose mapping is required when significant changes are made to the irradiator, to the load, fruit size, or packaging, that could affect the distribution and quantity of dose. Dose mapping shall comply with ASTM Standard E1204, Practice for the Application of Dosimetry in the Characterization of a Gamma Irradiation Facility for Food Processing, or ASTM Standard E1431, Practice for Dosimetry in Electron and Bremsstrahlung Irradiation Facilities for Food Processing.

Timer or cycle validation- Irradiation exposure times to assure delivery of the specified dose shall also be evaluated. In the case of radioisotope processing, this may involve validating timer settings

upon which product container movements are based, or in the case of electron or x-ray processing, validating conveyor speeds. Timers should be calibrated to NIST Time Signals.

Routine dosimetry- Routine dosimetry is part of a verification process for establishing that the irradiation process is in compliance. Dosimetry is only one component of a total quality assurance program for adherence to good manufacturing practices. An appropriate dosimetry system shall be selected, and dosimetry procedures shall be followed for irradiator characterization, process qualification, and routine processing, to ensure that all product has been treated with the minimum absorbed dose prescribed by USDA for mitigation of the particular target pest(s) presumed to infest/infect/contaminate a given commodity from a particular origin. If non-target pests (such as hitch hikers) are encountered, the inspector shall make inquiry to appropriate authorities as to treatment efficacy. The dosimetry system shall be periodically calibrated in accordance with ASTM Standard E1261, and is traceable to national or international standards. Proper dosimetric measurement procedures shall be employed, with appropriate statistical controls and documentation in accordance with ASTM Standard E1204 (for gamma facilities) or E1431 (for electron beam and x-ray [bremsstrahlung] facilities). Once the capability to process the items within prescribed absorbed-dose limits is established, it is necessary only to monitor and record the minimum and maximum absorbed dose during each production run, to verify compliance with the process specifications within a predetermined level of confidence. The facility SOP shall specify how frequently dosimeters will be used.

Important

USDA shall require that each carton shall bear a radiation-sensitive indicator (RSI) as evidence of treatment. RSI's (such as labels, papers, or inks that undergo a color change when exposed to irradiation) are not quantitative, and therefore shall not be used as a substitute for proper dosimetry.

Notifying the exporter or receiver

The irradiation facility shall notify (by telephone, fax, or E-mail) the exporter, receiver, or other designated person, immediately upon completion of the irradiation processing of his consignment, to expedite delivery. When the irradiation treatment has been conducted in a foreign country, the irradiation facility shall also request the national plant protection organization to issue a phytosanitary certificate and apply official seals, if required.

Treatment documentation (record keeping)

Phytosanitary certificate, and certificate of treatment- For offshore arrivals at a United States port of entry, a phytosanitary certificate (with treatment information, if any, filled in), and the irradiation processor's certificate of treatment (if a treatment was done) must accompany the shipment.

Records kept at the plant- Key pieces of information (to include (either on the certificate of treatment or in back-up files) shall include:

- Name of the product and quantity
- Grower's lot (batch) identification (to be shown also on each carton)
- Prescribed treatment
- Evidence of compliance with the prescribed treatment
- Ionizing energy source
- Dosimetry system calibration records
- Dose mapping records
- Dosimetry data (minimum and maximum)
- Date of irradiation
- Records, invoices, and bills of lading for each treated lot (batch) must be kept for one year, and made available by the irradiation processor for inspection by designated regulatory officials.

Official seals- Irradiated shipments leaving a facility on the mainland United States do not need USDA seals if destined to domestic markets. If the shipment is destined to foreign markets, however, USDA shall apply seals and issue a Phytosanitary Certificate if required. Irradiated or untreated shipments leaving Hawaii for the mainland United States shall have official seals applied by USDA, if required. Irradiated or untreated shipments leaving a foreign country for the United States shall have seals applied by the national plant protection organization (NPPO) in the country where the facility is located, and/or by USDA, if required.

Important

Disclaimer: The United States Department of Agriculture and its inspectors do not assume liability for any loss or damage resulting from any treatment prescribed or super vised. Treatments are approved to assure biological security against designated pests. From the literature available, agricultural commodities authorized for treatment are believed to be tolerant to the prescribed dose. However, the facility operator and shipper are responsible for determination of tolerance. Additionally, the Nuclear Regulator y Commission is responsible for ensuring that irradiation facilities are constructed and operated in a safe manner. Further, the Food and Drug Administration is responsible for ensuring that irradiated foods are safe and wholesome for human consumption [21 CFR par t 179].

SAFEGUARDING IRRADIATION TREATMENT FACILITIES

General Information

Safeguards may be aimed either at preventing the treated commodity from becoming reinfested, or preventing the surrounding environment from becoming infested by pests escaping from the untreated commodity. Pests of concern typically include Tephritid fruit flies, wood-boring insects, surface feeders such as mites, and miscellaneous hitchhikers such as snails.In some cases, the pests may be noxious weed seeds or plant disease organisms. The Compliance Agreement will specify the phytosanitary safeguards to be observed at the facility. If the pest risk cannot be mitigated, then shipment of product to the facility shall be disallowed.

The location of the irradiation facility, and the sensitivity of the surrounding environment are important considerations in determining which safeguards apply in a given case. At foreign facilities, the national plant protection organization of the particular country should also become involved. Other considerations include whether the commodity is treated in bulk or in the final package, and whether the target pests, due to their mobility, present an unusual risk.

USDA has a great deal of latitude in prescribing safeguards for individual facilities. This is particularly necessary, considering the various circumstances under which the treatment operation will be conducted. Details of a particular safeguarding regimen shall be established in cooperation with the facility manager, and tailored to meet existing circumstances. If the commodities/pest complexes/ product origins change at a particular facility, the safeguarding program shall be adjusted accordingly, with appropriate amendments or revisions made to the Compliance Agreement. The purpose of all mitigation and safeguarding activities is to prevent pests from moving from infested ecosystems to non infested ecosystems.

Safeguards

The following seven critical safeguarding topics, as addressed in the Compliance Agreement[1], are discussed in this section:

- Receiving
- Separation of treated from untreated commodities
- Packaging
- Marking/labeling

1 Refer back to ""Components of the Compliance Agreement" on **page-3-8-6**" for a detailed discussion of the requirements for notification, treatment verification, and documentation.

- General sanitation
- Wrapping
- Loading of containers

The USDA may require any of these safeguards under the following three different scenarios as described on **page-3-8-14**):

- Scenario 1: The irradiation facility is located within an infested area.
- Scenario 2: The irradiation facility is not located within an infested area, but the surrounding environment is susceptible to the target pests.
- Scenario 3: The irradiation facility is not located within an infested area, and the surrounding environment is not susceptible to the target pests.

Receiving

A record of origin (growing and shipping points) must accompany all arrivals at the facility.

For Scenarios 1 and 2, vans and sea containers used for delivery should form a pest-secure connection with the receiving area of the building, if pests are mobile. However, this would not be necessary if the commodity arrives in pest-proof cartons, or is wrapped in polyethylene (or equivalent) sheeting or insect netting. For Scenario 2, the irradiation facility shall not be allowed to receive the product that arrives non containerized (e.g., in an automobile or pickup truck). If a pest-secure connection is not possible, then the receiving door shall be opened for the minimum time possible, while the unloading is being expedited. (These precautions are not necessary in Scenario 3.)

When empty, the sea containers, truck vans, and air cargo containers in which the commodity arrived shall be swept clean, and the sweepings bagged and irradiated to at least the minimum dose designated for the product, or destroyed in a manner approved by USDA. If pests are at large in the emptied container, the container shall be treated immediately with a suitable insecticide, followed by visual inspection. (Use an aerosol insecticide for mobile pests, or a residual spray for others, following instructions on the label.)

Irradiation processing of agricultural commodities shall be expedited, to retard the development and possible emergence of pests from the commodity. USDA recommends that the consignment be kept in temporary cool storage if it is not possible to irradiate it within 24 hours of arrival.

Separation of treated from untreated commodities

The facility shall have a reliable system for separating treated from untreated products, to safeguard against commingling, cross-infestation, mistaken identity, and release without treatment. In Scenarios 1 and 2, the physical barrier shall also be a pest-proof (biological) barrier (i.e., a solid wall or a screen with a mesh size fine enough to exclude flying insects), unless the commodity arrives in pest-proof cartons, or if the target pests are immobile. In Scenario 3, a 6-ft barrier, such as a chain link fence, is adequate for all pests, and the type of carton is of minor importance

Packaging

The commodity shall arrive at the facility in pest-proof packaging if the pests are mobile, except if a pest-proof barrier (between pretreatment and post-treatment storage areas) is in place at the facility. This provision would apply only in Scenarios 1 and 2. If pests are not mobile, or if the surrounding area is not susceptible to infestation by the target pests in Scenario 3, then the type of packaging becomes less important. Seals or other devices may be used to visually indicate if packages have been opened. For pests that are not mobile, simple containment is the key, and the integrity of the container load is the main concern. Pest-proof packages, if required, may be constructed of any material that prevents the entry or escape of the pest, prevents egg-laying into the carton, and the dispersal of pupae. If openings in the carton are needed in order to maintain freshness of the commodity, they shall be double screened.

Important

If there are any questions concerning the adequacy or biological security of a particular package or configuration, shippers may send a sample for evaluation to:

USDA-APHIS-PPQ-CPHST
Treatmetn Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606
Tel: 919-513-2496
Fax: 919-513-1995

Marking / Labeling

In order to enable trace-back of shipments, unit loads shall be labeled or coded with identifiable treatment lot or batch numbers, packing and treatment facility identification and location, and the dates of packing and treatment. In addition, each carton (or smallest containment unit) shall bear a stamp identifying the lot or batch number and treatment facility. The markings on individual packages may be encrypted (e.g., bar coding). If the pallet load is broken down into smaller units before or during the process of entering the United States, the individual cartons must be labeled with the same information as the original pallet load.

Important

Cartons treated under USDA super vision in Hawaii shall be stamped TREATED--USDA APHIS. This may not be preprinted on the carton at the time of manufacture.

In the case of food commodities, the United States Food and Drug Administration (FDA) also requires the international irradiation logo (radura) to appear on each carton, along with the statement Treated by irradiation or Treated with radiation. (This may be preprinted on the carton.)

General Sanitation

A high level of sanitation shall be maintained around the facility, as well as within the pre- and post-treatment storage areas, and the equipment used for transporting the product through the irradiator. Windows, if they are going to be opened, must be equipped with screens. Facilities are advised to install black light traps for flying insects, and to contract with a pest control firm. Critical concerns of USDA include pest monitoring and minimizing the attractiveness of treatment facilities for pests. Disposal procedures shall be in place for rotted produce, produce with damaged packing, and produce that has been improperly irradiated. These materials shall be irradiated, at a dose sufficient to mitigate the potential pest risk, prior to disposal by incineration or burial in a sanitary landfill, if required by USDA. The area of the floor where the commodity is loaded onto the conveyor shall be swept clean at the end of the day, and the debris shall be bagged and irradiated to at least the minimum dose designated for the product.

Wrapping

Maintain the integrity of the pallet load or other configuration of packages representing a treatment unit by wrapping it before it leaves the irradiation facility. In Scenarios 2 and 3, (where the irradiation facility is not located within an infested area), a suitable method of wrapping would be to use strapping, so that each carton on an outside row of the pallet load is constrained by a metal or plastic strap. In Scenario 1, (where the irradiation facility is located in an infested area), the treatment unit shall be wrapped in polyethylene (or equivalent) sheet wrap or fine net wrapping. USDA, however, may waive the requirement for post-treatment wrapping if the cartons are pest-proof, and the pallet load is to be broken down into smaller shipping units, such as LD-3 air cargo containers or individual cartons.

Loading of containers

Empty containers or vans shall be carefully inspected, and decontaminated (if necessary), prior to loading with treated product. Empty containers shall be swept clean, and the sweepings bagged and put through the irradiator. If pests are at large in the empty container, the container shall be treated immediately with a suitable insecticide, followed by visual inspection. (Use an aerosol insecticide for mobile pests, or a residual spray for others, following instructions on the label.) In Scenario 1 (where the facility is located in an infested area), if the pests are mobile, special care should be taken to prevent the reentry of untreated pests into the treated product. The conveyance

shall be pest-proof. In addition, the driver shall make every effort to form a pest-secure connection between the conveyance and the building. If this is not possible, then the door to the loading dock shall be opened for the minimum time possible, while loading is being expedited. This precaution is not needed in Scenarios 2 and 3 (where the irradiation facility is not located in an infested area).

Three Scenarios

Scenario 1: The irradiation facility is located within an infested area.

The purpose of the safeguards, in this instance, is to protect the treated commodity from becoming re-infested. The following safeguarding topics would all seem to apply in scenario 1:

- receiving
- separation of treated from untreated commodities
- packaging
- marking/labeling
- general sanitation
- wrapping
- loading of containers

For **"separation of treated from untreated commodities"**, a screen or solid wall would be an important feature only if pests are mobile. Pest-proof **"packaging"** would also be an option in this case. Also, if the pests of concern are mobile, an appropriate **"wrapping"** option would be polyethylene (or equivalent) sheet wrap or net wrap. When you are **"loading containers"** loading of containers, a pest-secure connection to the building would be appropriate only if the pests are mobile and could fly in from outside the building.

Scenario 2: The irradiation facility is not located within an infested area, but the surrounding environment is susceptible to the target pests.

The purpose of safeguards, in this instance, is to protect the surrounding environment from escaping pests that have not been treated. However, owing to the high level of pest risk posed by this scenario, USDA and/or the particular state involved may not allow importation of untreated (potentially infested) commodities to an irradiation facility located within a sensitive, receptive environment in

the United States, without stringent safeguards and quality assurance activities. If this scenario were allowed, then the following safeguarding topics would be critically enforced:

- marking/labeling
- general sanitation
- wrapping

If the pests are mobile, then the following safeguarding topics would certainly apply, as well:

- receiving
- separation of treated from untreated commodities
- packaging

"Loading of containers" would not apply, since any surviving pests that escape into the environment would be sterile, and pose no risk.

Scenario 3. The irradiation facility is not located within an infested area, and the surrounding environment is not susceptible to the target pests.

Applicable safeguarding guarding, in this instance, include:

- separation of treated from untreated commodities
- general sanitation
- wrapping

For "separation of treated from untreated commodities", a 6-ft high barrier would suffice, except for mobile pests. For "wrapping", the strapping option may provide adequate quarantine security, though polyethylene (or equivalent) sheet wrap or netting could also be suitable.

4 Treatment Manual

Residue Monitoring

Overview

Contents

Overview **page-4-1-1**

Overview

Methyl bromide fumigants, except those with "Q" labels, are subject to requirements of the FIFRA Section 18 Quarantine Exemption. When commodities intended for food or feed are fumigated with methyl bromide under the FIFRA Section 18 Quarantine Exemption, one additional EPA requirement must be met: PPQ must monitor aeration by sampling the gas concentration to determine when a commodity may be released.

NOTICE

Currently, Plant Protection and Quarantine (PPQ) is *not* taking samples of commodities for residue monitoring. However, if residue monitoring becomes necessary, this section provides guidelines for taking samples that will be used for monitoring fumigant residues.

In the past, PPQ used residue monitoring to comply with the Environmental Protection Agency's (EPA's) guidelines for fumigation of edible food or feed products conducted under a Section 18 Quarantine Exemption. PPQ took and analyzed samples of fumigated commodities, and they reported the resulting data yearly to EPA. When a fumigation was conducted under a Section 18 Quarantine Exemption, samples were taken only when the commodity would be eaten by people or fed to animals. When the commodity would *not* be used for food or feed, PPQ did *not* take samples.

For example, if thyme would be used as an herb and fumigated under the schedule (T101-n-2), PPQ would sample the commodity because it would be eaten. On the other hand, if that same thyme were treated but imported as a cut flower, sampling would be unnecessary because it would be used for decoration—not eating.

Instructions for collecting, packaging, and shipping residue monitoring samples are included in this manual if residue monitoring becomes necessary.

4

Treatment Manual

Residue Monitoring

Instructions for Collecting, Packaging, and Shipping Residue Monitoring Samples

Contents

Safety **page-4-2-1**
Collecting the Sample **page-4-2-1**
Pre-treatment Sample **page-4-2-2**
Post-treatment Samples **page-4-2-2**
Labeling the Sample **page-4-2-2**
Storing the Sample **page-4-2-3**
Shipping Samples **page-4-2-3**
Quarantine Requirements **page-4-2-3**

Safety

Pre-treatment samples will be shipped with dry ice. Be sure to store dry ice in well-ventilated areas and to transport dry ice and samples packed in dry ice in well-ventilated containers. Wear gloves when handling dry ice. For detailed information, see the Material Safety Data Sheet for dry ice, in the Emergency Aid and Safety section.

The Department of Transportation considers dry ice a hazardous material and requires that aircraft record the amount of dry ice carried in the cargo hold. Amounts of 5 pounds or less are not stringently regulated; however, include the weight of dry ice on the shipping label. In addition, some overnight delivery companies have restrictions on shipping dry ice. Equip shipping containers with loose-fitting lids to prevent an explosive release of sublimating carbon dioxide. Identify dry ice as ORM-A on the shipping label. Also indicate on the label that the package contains diagnostic specimens.

Collecting the Sample

You must take a sample prior to treatment (pre-treatment) and after aeration is completed (post-treatment). To avoid contaminating the sample, handle it as little as possible. Take pre-treatment and post-treatment samples from the same general location within a given lot (that is, the same bags, boxes, or other containers).

Some ports receive commodities several times a month. For example, the port of Ft. Lauderdale received 20 shipments of chayote in October 1992. These shipments need not be sampled each time. For frequently received commodities, ports should develop a routine sample collection plan, such as one sample collected per week. However, when a new commodity is received or a commodity is received infrequently (once a week or less), collect a sample each time the commodity is treated.

Pre-treatment Sample

1. Collect a minimum of 450 grams (approximately 1 pound) except for herbs of which you need to collect 150 grams (approximately one-third pound). If you are collecting fruits or vegetables that are heavy (for example grapefruit or yams), be sure to collect at least two pieces of produce that weigh 450 grams.
2. Place these samples in containers with dry ice.
3. Ship the pre-treatment samples separately from post-treatment samples.

Post-treatment Samples

1. Collect a minimum of 450 grams (approximately 1 pound) except for herbs of which you need to collect 150 grams (approximately one-third pound). If you are collecting fruits or vegetables that are heavy (for example grapefruit or yams), be sure to collect at least two pieces of produce that weigh 450 grams.
2. Ship the post-treatment samples separately from the pre-treatment samples and in accordance with standard shipping practices. If the samples require refrigeration, then ship the samples with wet ice or ice packs. If the samples are normally shipped at ambient temperature (for example yams), then ship them without ice.

Labeling the Sample

Label each sample container with the State, county, date, and name of contents and whether the sample is “pre” or “post” treatment. For this label, use waterproof ink on a strip of masking tape or other label material. Be sure to attach the label before leaving the sampling site. Securely fasten a plastic envelope containing the yellow copy of the APHIS Form 2061 to the side of the sampling container. Label this envelope with the same information that you placed on the sample container (State, county, date, and name of contents and whether sample was “pre” or “post” treatment).

Storing the Sample

Immediately place the samples in a freezer or refrigerator until you are ready to package the samples for shipping.

Shipping Samples

Quarantine Requirements

Ship all samples in leakproof, double sealed containers. Make sure that your pre-treatment sample is secure since it does not meet entry requirements for the United States. The National Monitoring and Residue Monitoring Analysis Laboratory (NMRAL) will handle and dispose of samples in accordance with APHIS regulations.

Ship samples in coolers with dry ice packed above the samples. The lid of the cooler should be loose fitting to allow gasses to escape. Ship the samples using the contract overnight delivery service or the U.S. Postal Service Overnight Delivery. Ship the samples to:

USDA, APHIS, BBEP, NMRAL
Joseph Ford, Director
3505 25th Avenue, Building 9
Gulfport, MS 39501

Mail all correspondence to:

USDA, APHIS, BBEP, NMRAL
P.O. Box 3209
Gulfport, MS 39505-3209

The telephone number is 601/863-8124 or 863-1813.

See Appendix A for instructions on completing an APHIS Form 2061, Residue Sample for Food or Feed Product.

5

Treatment Manual

Treatment Schedules

Index to Schedules

Contents

T100 - Schedules for Fruit, Nuts, and Vegetables **page-5-2-1**
T200 - Schedules for Propagative Plant Material **page-5-3-1**
T300 - Schedules for Miscellaneous Plant Products **page-5-4-1**
T400 - Schedules for Miscellaneous Products **page-5-5-1**
T500 - Schedules for Plant Pests or Pathogens **page-5-6-1**

Index to Schedules

See the Index. (This information is now generated automatically from FrameMaker and the links are automatically maintained when generating and updating the Index.)

5

Treatment Manual

Treatment Schedules

T100 - Schedules for Fruit, Nuts, and Vegetables

Contents

T101—Methyl Bromide Fumigation **page-5-2-3**
T102—Water Treatment **page-5-2-46**
T103—High Temperature Forced Air **page-5-2-51**
T104—Pest Specific/Host Variable **page-5-2-57**
T105—Irradiation **page-5-2-60**
T106—Vapor Heat **page-5-2-69**
T107—Cold Treatment **page-5-2-76**
T108—Fumigation Plus Refrigeration of Fruits **page-5-2-80**
T109—Cold Treatment Plus Fumigation of Fruits **page-5-2-83**
T110—Quick Freeze **page-5-2-85**

Reporting Commodity Injury

Record any new or unusual observations relating to injury of commodity and report them to Quarantine Policy, Analysis and Support (QPAS) in Riverdale. Give pertinent details of the treatment and conditions regarding its application. In appraising the effect of a particular treatment, take care to distinguish between the actual or apparent effects directly attributable to the treatment and those relating to factors or conditions not subject to PPQ control.

Commodities in the T100 series are intended for consumption as food or feed. These commodities may have to be treated with methyl bromide to control a pest.

FIFRA Section 18 Exemption

Methyl bromide fumigants, except those with “Q” labels, are subject to requirements of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), Section 18 Quarantine Exemption. When commodities intended for food or feed are fumigated with methyl bromide under the FIFRA Section 18 Quarantine Exemption, one additional EPA requirement must be met: PPQ must monitor aeration by sampling the gas concentration to determine when a commodity may be released.

In this manual, fumigation schedules under the FIFRA Section 18 Quarantine Exemption are identified by the following note:

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

Determine the Correct Label for Fumigation

Always use the label of the fumigant to determine if the commodity can be treated. Fumigation schedules in this publication are intended to clarify and expand commercial labels for methyl bromide. The EPA only authorizes fumigation for commodities that are listed on the label of the gas being used for the fumigation. Also, to comply with State regulations, a fumigant must be registered in the State where it is being used.

Although the EPA only authorizes the use of a pesticide on a crop, animal, or site that is listed on the label of a pesticide, specific pests do not have to be listed on the label to use the pesticide. An amendment to FIFRA in 1978 permits the use of a pesticide to control a pest not on the label if the application is to a crop, animal, or site specified on the label, unless mentioned otherwise.

How Fruits and Vegetables Are Listed

Fruits and vegetables that are to be fumigated with methyl bromide (T101s) will be listed in alphabetical order. Each schedule will have an assigned letter, e.g., Apples T101-a-1, Zucchini T101-h-3. For fruits and vegetables which require treatment as a condition of entry, refer to the Fruits and Vegetables Manual (Nonpropagative) for the specific treatment. Also, monitor aeration. See **page-2-4-6**.

T101—Methyl Bromide Fumigation

T101-a-1 Apple and Pear

Pest: External feeders

Treatment: **T101-a-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

T101-a-3 Apricot

Pest: External feeders

Treatment: **T101-a-3** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

T101-b-1 Asparagus

Pest: External feeders such as Noctuidae spp., *Thrips* spp. (except *Scirtothrips dorsalis* from Thailand), *Copitarsia* spp.

Treatment: **T101-b-1** MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

T101-b-1-1 Asparagus from Thailand, Australia, and New Zealand

Pest: *Scirtothrips dorsalis* (Thailand), *Halotydeus destructor* (Australia) (New Zealand)

Treatment: **T101-b-1-1** MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	2.5 lbs	32	24
70-79 °F	3 lbs	38	29
60-69 °F	4 lbs	48	38

T101-c-1 Avocado (from Hawaii, Israel, or the Philippines)

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Bactrocera cucurbitae* (melon fly)

Treatment: **T101-c-1** MB at NAP—tarpaulin or chamber

This treatment is marginal as to host tolerance and shipper should be warned of possible injury. Treatment approved for issuance of 318.13-4e certification.

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	4 hrs
70 °F or above	2 lbs	26	16	14

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

Alternate Treatment—Fumigation plus refrigeration T108

T101-d-1 Banana

Pest: External feeders such as Noctuidae spp., *Thrips* spp., *Copitarsia* spp.

Treatment: **T101-d-1** MB at NAP—tarpaulin or chamber

This treatment is marginal as to host tolerance and shipper should be warned of possible injury.

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-e-1 Bean (except for fava bean), dry

Pest: Bruchidae (seed beetles)

Treatment: **T101-e-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	2.5 hrs	3 hrs	3.5 hrs	4 hrs
70 °F or above	3 lbs	38	—	24	—	—	—
60-69 °F	3 lbs	38	29	—	24	—	—
50-59 °F	3 lbs	38	29	—	—	24	—
40-49 °F	3 lbs	38	29	—	—	—	24

See also T101-k-2 or T101-K-2-1 for fresh beans

T101-g-1 Beet

Pest: Internal feeders

Treatment: **T101-g-1** MB chamber, 15" vacuum—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
90 °F or above	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

Beet

T101-g-1-1

Pest: External feeders

Treatment: **T101-g-1-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	3 hrs	3.5 hrs	4 hrs
90 °F and above	2 lbs	26	19	19	—	—
80-89 °F	2.5 lbs	32	24	24	—	—
70-79 °F	3 lbs	38	29	24	—	—
60-69 °F	3 lbs	38	29	—	24	—
50-59 °F	3 lbs	38	29	—	—	24

T101-h-1

Blackberry

Pest: External feeders such as Noctuidae spp., *Thrips* spp., *Copitarsia* spp., Pentatomidae spp., and *Tarsonemus* spp.

Treatment: **T101-h-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-i-1

Blueberry

Pest: External feeders

Treatment: **T101-i-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19

T101-i-1-1 Blueberry

Pest: *Ceratitis capitata* (Mediterranean fruit fly)

Treatment: **T101-i-1-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	3.5 hrs
70 °F or above	2 lbs	26	22	21

T101-n-2 Broccoli (Brassica oleracea var. botrytis)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Broccoli, Chinese (gai lon) (Brassica albogiabra)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Broccoli raap (rapini) (Brassica campestris)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Brussels sprouts (Brassica oleracea var. gemmifera)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-j-1 Cabbage

Includes both European and Chinese cabbage

Pest: External feeders

Treatment: **T101-j-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

For other *Brassica* spp., use the leafy vegetable schedule T104-n-2

T101-n-2 Cabbage (Brassica oleracea)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Cabbage, Chinese (bok choy) (Brassica chinensis)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Cabbage, Chinese (napa) (Brassica pekinensis)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Cabbage, Chinese mustard (gai choy) (Brassica campestris)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-k-1 Cantaloupe

Pest: External feeders

Treatment: **T101-k-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above*	1.5 lbs	19	14
70-79 °F*	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

***** Use “MB 100” at 70 °F or above, use MB “Q” label at 40 °F or above.

For other melons, see T101-o-2

T101-l-1 Carrot

Pest: External feeders

Treatment: **T101-l-1** MB at NAP—tarpaulin or chamber—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	3 hrs	3.5 hrs	4 hrs
90 °F and above	2 lbs	26	19	19	—	—
80-89 °F	2.5 lbs	32	24	24	—	—
70-79 °F	3 lbs	38	29	24	—	—
60-69 °F	3 lbs	38	29	—	24	—
50-59 °F	3 lbs	38	29	—	—	24

T101-m-1 Carrot

Pest: Internal feeders

Treatment: **T101-m-1** MB, chamber, 15" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
90 °F or above	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

T101-n-1 Cassava (manihot and yuca)

Pest: External feeders

Treatment: **T101-n-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	3 hrs	3.5 hrs
90 °F or above	2 lbs	26	19	19	—
80-89 °F	2.5 lbs	32	24	24	—
70-79 °F	3 lbs	38	29	24	—
60-69 °F	3 lbs	38	29	—	24

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Cauliflower (Brassica oleracea var. botrytis)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Cavalo broccolo (Brassica oleracea var. botrytis)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-1 Celeriac (celery root)

Pest: External feeders

Treatment: **T101-n-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	3 hrs	3.5 hrs
90 °F or above	2 lbs	26	19	19	—
80-89 °F	2.5 lbs	32	24	24	—
70-79 °F	3 lbs	38	29	24	—
60-69 °F	3 lbs	38	29	—	24

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-o-1 Celery (above ground parts)

Pest: External feeders

Treatment: **T101-o-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

For below ground parts, use T101-n-1

T101-p-1 Chayote (fruit only)

Pest: External feeders

Treatment: **T101-p-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

For below ground parts, use T101-a-2 (Dasheen)

T101-r-1 Cherry

Pest: Insects other than fruit flies

Treatment: **T101-r-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

T101-s-1 Cherry

Pest: *Rhagoletis indifferens* (Western cherry fruit fly) and *Cydia pomonella* (codling moth)

Treatment: **T101-s-1** MB at NAP—chamber only

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
70 °F or above	2 lbs	2 hrs
60-69 °F	2.5 lbs	2 hrs
50-59 °F	3 lbs	2 hrs
40-49 °F	4 lbs	2 hrs

T101-t-1 Chestnut

Pest: *Cydia splendana* (nut fruit tortrix) and *Curculio* spp.

Treatment: **T101-t-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs
90 °F and above	4 lbs	58	34	34	—	—	—
80-89 °F	4 lbs	58	32	—	32	—	—
70-79 °F	5 lbs	72	42	—	42	—	—
60-69 °F	5 lbs	72	40	—	—	40	—
50-59 °F	6 lbs	85	50	—	—	50	—
40-49 °F	6 lbs	85	48	—	—	—	48

See also T101-u-1

Does not include water chestnut

T101-u-1 Chestnut

Pest: *Cydia splendana* (nut fruit tortrix) and *Curculio* spp.

Treatment: **T101-u-1** MB in 26" vacuum—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
80 °F or above	3 lbs	2 hrs
70-79 °F	4 lbs	2 hrs
60-69 °F	4 lbs	3 hrs
50-59 °F	4 lbs	4 hrs
40-49 °F	4 lbs	5 hrs

Does not include water chestnut

T101-v-1 Chicory (above ground parts)

Pest: External feeders

Treatment: **T101-v-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

See T101-n-1 for below ground parts

See T101-z-1 for below ground parts

See T101-a-2 for below ground parts

T101-n-1 Chicory root

Pest: External feeders

Treatment: **T101-n-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	3 hrs	3.5 hrs
90 °F or above	2 lbs	26	19	19	—
80-89 °F	2.5 lbs	32	24	24	—
70-79 °F	3 lbs	38	29	24	—
60-69 °F	3 lbs	38	29	—	24

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD)..

T101-w-1 Cipollini (bulbs)

Pest: *Exosoma lusitanica* (chrysomelid beetle)

Treatment: **T101-w-1** MB in 15" vacuum—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
80 °F or above	2 lbs.	2 hrs
70-79 °F	3 lbs.	2 hrs
60-69 °F	4 lbs.	2 hrs
50-59 °F	4 lbs.	3 hrs
40-49 °F	4 lbs.	4 hrs

T101-w-1-2 Citrus from U.S. (interstate movement)

Pest: *Ceratitis capitata* (Mediterranean fruit fly)

Treatment: **T101-w-1-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	22

Includes only kumquats, lemons, limes, oranges, tangelos, and tangerines for interstate movement

T101-j-2-1 Clementines (Tangerines) from Mexico

Pest: *Anastrepha* spp.

Treatment: **T101-j-2-1** MB at NAP—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
70-85 °F	2.5 lbs	2 hrs

Load limit not to exceed 80 percent of chamber capacity

Inspect a representative sample of the fruit. If the level of infestation with fruit flies is more than 0.5 percent for the lot, then the fruit is ineligible for fumigation.

T101-n-2 Coles (Brassica spp.)*

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

Important

*Coles (Brassica spp.), EPA Crop Group 5, are restricted to broccoli (Brassica oleracea var. botrytis); broccoli, Chinese (gai lon) (Brassica albogiabra); broccoli raap (rapini) (Brassica campestris); brussels sprouts (Brassica oleracea var. gemmifera); cabbage (Brassica oleracea); Cabbage, Chinese (bok choy) (Brassica chinensis); Cabbage, Chinese (napa) (Brassica pekinensis); cabbage, Chinese mustard (gai choy) (Brassica campestris); cauliflower (Brassica oleracea var. botrytis); cavalo broccolo (Brassica oleracea var. botrytis); collards (Brassica oleracea var. acephala); kale (Brassica oleracea var. acephala); kohlrabi (Brassica oleracea var. gongyiodes); mizuna (Brassica rapa Japonica Group); mustard greens (Brassica juncea); mustard spinach (Brassica rapa Perviridis Group); rape greens (Brassica napus)

Of these, cabbage (Brassica oleracea) (labeled treatment T101-j-1) is the only vegetable in this group not covered by a FIFRA Section 18 Exemption.

T101-n-2 Collard Greens (Brassica oleracea var. acephala)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-x-1 Copra

(Dried coconuts and whole coconuts without the husk)

Pest: External feeders

Treatment: **T101-x-1** MB (“Q” label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24

T101-x-1-1 Corn-on-the-cob

(Green corn, sweet corn)

Pest: *Ostrinia nubilalis* (European corn borer)

Treatment: **T101-x-1-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2.5 hrs
70 °F or above	2.5 lbs	32	24

T101-y-1 Cucumber

Pest: External feeders

Treatment: **T101-y-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29

T101-z-1 Dasheen

(Eddoe, malanga, tannia, tanya, taro, and yautia)

Pest: External feeders

Treatment: **T101-z-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	3 hrs	3.5 hrs	4 hrs
90 °F or above	2 lbs	26	19	19	—	—
80-89 °F	2.5 lbs	32	24	24	—	—
70-79 °F	3 lbs	38	29	24	—	—
60-69 °F	3 lbs	38	29	—	24	—
50-59 °F	3 lbs	38	29	—	—	24
40-49°F	4 lbs	48	40	—	—	32

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

This schedule may be used for other root and tuber vegetables not listed on the "Q" label, such as celeriac (celery root) and chicory root.

T101-a-2 Dasheen

Pest: Internal feeders

Treatment: **T101-a-2** MB chamber, 15" vacuum—chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90 °F or above	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

This schedule may be used for other root and tuber vegetables not listed on the “Q” label, such as celeriac (celery root) and chicory root.

T101-b-2 Endive

Pest: External feeders

Treatment: **T101-b-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-c-2 Fava bean (dried)

Pest: Bruchidae (seed beetles)

Treatment: **T101-c-2** MB in 26" vacuum—chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70 °F or above	3 lbs	3.5 hrs
60-69 °F	3 lbs	4 hrs
50-59 °F	3 lbs	4.5 hrs
40-49 °F	3 lbs	5 hrs

T101-d-2 Fava bean (dried)

Pest: Bruchidae (seed beetles)

Treatment: **T101-d-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	11 hrs	12hrs	13 hrs	14 hrs
70 °F and above	3.5 lbs	46	28	27	—	—	—
60-69 °F	3.5 lbs	46	28		27		
50-59 °F	3.5 lbs	46	28			27	
40-49 °F	3.5 lbs	46	28				27

If fresh, see Green Pod Vegetables

T101-e-2 Garlic

Pest: *Brachycerus* spp. (garlic beetles) and *Dyspessa ulula* (garlic carpenterworm)

Treatment: **T101-e-2** MB in 15" vacuum—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
90 °F or above	2 lbs	1.5 hrs
80-89 °F	2 lbs	2 hrs
70-79 °F	2.5 lbs	2 hrs
60-69 °F	3 lbs	2 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	4 hrs

Load limit not to exceed 80 percent of chamber capacity

Treatment is waived for shipments of garlic for food purposes from Italy and Spain when accompanied by an official phytosanitary certificate stating freedom from *Brachycerus* spp. and *Dyspessa ulula* and inspection at port of entry discloses no pests. This exemption from treatment only applies to garlic for food purposes.

T101-f-2 Ginger (rhizome)

Pest: Internal feeders

Treatment: **T101-f-2** MB in 15" vacuum—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
90 °F or above	2 lbs	3 hrs
80-89 °F	2.5 lbs	3 hrs
70-70 °F	3 lbs	3 hrs
60-69 °F	3 lbs	3.5 hrs

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-g-2 Ginger (rhizome)

Pest: External feeders

Treatment: **T101-g-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	3 hrs	3.5 hrs
90 °F or above	2 lbs	26	19	19	—
80-89 °F	2.5 lbs	32	24	24	—
70-79 °F	3 lbs	38	29	24	—
60-69 °F	3 lbs	38	29	—	24

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-h-2 Grape

Pest: *Lobesia botrana* (vine moth)

Treatment: **T101-h-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

T101-h-2-1 Grape

Pest: *Ceratitis capitata* (Mediterranean fruit fly) or *Ceratitis capitata* and *Lobesia botrana* (vine moth)

Treatment: **T101-h-2-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	2.5 hrs	3 hrs	3.5 hrs	4 hrs
70 °F or above	2 lbs	26	22	22	—	21	—
65-69 °F	2 lbs	26	22	22	—	—	19

T101-i-2 Grape

Pest: Insects other than *Ceratitis capitata* (Mediterranean fruit fly) and *Lobesia botrana* (vine moth)

Treatment: **T101-i-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

If mealybugs are found, use treatment schedule T104-a-2.

T101-i-2-1 Grapes from Chile

Pest: External feeders

Treatment: **T101-i-2-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

If mealybugs are found, use treatment schedule T104-a-2.

T101-j-2 Grapefruit and other kinds of citrus

Pest: *Aleurocanthus woglumi* (citrus blackfly)

Treatment: **T101-j-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	16	12
70-79 °F	1.5 lbs	19	15
65-69 °F	1.75 lbs	23	17

T101-j-2-1 Grapefruit from Mexico

Pest: *Anastrepha* spp.

Treatment: **T101-j-2-1** MB at NAP—chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70-85 °F	2.5 lbs	2 hrs

Load limit not to exceed 80 percent of chamber capacity

Inspect a representative sample of the fruit. If the level of infestation with fruit flies is more than 0.5 percent for the lot, then the fruit is ineligible for fumigation.

T101-k-2 Green pod vegetables

Snap, string, yard-long beans, peas, and pigeon peas, lablab beans

Two alternative treatments, T101-k-2 or T101-k-2-1

Pest: *Cydia fabivora*, *Epinotia aporema*, and *Maruca testulalis* (exotic legume pod borers) and leaf miners

Treatment: **T101-k-2** MB in 15" vacuum—chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90 °F or above	0.5 lb	1.5 hrs
80-89 °F	1 lb	1.5 hrs
70-79 °F	1.5 lbs	1.5 hrs
60-69 °F	2 lbs	1.5 hrs
50-59 °F	2.5 lbs	1.5 hrs
40-49 °F	3 lbs	1.5 hrs

T101-k-2-1 Green pod vegetables

Snap, string, yard-long beans, peas, and pigeon peas, lablab beans

Two alternative treatments, T101-k-2 or T101-k-2-1

Pest: *Cydia fabivora*, *Epinotia aporema*, and *Maruca testulalis* (exotic legume pod borers) and leaf miners

Alternative treatment: **T101-k-2-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29

The term "green pod vegetables" refers to legumes, not peppers nor okra. Do not treat snow peas from Guatemala for Agromyzid leaf miners unless destined for Florida.

T101-n-2-1-1 Herbs and Spices, Dried*

Pest: Various stored product pests, not including khapra beetle

Treatment: T101-n-2-1-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	4 hrs	16 hrs	24 hrs
70 °F or above	2 lbs	24	16	10	—
60-69 °F	2 lbs	24	16	—	10
50-59 °F	3 lbs	36	24	15	—
40-49 °F	3 lbs	36	24	—	15

*Includes all dried plant parts, as well as seeds.

Important

If khapra beetle is intercepted on herbs and spices (dried), do not use this schedule. Contact the Center for Plant Health Science & Technology (CPHST), tel: 1-919-513-2496.

Important

Dried herbs and spices are restricted to Allspice (Pimenta dioica), Angelica (Angelica archanagelica), Anise (anise seed) (Pimpinella anisum), Anise star (Illicium verum), Annatto (seed), Balm (lemon baalm) (Melissa officinalis), Basil (Ocimum basilicum), Borage (Borago officinalis), Bumet (Sanguisorba minor), Camomile (Anthemis nobilis), Caper buds (Capparis spinosa), Caraway (Carum carvi), Curaway, black (Nigelia sativa), Cardamom (Elettaria cardamomum), Cassia bark (Cinnamomum aromaticum), Cassia buds (Cinnamomum aromaticum), Catnip (Nepeta cataria), Celery seed (Apicum graveolens), Chervil (dried) (Anthriscus cerefolium), Chive (Allium schoenoprasum), Chive, Chinese (Allium tuberosum), Cinnamon (Cinnamomum verum), Clary (Salvia sciarea), Clove buds (Eugenia caryophyllata), Coriander (cilantro or Chinese parsley) (leaf) (Coriandrum sativum), Coriandor (cilantro) (seed) (Coriandrum sativum), Costmary (Chrysanthemum balsamita), Culantro (leaf) (Eryngium foetidum), Culantro (seed) (Eryngium foetidum), Cumin (Cuminum cyminum), Curry (leaf) (Murrya koenigii), Dill (dillweed) (Anethum graveolens), Dill (seed) (Anethum graveolens), Fennel (common) (Foeniculum vulgare), Fennel, Florence (seed) (Foeniculum vulgare Azoricum Group), Fenugreek (Trigonella foenumgraecum), Grains of paradise (Aframomum melegueta), Horehound (Marrubium vulgare), Hyssop (Hyssopus officinalis), Juniper berry (Juniperus communis), Lavender (Lavendula offinalis), Lemongrass (Cymbopogon citratus), Lovage (leaf) (Levisticum officinale), Lovage (seed) (Levisticum officinale), Mace (Myristica fragrans), Marigold (Calendula officinalis), Marjoram (Origanum spp.) (includes sweet or annual marjoram, wild marjoram or oregano, and pot marjoram), Mustard (seed) (Brassica junceca, B. hirta, B. nigra), Nasturtium (Tropaeolum majus), Nutmeg (Myristica fragrans), Parsley (dried) (Petroselinum crispum), Pennyroyal (Mentha pulegium), Pepper, black (Piper nigrum), Pepper, white, Poppy (seed) (Papaver somniferum), Rosemary (Rosemarinus officinalis), Rue (Ruta graveolens), Saffron (Crocus sativus), Sage (Salvia officinalis), Savory summer and winter (Satureja spp.), Sweet bay (bay leaf) (Laurus nobilis), Tansy (Tanacetum vulagre), Tarragan (Artemisia dracunculus), Thyme (Thymus spp.), Vanilla (Vanillia planifolia), Wintergreen (Gaultheria procumbens), Woodruff (Galium odorata), Wormwood (Artemisia absinthium).

T101-n-2 Herbs, fresh (Includes all fresh plant parts except seeds)

Pest: External feeders and leaf miners

Treatment: T101-n-2 MB at NAP-tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	25	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 ° F	3.5 lbs	43	34
40-44 ° F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

Important

Fresh herbs and spices are restricted to Allspice (Pimenta dioica), Angelica (Angelica archanagelica), Anise (anise seed) (Pimpinella anisum), Anise star (Illicium verum), Annatto (seed), Balm (lemon baalm) (Melissa officinalis), Basil (Ocimum basilicum), Borage (Borago officinalis), Bumet (Sanguisorba minor), Camomile (Anthemis nobilis), Caper buds (Capparis spinosa), Caraway (Carum carvi), Curaway, black (Nigelia sativa), Cardamom (Elettaria cardamomum), Cassia bark (Cinnamomum aromaticum), Cassia buds (Cinnamomum aromaticum), Catnip (Nepeta cataria), Celery seed (Apicum graveolens), Chervil (dried) (Anthriscus cerefolium), Chive (Allium schoenoprasum), Chive, Chinese (Allium tuberosum), Cinnamon (Cinnamomum verum), Clary (Salvia sciarea), Clove buds (Eugenia caryophyllata), Coriander (cilantro or Chinese parsley) (leaf) (Coriandrum sativum), Coriandor (cilantro) (seed) (Coriandrum sativum), Costmary (Chrysanthemum balsamita), Culantro (leaf) (Eryngium foetidum), Culantro (seed) (Eryngium foetidum), Cumin (Cuminum cyminum), Curry (leaf) (Murrya koenigii), Dill (dillweed) (Anethum graveolens), Dill (seed) (Anethum graveolens), Fennel (common) (Foeniculum vulgare), Fennel, Floronce (seed) (Foeniculum vulgare Azoricum Group), Fenugreek (Trigonella foenumgraecum), Grains of paradise (Aframomum melegueta), Horehound (Marrubium vulgare), Hyssop (Hyssopus officinalis), Juniper berry (Juniperus communis), Lavender (Lavendula offinalis), Lemongrass (Cymbopogon citratus), Lovage (leaf) (Levisticum officinale), Lovage (seed) (Levisticum officinale), Mace (Myristica fragrans), Marigold (Calendula officinalis), Marjoram (Origanum spp.) (includes sweet or annual marjoram, wild marjoram or oregano, and pot marjoram), Mustard (seed) (Brassica junceca, B. hirta, B. nigra), Nasturtium (Tropaeolum majus), Nutmeg (Myristica fragrans), Parsley (Petroselinum crispum), Pennyroyal (Mentha pulegium), Pepper, black (Piper nigrum), Pepper, white, Poppy (seed) (Papaver somniferum), Rosemary (Rosemarinus officinalis), Rue (Ruta graveolens), Saffron (Crocus sativus), Sage (Salvia officinalis), Savory summer and winter (Satureja spp.), Sweet bay (bay leaf) (Laurus nobilis), Tansy (Tanacetum vulagre), Tarragan (Artemisia dracunculus), Thyme (Thymus spp.), Vanilla (Vanillia planifolia), Wintergreen (Gaultheria procumbens), Woodruff (Galium odorata), Wormwood (Artemisia absinthium)

T101-l-2 Horseradish

Pest: *Baris lepidii* (imported crucifer weevil)

Treatment: **T101-l-2** MB in 15" vacuum—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
90 °F or above	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs

T101-n-2 Kale (Brassica oleracea var. acephala)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-m-2 Kiwi

Pest: External feeders, *Nysius huttoni* (wheat bug)

Treatment: **T101-m-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-m-2-1 Kiwi

Pest: *Ceratitus capitata* (Mediterranean fruit fly)

Treatment: **T101-m-2-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	3.5 hrs	4 hrs
70 °F or above	2 lbs	26	22	21	—
65-69 °F	2 lbs	26	22	—	19

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Kohlrabi (Brassica oleracea var. gongyiodes)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Leafy vegetables

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

Important

Leafy vegetables, EPA Crop Group 4, (Except Brassica Vegetables) are restricted to amaranth (leafy amaranth, Chinese spinach, tampala) (Amaranthus spp.); arugula (Roquette) (Eruca sativa); cardoon (Cyanara cardunculus); celery (Apium graveolens var. dulcea); celery, Chinese (Apium graveolens var. secalinum); celtuce (Lactuca sativa var. angustana); chervil (Anthriscus cerefolium); chrysanthemum, edible-leaved (Chrysanthemum coronanium var. coronanium); chrysanthemum, garland (Chrysantesmum coronarium var. spatiosum); corn salad (Valerianella locusta); cress garden (Lepidium sativum); cress upland (yellow rocket, winter cress) (Barbarea vulgaris); dandelion (Taraxacum offincinale); dock (sorrel) (Rumex spp.); endive (escarole) (Cichorium endivia); fennel, Florence (finochio) (Foeniculum vulgare Azoricum Group); lettuce, head and leaf (Lactuca sativa); Orach(Atriplex hortensis); parsley (Petroselinum crispum); purslane, garden (Portulaca oleracea); purslane, winter (Montia perfoliata); radicchio (red chicory) (Cichorium intybus); rhubarb (Rheum rhabarbarum); spinach (Spinacia oleracea); spinach, New Zealand (Tetragonia tetragonioides, T. expansa); spinach, vine (Malabar spinach, Indian spinach) (Basella alba); swiss chard (Beta vulgaris var. cicia). Reference 40 CFR 180.34 (f)(a)(iv)(A)

T101-q-2 Leeks

Pest: Internal feeders (including leafminers)

Treatment: **T101-q-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	2.5 hrs	3 hrs	3.5 hrs
90 °F or above	2 lbs	26	19	—	—	—
80-89 °F	2.5 lbs	32	24	—	—	—
70-79 °F	3 lbs	38	29	—	—	—
60-69 °F	3 lbs	38	26	26	—	—
50-59 °F	3 lbs	38	26	—	26	—
40-49 °F	3 lbs	38	26	—	—	26

T101-n-2-1 Lemons from Chile

Pest: External feeders and *Brevipalpus chilensis* (Chilean false spider mite of grapes)

Treatment: **T101-n-2-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29

T101-e-1 Lentils (Dry)

Pest: Bruchidae (seed beetles)

Treatment: **T101-e-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	2.5 hrs	3 hrs	3.5 hrs	4 hrs
70 °F or above	3 lbs	38	—	24	—	—	—
60-69 °F	3 lbs	38	29	—	24	—	—
50-59 °F	3 lbs	38	29	—	—	24	—
40-49 °F	3 lbs	38	29	—	—	—	24

T101-n-2 Lettuce from Spain

Pest: *Autographa gamma*, *Helicoverpa armigera*, *Mamestra brassicae*, *Spodoptera littoralis*

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber (see Leafy vegetables for treatment schedule)

T101-n-2-1 Limes from Chile

Pest: External feeders and *Brevipalpus chilensis* (Chilean false spider mite of grapes)

Treatment: **T101-n-2-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29

T101-b-1-1 Lychee (Litchi)

Pest: Mealybugs (Pseudococcidae)

Treatment: **T101-b-1-1** MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	2.5 lbs	32	24
70-79 °F	3 lbs	38	29
60-69 °F	4 lbs	48	38

Important

T101-b-1-1 is not a substitute for the mandatory cold treatment of lychee from China and Taiwan, T107-h, which targets the pests *Bactrocera dorsalis* (Oriental fruit fly), *Bactrocera curubitae* (melon fly) and ***Conopomorpha sinensis*** (lychee fruit borer). Because mealybugs are not controlled by T107-h, T101-b-1-1 can be used as a follow-up treatment if mealybugs are found.

T101-o-2 Melons

(Including honeydew, muskmelon, and watermelon)

Pest: External feeders such as Noctuidae spp., *Thrips* spp., *Copitarsia* spp.

Treatment: **T101-o-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above*	1.5 lbs	19	14
70-79 °F*	2 lbs	26	19
60-69 °F*	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

* Use “MB 100” at 60 °F or above, use MB “Q” label at 40 °F or above

For cantaloupe, see T101-k-1

T101-n-2 Mizuna (Brassica rapa Japonica Group)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Mustard greens (Brassica juncea)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-n-2 Mustard spinach (Brassica rapa Perviridis Group)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-a-3 Nectarine

Pest: External feeders

Treatment: **T101-a-3** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

T101-p-2 Okra

Pest: *Pectinophora gossypiella* (pink bollworm)

Treatment: **T101-p-2** MB at NAP—chamber only

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
90 °F or above	1 lb	2 hrs
80-89 °F	1.5 lbs	2 hrs
70-79 °F	2 lbs	2 hrs
60-69 °F	2.5 lbs	2 hrs
50-59 °F	3 lbs	2 hrs
40-49 °F	3.5 lbs	2 hrs

Okra may be injured by fumigation if moisture is present.

The term “okra” does **not** include Chinese okra (*Luffa* spp.), which is a cucurbit.

T101-q-2 Onion*

Pest: Internal feeders (and leafminers)

Treatment: **T101-q-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	2.5 hrs	3 hrs	3.5 hrs
90 °F or above	2 lbs	26	19	—	—	—
80-89 °F	2.5 lbs	32	24	—	—	—
70-79 °F	3 lbs	38	29	—	—	—
60-69 °F	3 lbs	38	26	26	—	—
50-59 °F	3 lbs	38	26	—	26	—
40-49 °F	3 lbs	38	26	—	—	26

*The term “onion” includes dry bulbs. It also includes leeks, shallots and chives for both above ground and below ground parts.

T101-j-2-1 Oranges from Mexico

Pest: *Anastrepha* spp.

Treatment: **T101-j-2-1** MB at NAP—chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70-85 °F	2.5 lbs	2 hrs

Load limit not to exceed 80 percent of chamber capacity

Inspect a representative sample of the fruit. If the level of infestation with fruit flies is more than 0.5 percent for the lot, then the fruit is ineligible for fumigation.

T101-g-1 Parsnip

Pest: Internal feeders

Treatment: **T101-g-1** MB chamber, 15" vacuum—chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90 °F or above	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

T101-a-3 Peach

Pest: External feeders

Treatment: **T101-a-3** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

T101-a-1 Pear

Pest: External feeders

Treatment: T101-a-1 MB at NAP-tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

T101-e-1 Peas (Dry)

Pest: Bruchidae (seed beetles)

Treatment: **T101-e-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	2.5 hrs	3 hrs	3.5 hrs	4 hrs
70 °F or above	3 lbs	38	—	24	—	—	—
60-69 °F	3 lbs	38	29	—	24	—	—
50-59 °F	3 lbs	38	29	—	—	24	—
40-49 °F	3 lbs	38	29	—	—	—	24

See also T101-K-2 or T101-K-1 for fresh peas

T101-a-3 Peppers

Pest: Internal Pests (except fruit flies) and External Pests (except mealy bugs)

Treatment: T101-a-3 MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

Important

This treatment is not effective against fruit flies or mealy bugs. For fruit flies, use T106-b (vapor heat). For mealy bugs, use T104-a-2 (fumigation). Certain varieties of peppers are sensitive to methyl bromide and may develop darkening of the seed cavity.

T101-r-2 Pineapple

Pest: Internal feeders

Treatment: **T101-r-2** MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	6 hrs
70 °F or above	2 lbs	26	22	16

T101-s-2 Pineapple

Pest: External feeders

Treatment: **T101-s-2** MB ("Q" label only if under 70 °F, 21.1 °C) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above*	1.5 lbs	19	14
70-79 °F*	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F**	4 lbs	48	38

* Use "MB 100" at 70 °F or above, use MB "Q" label at 40 °F or above

** 40–49°F temperature range may cause pineapple core to turn purple.

T101-t-2 Plantain

Pest: External feeders such as Noctuidae spp., *Thrips* spp., *Copitarsia* spp.

Treatment: **T101-t-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-a-3 Plum

Pest: External feeders

Treatment: **T101-a-3** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

T101-u-2 Potato (white or Irish)

Pest: *Graphognathus* spp. (whitefringed beetles)

Treatment: **T101-u-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	2.5 lbs	30	20
70-79 °F	3 lbs	36	24

T101-v-2 Potato (white or Irish)

Pest: *Ostrinia nubilalis* (European corn borer) and *Phthorimaea operculela* (potato tuberworm)

Treatment: **T101-v-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2.75 lbs	33	22

T101-e-1 Pulses, dried

Pest: Bruchidae (seed beetles)

Treatment: **T101-e-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	2.5 hrs	3 hrs	3.5 hrs	4 hrs
70 °F or above	3 lbs	38	—	24	—	—	—
60-69 °F	3 lbs	38	29	—	24	—	—
50-59 °F	3 lbs	38	29	—	—	24	—
40-49 °F	3 lbs	38	29	—	—	—	24

T101-w-2 Pumpkin

Includes calabaza varieties

Pest: External feeders

Treatment: **T101-w-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24

T101-g-1 Radish

Pest: Internal feeders

Treatment: **T101-g-1** MB chamber, 15" vacuum—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
90 °F or above	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

T101-n-2 Rape greens (Brassica napus)

Pest: External feeders and leaf miners

Treatment: **T101-n-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	2 lbs	26	14
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
45-49 °F	3.5 lbs	43	34
40-44 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

Of these, cabbage (Brassica oleracea) (labeled treatment T101-j-1) is the only vegetable in this group not covered by a FIFRA Section 18 Exemption.

T101-x-2 Raspberry

Pest: External feeders such as Noctuidae spp., *Thrips* spp., *Copitarsia* spp., Pentatomidae spp.

Treatment: **T101-x-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-q-2 Shallots

Pest: Internal feeders (including leafminers)

Treatment: **T101-q-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	2.5 hrs	3 hrs	3.5 hrs
90 °F or above	2 lbs	26	19	—	—	—
80-89 °F	2.5 lbs	32	24	—	—	—
70-79 °F	3 lbs	38	29	—	—	—
60-69 °F	3 lbs	38	26	26	—	—
50-59 °F	3 lbs	38	26	—	26	—
40-49 °F	3 lbs	38	26	—	—	26

T101-y-2 Squash (winter, summer, and chayote)

Pest: External feeders

Treatment: **T101-y-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

If zucchini, see T101-h-3

If pumpkin, see T101-w-2

T101-z-2 Strawberry

Pest: External feeders

Treatment: **T101-z-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29

T101-b-3-1 Sweet Potato *(Ipomoea)*

Pest: External and internal feeders

Treatment: **T101-b-3-1** MB at NAP—tarpaulin or chamber

This treatment is also required for the interstate movement from Hawaii.

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	4.0 hrs
90 °F or above*	2.5 lbs	32	20	20
80-89 °F*	3 lbs	38	24	24
70-79 °F*	3.5 lbs	44	28	28
60-69 °F	4 lbs	50	32	32

***** Use “MB 100” at 70°F or above, use MB “Q” label at 60 °F or above

NOTICE

Temperatures below 70°F may cause injury to sweet potatoes. Fumigation below 70 °F is to be made only on specific request from the importer.

NOTICE

Sweet potatoes should be cured, free from surface moisture, and held at the fumigation temperature for 24 hours following treatment. This is not mandatory; however, following this advise will help maintain the quality of the fumigated product.

T101-c-3 Tomato (from Hawaii)

Pest: *Ceratitis capitata* (Mediterranean fruit fly)

Treatment: **T101-c-3** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	3.5 hrs	4 hrs
70 °F or above	2 lbs	26	21	21	—
65-69 °F	2 lbs	26	21	—	19

Treatment is marginal as to host tolerance and shipper should be warned of possible injury.

T101-c-3-1 Tomato (from Chile)

Pest: *Scrobopalpula absoluta* (tomato fruit moth) and *Rhagoletis tomatis* (tomato fruit fly)

Treatment: **T101-c-3-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F or above	3 lbs	43	33

T101-d-3 Tuna (Opuntia) and all other fruits from cacti (prickly pear, pitahaya)

Pest: *Ceratitis capitata* (Mediterranean fruit fly)

Treatment: **T101-d-3** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	3.5 hrs
70 °F or above	2 lbs	26	21	21

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-e-3 Tuna (Opuntia) and all other fruits from cacti (prickly pear, pitahaya)

Pest: External feeders and leaf miners

Treatment: **T101-e-3** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

Important

Do not use this treatment schedule if its FIFRA Section 18 Exemption has expired. For the current exemption status, call your local State Plant Health Director (SPHD).

T101-g-1 Turnip

Pest: Internal feeders

Treatment: **T101-g-1** MB chamber, 15" vacuum—chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90 °F or above	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

T101-f-3 Yam (Dioscorea)

Pest: Internal and external feeders

Treatment: **T101-f-3** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	4 hrs
90 °F or above	2.5 lbs	32	20	20
80-89 °F	3 lbs	38	24	24
70-79 °F	3.5 lbs	44	28	28
60-69 °F	4 lbs	50	32	32

NOTICE

Temperatures below 70°F may cause injury to yams. Fumigation below 70 °F is to be made only on specific request from the importer.

NOTICE

Sweet potatoes and yams should be cured, free from surface moisture, and held at the fumigation temperature for 24 hours following treatment. This is not mandatory; however, following this advise will help maintain the quality of the fumigated product.

T101-h-3 Zucchini

Pest: External feeders

Treatment: **T101-h-3** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft')	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24

If another variety of squash, see T101-y-2

T102—Water Treatment

Important

Whenever water comes into contact with fresh produce, the water's quality dictates the potential for pathogen contamination. To reduce the risk of food-borne illnesses, the water used for washing, treatments, and cooling must be fortified with sodium hypochlorite (household bleach), and constantly maintained at a chlorine level between 50 and 200 ppm.

T102-b Cherimoya from Chile

Pest: *Brevipalpus chilensis* (Chilean false spider mite of grapes)

Treatment: **T102-b** Soapy water and wax

1. Immerse fruit for 20 seconds in soapy water bath of one part soap solution (such as Deterfruit) to 3,000 parts water.
2. Follow the soapy bath with a pressure shower rinse to remove all the soapy excess.
3. Immerse fruit for 20 seconds in an undiluted wax coating (such as Johnson's Wax Primafresh 31 Kosher fruit coating). The wax coating should cover the entire surface of the fruit.

Important

At the port of entry, the PPQ officer should check to make sure the wax coating covers the entire surface of the fruit.

T102-c Durian and other large fruits such as breadfruit

Pest: External Feeders

Treatment: **T102-c** Warm, soapy water and brushing

1. Add detergent (such as Deterfruit) to warm water (110 ° to 120 ° F) at the rate of one part detergent or soap to 3,000 parts water.
2. Immerse the fruit for at least 1 minute in the warm detergent water.
3. Using a brush with stiff bristles, have the importer or the importer's agent scrub each fruit to remove any insects.
4. Using a pressure shower, have the importer or the importer's agent rinse the fruit free from residue (detergent and dead insects).
5. Inspect each brushed and cleaned fruit. Pay particular attention to external feeders such as mealybugs and scales. If any insects remain, have the fruit retreated or have it destroyed.

T102-e Limes

Pest: Mealybugs (Pseudococcidae) and other surface pests

Treatment: **T102-e** Hot water immersion

1. Fruit must be treated in a certified hot water immersion treatment tank, and the treatment must be monitored by an inspector.
   - **A.** Fruit must be submerged at least 4 inches below the water's surface.
   - **B.** Water must circulate continually and be kept at 120.2 °F (or above) for 20 minutes. Treatment time begins when the water temperature reaches at least 120.2 °F in all locations of the tank.
2. Cooling and waxing the fruit are both optional, and are the sole responsibility of the processor.

NOTICE

Phytotoxic damage (increased yellowing) may occur if the temperature reaches 125.6 °F or if the treatment duration significantly exceeds 20 minutes.

T102-b-1 Limes from Chile

Pest: *Brevipalpus chilensis* (Chilean false spider mite of grapes)

Treatment: **T102-b-1** Soapy water and wax

1. Immerse fruit for 20 seconds in soapy water bath of one part soap solution (such as Deterfruit) to 3,000 parts water.
2. Follow the soapy bath with a pressure shower rinse to remove all the soapy excess.
3. Immerse fruit for 20 seconds in an undiluted wax coating (such as Johnson's Wax Primafresh 31 Kosher fruit coating). The wax coating should cover the entire surface of the fruit.

Important

At the port of entry, the PPQ officer should check to make sure the wax coating covers the entire surface of the fruit.

T102-d-1 Longan fruit from Hawaii

Pest: *Ceratitis capitata* (Mediterranean fruit fly) and *Bactrocera dorsalis* (Oriental fruit fly)

Treatment: **T102-d-1** Hot water immersion

Important

Fruit must be at ambient temperature before the treatment begins

1. Submerge the fruit at least 4 inches below the water's surface in a hot water immersion treatment tank certified by APHIS.
2. Keep the fruit submerged for 20 minutes after the water temperature reaches at least 120.2 °F in all locations of the tank. The water must circulate continually and be kept at 120.2 °F (or above) for the duration of the treatment.

NOTICE

Phytotoxic damage (increased yellowing) may occur if the temperature exceeds 121.1 °F.

3. Cool the fruit to ambient temperature. Hydrocooling for 20 minutes at 75.2 °F is recommended, though not required, to prevent injury to the fruit from the hot water immersion treatment.

T102-d Lychee (litchi) fruit from Hawaii

Pest: *Ceratitis capitata* (Mediterranean fruit fly) and *Bactrocera dorsalis* (Oriental fruit fly)

Treatment: T102-d Hot water immersion

1. Lychees must be thoroughly examined at the packinghouse by an inspector and found free of ***Cryptophlebia spp.*** (Lychee fruit moth) and other plant pests[1]
2. Fruit must be grown and treated in Hawaii, under monitoring of an inspector, in a certified hot water immersion treatment tank.[2]
   - **A.** Fruit must be submerged at least 4 inches below the water's surface.

1 Because ***Eriophyes litchii*** (lychee mite) cannot be effectively detected by inspection, and would not be effectively eliminated by hot water immersion, the lychees may not be shipped into Florida. Each carton must be stamped "Not for importation into or distribution in Florida."

2 Use of Treatment T102D is at the risk of the shipper. Limited research on fruit quality after treatment application indicated that fruit quality varies among cultivars. 'Kaimana' and 'Kwai Mi' ('Tai So') tolerate the treatment better than 'Brewster' and 'Groff'; no other cultivars were tested.

B. Water must circulate constantly, and be kept at 120.2 °F (or above) for 20 minutes. Treatment time begins when the water temperature reaches at least 120.2 °F in all locations throughout the tank.[3]

Temperatures exceeding 121.1 °F can cause phytotoxic damage.

3. Hydrocooling for 20 minutes at 75.2 °F is recommended, though not required, to prevent injury to the fruit from the hot water treatment.

T102-a Mango

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Anastrepha spp.*, *Anastrepha ludens* (Mexican fruit fly)

Treatment: **T102-a** Hot water dip

Fruit must be treated in country of origin at a certified facility and under the monitoring of APHIS personnel.

1. Mangoes must be pre-sorted by weight class. Treatment of mixed loads is not allowed.

2. Pulp temperature must be 70 °F or above before start of treatment.

3. Fruit must be submerged at least 4 inches below the water's surface.

4. Water must circulate constantly and be kept at least 115 °F throughout the treatment with the following tolerances:

- ***During the first 5 minutes of a treatment***—temperatures below 113.7 °F are allowed during the first 5 minutes of a treatment only if the temperature is at least 115 °F at the end of the 5 minute period.
- ***For treatments lasting 65 to 75 minutes***—temperatures may fall as low as 113.7 °F for no more than 10 minutes under emergency conditions.
- ***For treatments lasting 90 to 110 minutes***—temperatures may fall as low as 113.7 °F for no more than 15 minutes under emergency conditions.

3 Treatment does not begin until after the fruit is immersed and the water temperature recovers to 120.2 °F (or above). Therefore, before the start of the treatment, fruit pulp temperatures of 70 °F (or above) are recommended to minimize water temperature recovery time and the overall time fruit are immersed in heated water. Fruit quality of treated lychees with initial pulp temperatures below 68 °F has not been studied.

5. Determine the dip time from Tables **Table 5-2-1**, **Table 5-2-2**, or **Table 5-2-3**.

Important

Dip times for T102-a are valid if the fruit is not hydrocooled within 30 minutes of removal from the hot water immersion tank.

However, if hydocooling starts immediately after the hot water immersion treatment, then the original dip time must be extended for an additional 10 minutes.

(Hydrocooling is optional and may be done only at temperatures of 70°F or above, for any length of time, or not at all.)

TABLE 5-2-1: Determine Dip Time Based on Origin of Fruit[1]

If the origin of the fruit is:	And the shape of the fruit is:	And the weight is (grams):	Then dip:
Puerto Rico, U.S. Virgin Islands, or West Indies (excluding Aruba, Bonaire, Curacao, Margarita, Tortuga or Trinidad and Tobago)	Flat, elongated varieties[2]	Up to 400 grams	65 minutes
		400 to 570 grams	75 minutes
	Rounded varieties[3]	Up to 500 grams	75 minutes
		500 to 700 grams	90 minutes
		701 to 900 grams	110 minutes

1 Vaild if the fruit is not hydrocooled within 30 minutes of removal from the hot water immersion tank.

2 Such as ‘Frances,’ ‘Carrot,’ ‘Zill,’ ‘Ataulfo,’ ‘Carabao,’ ‘Irwin’, and Manila

3 Such as ‘Tommy Atkins,’ ‘Kent,’ ‘Hayden,’ and ‘Keitt.’

TABLE 5-2-2: Determine Dip Time Based on Origin of Fruit[1]

If the origin of the fruit is:	And the shape of the fruit is:	And the weight is (grams):	Then dip:
Mexico or Central America (north of and including Costa Rica)	Flat, elongated varieties[2]	Up to 375 grams	65 minutes
		400 to 570 grams	75 minutes
	Rounded varieties[3]	Up to 500 grams	75 minutes
		500 to 700 grams	90 minutes
		701 to 900 grams	110 minutes

1 Vaild if the fruit is not hydrocooled within 30 minutes of removal from the hot water immersion tank

2 Such as ‘Frances,’ ‘Carrot,’ ‘Zill,’ ‘Ataulfo,’ ‘Carabao,’ ‘Irwin.’, and Manila

3 Such as ‘Tommy Atkins,’ ‘Kent,’ ‘Hayden,’ and ‘Keitt.’

TABLE 5-2-3: Determine Dip Time Based on Origin of Fruit[1]

If the origin of the fruit is:	And the shape of the fruit is:	And the weight is (grams):	Then dip:
Panama, South America or West Indies islands of Aruba, Bonaire, Curacao, Margarita, Tortuga, or Trinidad and Tobago	Flat, elongated varieties[2]	Up to 375 grams	65 minutes
		375 to 570 grams	75 minutes
	Rounded varieties[3]	Up to 425 grams	75 minutes
		425 to 650 grams	90 minutes

1 Vaild if the fruit is not hydrocooled within 30 minutes of removal from the hot water immersion tank

2 Such as 'Frances,' 'Carrot,' 'Zill,' 'Ataulfo,' 'Carabao,' 'Irwin.', and Manila

3 Such as 'Tommy Atkins,' 'Kent,' 'Hayden,' and 'Keitt.'

T102-b-2 Passion Fruit from Chile

Pest: *Brevipalpus chilensis* (Chilean false spider mite of grapes)

Treatment: **T102-b-2** Soapy water and wax

1. Immerse fruit for 20 seconds in soapy water bath of one part soap solution (such as Deterfruit) to 3,000 parts water.
2. Follow the soapy bath with a pressure shower rinse to remove all the soapy excess.
3. Immerse fruit for 20 seconds in an undiluted wax coating (such as Johnson's Wax Primafresh 31 Kosher fruit coating). The wax coating should cover the entire surface of the fruit.

Important

At the port of entry, the PPQ officer should check to make sure the wax coating covers the entire surface of the fruit.

T103—High Temperature Forced Air

T103-a-1 Citrus from Mexico and infested areas in the United States

Pest: *Anastrepha* spp.

Treatment: T103-a-1 High-temperature forced air treatment

1. Prepare fruit for treatment

   A. Place temperature probes into the center of the largest fruit in the load.

   The number and placement of temperature probes must be approved by the Center for Plant Health Science & Technology (CPHST) before Plant Protection and Qurantine

(PPQ) can authorize treatment. CPHST grants approval of treatment equipment and facilities through a chamber certification procedure.

Only fruit varieties listed in **Table 5-2-4** are authorized by PPQ for shipment with treatment T103-a-1. Also, this fruit cannot exceed the maximum commercial size for varieties listed in **Table 5-2-4**. Fruit can be sized before or after the heat treatment. The largest fruit in a load can be identified by either:

- sizing all fruit prior to heating and selecting the largest size class among the load or
- acquiring fruit of the largest permitted maximum commercial size class.

B. Place the fruit containing the temperature probes inside the hot air chamber at chamber locations specified by PPQ during the chamber certification.

TABLE 5-2-4: Maximum Commercial Size of Citrus Varieties Authorized by PPQ for Shipment with Treatment T103-a-1

Citrus Variety[11]	Standard Count[22]	Size Container (in bu.)	Max. Weight / fruit (g)	oz.	Max. Diameter (inches)
Navel Orange	100	1 2/5	450	15.9	3 13/16
Orange (other than Navel Orange)	100	1 2/5	468	16.4	3 13/16
Tangerine	120	4/5	245	8.6	Not specified
Grapefruit	70	1 2/5	536	18.8	4 5/16

1 For tolerance data and research citations, contact USDA-ARS Subtropical Research Center or the Center for Plant Health Science & Technology (CPHST).

2 Standard pack count is an index based on the approximate number of fruit of uniform diameter that fit into a 1 2/5-bushel container (4/5-bushel container in the case of tangerines).

2. Increase fruit temperature within specifications

A. Increase the fruit center temperature to 44 °C (111.2 °F) within 90 minutes or more (minimum approach time is 90 minutes) for all temperature probes.

B. Keep the fruit center temperature at 44 °C (111.2 °F) or hotter for 100 minutes.

Fruit center temperatures must be recorded every two (2) minutes for the duration of the treatment.

The total treatment time will vary with the time required to reach 44 °C (111.2 °F).

EXAMPLE: The center temperature of fruit located in the coolest location inside a forced air chamber required 112 minutes to reach 44 °C. Therefore, the total treatment time for this particular fruit load would be 112 + 100 = 212 minutes

EXAMPLE: The center temperature of fruit located in the coolest location inside a forced air chamber required 80 minutes to reach 44 °C. Therefore, 10 minutes would be added (80+10=90) and the total treatment time for this particular fruit load would be 90 + 100 = 190 minutes

3. Reduce fruit temperature

Reduce the temperature of the fruit after the treatment is completed. (Hydrocooling after treatment is optional.)

T103-b-1 Citrus from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera dorsalis*** (Oriental fruit fly), and ***B. cucurbitae*** (melon fly)

Treatment: **T103-b-1** High temperature forced air

The steps must occur in order:

1. Insert temperature probes (sensors) into the centers of the largest fruits. The number of sensors must be approved in advance. Sensors shall be physically placed in various parts of the load so that high, middle, and low areas are all represented.

NOTICE

Do not begin treatment until the fruit center temperatures reach ambient temperature.

2. Load fruits (placed in open trays, bulk bins, or ventilated boxes) into the treatment chamber, and attach sensors to the recorder monitor. Set the monitor to record the temperatures from all sensors at least once every 5 minutes.
3. Heat the fruit in the chamber using forced hot air until the fruit center temperature (all sensors) reaches at least 117.0 °F (47.2 °C).

◆ The temperature of the forced air used to heat the fruit in the chamber may be constant (single air temperature) or increased (from ambient air temperature) in a series of two or more steps, or ramped over the treatment duration.

- Treatment time will vary, but in every case it must be at least 4 hours or more in duration. The total time leading up to the end-point temperature (117.0 °F or 47.2 °C) is counted as part of the treatment.

4. Cool the fruit by forced air or hydrocooling. Cooling can be initiated immediately after all sensors reach at least 117.0 °F (47.2 °C).

NOTICE

Tolerance of Citrus to Treatment—Users of this treatment for citrus should test the specific cultivar to determine how well it will tolerate the required heat treatment. Of all citrus species tested to date, grapefruit showed the highest tolerance to this treatment. The tolerance of citrus treated in excess of 7 hours has not been determined. Although the method of cooling fruit after treatment is optional, research indicated that forced air cooling using ambient air temperature produced the least fruit injury.

T103-c-1 Mango from Mexico

Pest: *Anastrepha ludens* (Mexican fruit fly), *Anastrepha obliqua* (West Indian fruit fly), and *Anastrepha serpentina* (black fruit fly)

Treatment: **T103-c-1** Single-stage high temperature forced air

Size of fruit—standard sizes 8 to 14

Weight of fruit—Must not exceed 1 1/2 pounds. (700 grams)

The steps must occur in order:

1. Probe at least three of the largest mangoes at the seed's surface. Insert probes into the thickest portion of the fruit's pulp.
2. Record temperatures at least once every two minutes until the treatment is concluded.
3. Introduce air heated to 122 °F (50 °C) in the chamber.
4. Conclude the treatment once the temperature at the seed's surface (based on the coolest part of the fruit) reaches 118 °F (48 °C).

NOTICE

Treatment time will vary depending on the size of the fruit and the number of boxes treated.

T103-d-1 Mountain Papaya from Chile

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera dorsalis*** (Oriental fruit fly), and ***B. cucurbitae*** (melon fly)

Treatment: **T103-d-1** High temperature forced air

The steps must occur in order:

1. Insert temperature probes (sensors) into the centers of the largest fruits. The number of sensors must be approved in advance. Sensors shall be physically placed in various parts of the load so that high, middle, and low areas are all represented.

NOTICE

Do not begin treatment until the fruit center temperatures reach ambient temperature.

2. Load fruits (placed in open trays, bulk bins, or ventilated boxes) into the treatment chamber and attach sensors to the recorder monitor. Set the monitor to record the temperatures from all sensors at least once every 5 minutes.
3. Heat the fruit in the chamber using forced hot air until the fruit center temperature (all sensors) reaches at least 117.0 °F (47.2 °C).

- The temperature of the forced air used to heat the fruit in the chamber may be constant (single air temperature) or increased (from ambient air temperature) in a series of two or more steps, or ramped over the treatment duration.
- Treatment time will vary, but in every case it must be at least 4 hours or more in duration. The total time leading up to the end-point temperature (117.0 °F or 47.2 °C) is counted as part of the treatment.

4. Cool the fruit by forced air or hydrocooling. Cooling can be initiated immediately after all sensors reach at least 117.0 °F (47.2 °C).

NOTICE

If papayas are hydrocooled with water lower than 54.5 °F (12.5 °C), the fruit may be damaged.

NOTICE

Tolerance of Papayas to Treatment—To enable the papayas to tolerate the treatment, the fruit may first have to be conditioned. Such conditioning is the responsibility of the shipper and at the shipper's risk.

T103-d-2 Papaya from Belize and Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera dorsalis*** (Oriental fruit fly), and ***B. cucurbitae*** (melon fly)

Treatment: **T103-d-2** High temperature forced air

The steps must occur in order:

1. Insert temperature probes (sensors) into the centers of the largest fruits. The number of sensors must be approved in advance. Sensors shall be physically placed in various parts of the load so that high, middle, and low areas are all represented.

NOTICE

Do not begin treatment until the fruit center temperatures reach ambient temperature.

2. Load fruits (placed in open trays, bulk bins, or ventilated boxes) into the treatment chamber and attach sensors to the recorder monitor. Set the monitor to record the temperatures from all sensors at least once every 5 minutes.
3. Heat the fruit in the chamber using forced hot air until the fruit center temperature (all sensors) reaches at least 117.0 °F (47.2 °C).

- The temperature of the forced air used to heat the fruit in the chamber may be constant (single air temperature) or increased (from ambient air temperature) in a series of two or more steps, or ramped over the treatment duration.
- Treatment time will vary, but in every case it must be at least 4 hours or more in duration. The total time leading up to the end-point temperature (117.0 °F or 47.2 °C) is counted as part of the treatment.

4. Cool the fruit by forced air or hydrocooling. Cooling can be initiated immediately after all sensors reach at least 117.0 °F (47.2 °C).

NOTICE

If papayas are hydrocooled with water lower than 54.5 °F (12.5 °C), the fruit may be damaged.

NOTICE

Tolerance of Papayas to Treatment—To enable the papayas to tolerate the treatment, the fruit may first have to be conditioned. Such conditioning is the responsibility of the shipper and at the shipper's risk.

T103-e Rambutan from Hawaii

Pest: *Ceratitis capitata* (Mediterranean fruit fly), and *Bactrocera dorsalis* (Oriental fruit fly)

Treatment: T103-e High temperature forced air

1. Raise the temperature of the fruit using forced hot air until the fruit center temperature (all sensors) reaches at least 117.0 °F (47.2 °C) in a minimum time of 1 hour or longer . Heat the fruit in the chamber

2. Hold the fruit temperature at 117 ° F (47.2 ° C) or above for 20 minutes. During the treatment, the relative humidity must be maintained at 90 per cent or greater.
3. Cooling the fruit is optional

T104—Pest Specific/Host Variable

For the treatments that follow, never exceed the labeled or Section 18 dosage and time for the specific commodity at the given temperature. Moreover, the specific commodity being treated determines if the schedule is a labeled treatment or one authorized under a Section 18 exemption. For example, oranges cannot be treated for hitchhikers using T104A-1 at 40-49 °F because this schedule requires 4 pounds of methyl bromide/1,000 ft^3. Whereas, the methyl bromide "Q" label allows a maximum of only 3 pounds at this temperature range. Therefore, the oranges would have to be raised to at least 50 °F before fumigation could be initiated because at 50 °F a dosage of only 3 pounds/1,000 ft^3 is required.

Although the following treatments are pest specific, the treatment schedule for the associated host will determine if and when a pest specific treatment can be used. Always check the schedule for the host before selecting the proper treatment schedule. Also, consult the methyl bromide labeling brochure, and do not exceed the restrictions on dosage and exposure time.

T104-a-1 Various Commodities*

Pest: Hitchhikers and surface pests such as: thrips, aphids, scale insects, leafminers, spider mites, lygaeid bugs, ants, earwigs, and surface feeding caterpillars.

Treatment: **T104-a-1** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	1.5 lbs	19	14
70-79 °F	2 lbs	26	19
60-69 °F	2.5 lbs	32	24
50-59 °F	3 lbs	38	29
40-49 °F	4 lbs	48	38

Important

* To comply with dosage restrictions imposed by the methyl bromide "Q" label, the following fruits and vegetables may be fumigated only at the following temperatures (the items bolded are under FIFRA Section 18 Exemption. For the current exemption status, call your local State Plant Health Director (SPHD):

40 °F or above (maximum dosage, 4 pounds/1,000 ft^3):
Apple, apricot, asparagus, **banana**, **blackberry**, cabbage, **cactus fruit (tuna)**, cantaloupe, **celery**, chayote, cherry, chestnut, **chicory**, cipolini, cucumber, **Dasheen**, **endive**, fava bean (dried), **fresh herbs**[1], grape, honeydew melon, **kiwi**, **leafy vegetables**, muskmelon, nectarine, peach, **pear**, pepper, pineapple, **plantain**, plum, **raspberry**, **snow peas**[2]**,** squash (summer, winter), stone fruit, sweet potato, watermelon, yam.

50 °F or above (maximum dosage, 3 pounds/1,000 ft^3):
Bean, beet, carrot, citron (ethrog), coconut, Corn-on-the-cob (sweet corn), eggplant, garlic, **ginger**, grapefruit, green pod vegetables, horseradish, Jerusalem artichoke, kumquat, lemon, lime, okra, onion, orange, parsnip, pea, potato, radish, rutabaga, salsify, strawberry, sugar beet, tangelo, tangerine, tomato, turnip.

60 °F or above (maximum dosage, 2.5 pounds/1,000 ft^3):
Pimento, pumpkin, zucchini.

70 °F or above (maximum dosage, 2 pounds/1,000 ft^3):
Avocado, blueberry, cocoa bean.

1 Fresh herbs must be on the approved list shown under T101-n-2, Herbs, fresh (Includes all fresh plant parts except seeds).

2 Snow peas may be damaged at dosages higher than 3 lbs,/1000 cu. ft., and the dosage used in the 40 °F or above temperature range, 4 lbs./1000 cu. ft., should be used only at the importer's request.

T104-a-2 Various Commodities*

Pest: Mealybugs (Pseudococcidae)

Treatment: **T104-a-2** MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	2.5 lbs	32	24
70-79 °F	3 lbs	38	29
60-69 °F	4 lbs	48	38

Important

* To comply with dosage restrictions imposed by the methyl bromide "Q" label, the following fruits and vegetables may be fumigated only at the following temperatures (the items bolded are under Section 18 Exemption. FIFRA Section 18 Exemption. For the current exemption status, call your local State Plant Health Director (SPHD):

60 °F or above (maximum dosage, 4 pounds/1,000 ft^3):
Apple, apricot, asparagus, **banana**, **blackberry**, cabbage, cantaloupe, **celery**, chayote, cherry, chestnut, **chicory**, cipolini, cucumber, **dasheen**, **endive**, fava bean (dried), grape, **fresh herbs**[1], honeydew melon, **kiwi**, **leafy vegetables**, **lychee (litchi)**, muskmelon, nectarine, peach, **pear**, pepper, pineapple, **plantain**, plum, **raspberry**, **snow peas,** squash (summer, winter), stone fruit, sweet potato, watermelon.

70 °F or above (maximum dosage, 3 pounds/1,000 ft^3):
Bean, beet, carrot, citron (ethrog), coconut, corn-on-the-cob (sweet corn), eggplant, garlic, **ginger root**, grapefruit, green pod vegetables, horseradish, Jerusalem artichoke, kumquat, lemon, lime, okra, onion, orange, parsnip, potato, radish, rutabaga, salsify, scallion, shallot, strawberry, sugar beet, tangelo, tangerine, tomato, turnip.

80 °F or above (maximum dosage, 2.5 pounds/1,000 ft^3):
Peppers, pimento, pumpkin, zucchini.

1 Fresh herbs must be on the approved list shown under T101-n-2, Herbs, fresh (Includes all fresh plant parts except seeds).

T105—Irradiation

T105-a-4 Abiu from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

T105-a-5 Atemoya from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

T105-a-9 Bell pepper from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

T105-a-2 Carambola from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

T105-a-10 Eggplant from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

T105-b-1 Fruits and Vegetables

Pest: ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: T105-b-1 Irradiation

The minimum absorbed dose of gamma irradiation shall be 250 Gray (25 krad), but shall not exceed the 1000-Gray (100 krad) limit imposed by Food and Drug Administration regulations. Documentation of the dosage shall accompany the shipment.

Dose mapping is required for each commodity and/or size. Different configurations, packaging, and/or mixed commodities should also be dose mapped.

Important

The treatment shall be conducted only on Hawaiian-grown produce, and treated at an approved facility, which may be located in any of the following
—Hawaii
—In areas of the mainland United States that do **not** support fruit files (any State except AL, AZ, CA, FL, GA, KY, LA, MS, NV, NM, NC, SC, TN, TX, or VA)
—At the maritime ports of Gulfport, MS; or Wilmington, NC; or the airport of Atlanta, GA if the conditions of 7CFR 305.2 (b) are met.

Important

When designing the facility's dosimetry system and procedures for its operation, the facility operator must address guidance and principles from American Society for Testing Materials (ASTM) standards or an equivalent standard recognized by the Administrator of APHIS.

(The American Society for Testing and Materials (ASTM) publication, 51261-2002 (E), "**Standard Guide for Selection and Calibration of Dosimetry Systems for Radiation Processing"** is available from: ASTM, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA 19428-2959).

T105-b-2 Fruits and Vegetables

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly)

Treatment: T105-b-2 Irradiation

The minimum absorbed dose of gamma irradiation shall be 225 Gray (22.5 krad), but shall not exceed the 1000-Gray (100 krad) limit imposed by Food and Drug Administration regulations. Documentation of the dosage shall accompany the shipment.

Dose mapping is required for each commodity and/or size. Different configurations, packaging, and/or mixed commodities should also be dose mapped.

Important

The treatment shall be conducted only on Hawaiian-grown produce, and treated at an approved facility, which may be located in any of the following
—Hawaii
—In areas of the mainland United States that do **not** support fruit files (any State except AL, AZ, CA, FL, GA, KY, LA, MS, NV, NM, NC, SC, TN, TX, or VA)
—At the maritime ports of Gulfport, MS; or Wilmington, NC; or the airport of Atlanta, GA if the conditions of 7CFR 305.2 (b) are met.

Important

When designing the facility's dosimetry system and procedures for its operation, the facility operator must address guidance and principles from American Society for Testing Materials (ASTM) standards or an equivalent standard recognized by the Administrator of APHIS.

(The American Society for Testing and Materials (ASTM) publication, 51261-2002 (E), "**Standard Guide for Selection and Calibration of Dosimetry Systems for Radiation Processing"** is available from: ASTM, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA 19428-2959).

T105-b-3 Fruits and Vegetables

Pest: ***Bactrocera cucurbitae*** (melon fly)

Treatment: T105-b-3 Irradiation

The minimum absorbed dose of gamma irradiation shall be 210 Gray (21 krad), but shall not exceed the 1000-Gray (100 krad) limit imposed by Food and Drug Administration regulations. Documentation of the dosage shall accompany the shipment.

Dose mapping is required for each commodity and/or size. Different configurations, packaging, and/or mixed commodities should also be dose mapped.

Important

The treatment shall be conducted only on Hawaiian-grown produce, and treated at an approved facility, which may be located in any of the following
—Hawaii
—In areas of the mainland United States that do **not** support fruit files (any State except AL, AZ, CA, FL, GA, KY, LA, MS, NV, NM, NC, SC, TN, TX, or VA)
—At the maritime ports of Gulfport, MS; or Wilmington, NC; or the airport of Atlanta, GA if the conditions of 7CFR 305.2 (b) are met.

Important

When designing the facility's dosimetry system and procedures for its operation, the facility operator must address guidance and principles from American Society for Testing Materials (ASTM) standards or an equivalent standard recognized by the Administrator of APHIS.

(The American Society for Testing and Materials (ASTM) publication, 51261-2002 (E), "**Standard Guide for Selection and Calibration of Dosimetry Systems for Radiation Processing"** is available from: ASTM, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA 19428-2959).

T105-b-4 Fruits and Vegetables

Pest: ***Anastrepha fraterculus*** (South American fruit fly), ***Anastrepha suspensa*** (Caribbean fruit fly), ***Anastrepha ludens*** (Mexican fruit fly), ***Anastrepha obliqua*** (West Indian fruit fly), ***Anastrepha serpentina*** (Sapote fruit fly), ***Bactrocera tryoni*** (Queensland fruit fly), and ***Bactrocera jarvisi*** (No common name), ***Bactrocera latifrons*** (Malaysian fruit fly),

Treatment: T105-b-4 Irradiation

The minimum absorbed dose of gamma irradiation shall be 150 Gray (15 krad), but shall not exceed the 1000-Gray (100 krad) limit imposed by Food and Drug Administration regulations. Documentation of the dosage shall accompany the shipment.

Dose mapping is required for each commodity and/or size. Different configurations, packaging, and/or mixed commodities should also be dose mapped.

Important

The treatment shall be conducted only on Hawaiian-grown produce, and treated at an approved facility, which may be located in any of the following
—Hawaii
—In areas of the mainland United States that do **not** support fruit files (any State except AL, AZ, CA, FL, GA, KY, LA, MS, NV, NM, NC, SC, TN, TX, or VA)
—At the maritime ports of Gulfport, MS; or Wilmington, NC; or the airport of Atlanta, GA if the conditions of 7CFR 305.2 (b) are met.

Important

When designing the facility's dosimetry system and procedures for its operation, the facility operator must address guidance and principles from American Society for Testing Materials (ASTM) standards or an equivalent standard recognized by the Administrator of APHIS.

(The American Society for Testing and Materials (ASTM) publication, 51261-2002 (E), "**Standard Guide for Selection and Calibration of Dosimetry Systems for Radiation Processing"** is available from: ASTM, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA 19428-2959).

T105-c Fruits and Vegetables

Pest: ***Sternochetus mangiferae*** (Mango seed weevil)

Treatment: T105-c Irradiation

The minimum absorbed dose of gamma irradiation shall be 300 Gray (30 krad), but shall not exceed the 1000-Gray (100 krad) limit imposed by Food and Drug Administration regulations. Documentation of the dosage shall accompany the shipment.

Dose mapping is required for each commodity and/or size. Different configurations, packaging, and/or mixed commodities should also be dose mapped.

Important

The treatment shall be conducted only on Hawaiian-grown produce, and treated at an approved facility, which may be located in any of the following
—Hawaii
—In areas of the mainland United States that do **not** support fruit files (any State except AL, AZ, CA, FL, GA, KY, LA, MS, NV, NM, NC, SC, TN, TX, or VA)
—At the maritime ports of Gulfport, MS; or Wilmington, NC; or the airport of Atlanta, GA if the conditions of 7CFR 305.2 (b) are met.

Important

When designing the facility's dosimetry system and procedures for its operation, the facility operator must address guidance and principles from American Society for Testing Materials (ASTM) standards or an equivalent standard recognized by the Administrator of APHIS.

(The American Society for Testing and Materials (ASTM) publication, 51261-2002 (E), "**Standard Guide for Selection and Calibration of Dosimetry Systems for Radiation Processing"** is available from: ASTM, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA 19428-2959).

T105-a-6 Longan from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

Important

Longan from Hawaii is prohibited into Florida. All cartons in which the litchi or longan is packed must be stamped, "**Not for importation or distribution in FL.**"

T105-a-3 Lychee (Litchi) fruit from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

Important

Lychee (Litchi) fruit from Hawaii is prohibited into Florida. All cartons in which the litchi or longan is packed must be stamped, "**Not for importation or distribution in FL.**"

T105-a-11 Mango from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly), ***Sternochetus mangiferae*** (formerly known as Cryptorhynchus mangiferae)(Mango seed weevil)

Treatment: Use T105-a-11 Irradiation

The minimum absorbed dose of gamma irradiation shall be 300 Gray (30 krad), but shall not exceed the 1000-Gray (100 krad) limit imposed by Food and Drug Administration regulations. Documentation of the dosage shall accompany the shipment.

Dose mapping is required for each commodity and/or size. Different configurations, packaging, and/or mixed commodities should also be dose mapped.

Important

The treatment shall be conducted only on Hawaiian-grown produce, and treated at an approved facility, which may be located in any of the following
—Hawaii
—In areas of the mainland United States that do **not** support fruit files (any State except AL, AZ, CA, FL, GA, KY, LA, MS, NV, NM, NC, SC, TN, TX, or VA)

NOTICE

The papayas, carambolas and lychees destined for irradiation treatment may arrive in the same container, but must not be commingled with other fruits and vegetables.

These shipments must be accompanied by a Limited Permit (PPQ Form 530).

Important

When designing the facility's dosimetry system and procedures for its operation, the facility operator must address guidance and principles from American Society for Testing Materials (ASTM) standards or an equivalent standard recognized by the Administrator of APHIS.

(The American Society for Testing and Materials (ASTM) publication, 51261-2002 (E), "**Standard Guide for Selection and Calibration of Dosimetry Systems for Radiation Processing"** is available from: ASTM, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA 19428-2959).

T105-a-1 Papaya from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: T105-a-1 Irradiation

The minimum absorbed dose of gamma irradiation shall be 250 Gray (25 krad), but shall not exceed the 1000-Gray (100 krad) limit imposed by Food and Drug Administration regulations. Documentation of the dosage shall accompany the shipment.

Dose mapping is required for each commodity and/or size. Different configurations, packaging, and/or mixed commodities should also be dose mapped.

Important

The treatment shall be conducted only on Hawaiian-grown produce, and treated at an approved facility, which may be located in any of the following
—Hawaii
—In areas of the mainland United States that do **not** support fruit files (any State except AL, AZ, CA, FL, GA, KY, LA, MS, NV, NM, NC, SC, TN, TX, or VA)

NOTICE

The papayas, carambolas and lychees destined for irradiation treatment may arrive in the same container, but must not be commingled with other fruits and vegetables.

These shipments must be accompanied by a Limited Permit (PPQ Form 530).

Important

When designing the facility's dosimetry system and procedures for its operation, the facility operator must address guidance and principles from American Society for Testing Materials (ASTM) standards or an equivalent standard recognized by the Administrator of APHIS.

(The American Society for Testing and Materials (ASTM) publication, 51261-2002 (E), "**Standard Guide for Selection and Calibration of Dosimetry Systems for Radiation Processing"** is available from: ASTM, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA 19428-2959).

T105-a-12 Pineapple (other than smooth Cayenne) from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

T105-a-7 Rambutan from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

T105-a-8 Sapodilla from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

T105-a-13 Squash (Italian) from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

T105-a-15 Sweetpotato from Hawaii

Pest: ***Euscepes postfasciatus*** (sweetpotato scarabee), ***Omphisa anastomosalis*** (sweetpotato stem borer), ***Dysmicoccus neobrevipes*** (gray pineapple mealybug), ***Elytrotreinus subtruncatus*** (ginger weevil), ***Meloidogyne konaensis*** (Kona coffee root-knot nematode)

Treatment: Use T105-a-15 Irradiation

The minimum absorbed dose of gamma irradiation shall be 400 Gray (40 krad), but shall not exceed the 1000-Gray (100 krad) limit imposed by Food and Drug Administration regulations. Documentation of the dosage shall accompany the shipment.

Dose mapping is required for each commodity and/or size. Different configurations, packaging, and/or mixed commodities should also be dose mapped.

Important

The treatment shall be conducted only on Hawaiian-grown produce, and treated at an approved facility, which may be located in any of the following
—Hawaii
—In areas of the mainland United States that do **not** support fruit files (any State except AL, AZ, CA, FL, GA, KY, LA, MS, NV, NM, NC, SC, TN, TX, or VA)

.

Important

When designing the facility's dosimetry system and procedures for its operation, the facility operator must address guidance and principles from American Society for Testing Materials (ASTM) standards or an equivalent standard recognized by the Administrator of APHIS.

(The American Society for Testing and Materials (ASTM) publication, 51261-2002 (E), "**Standard Guide for Selection and Calibration of Dosimetry Systems for Radiation Processing"** is available from: ASTM, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA 19428-2959).

T105-a-14 Tomato from Hawaii

Pest: ***Ceratitis capitata*** (Mediterranean fruit fly), ***Bactrocera cucurbitae*** (melon fly), and ***Bactrocera dorsalis*** (Oriental fruit fly)

Treatment: Use T105-a-1 Irradiation

T106—Vapor Heat

T106-b-1 Bell Pepper

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Bactrocera cucurbitae* (melon fly)

Treatment: T106-b-1 Vapor heat

1. Raise temperature of article by saturated water vapor at 112 °F until approximate center of fruit reaches 112 °F within a time period designated by the PPQ officer.
2. Hold fruit temperature at 112 °F for 8.75 hours, then cool immediately.

Pretreatment conditioning is optional and is the responsibility of the shipper. Treatment is required for shipments from Hawaii.

Important

Commodities should be exposed at 112 °F to determine tolerance to the treatment before commercial shipments are attempted.

T106-a-1 Clementine from Mexico

Pest: *Anastrepha* spp. (includes Mexican fruit fly, *A. ludens*)

Treatment: T106-a-1 Vapor heat

Raise fruit pulp temperatures gradually to 110 °F until center of fruit reaches that temperature in 8 hours. Hold temperature at 110 °F for 6 hours.

T106-a-1-1 Clementine or Orange from Mexico (Alternate treatment)

Treatment: T106-a-1-1 Vapor heat

Raise fruit pulp temperature to 110 °F until the center of fruit reaches that temperature in 6 hours. Hold temperature at 110 °F for 4 hours. During the initial raising of fruit temperature, the first 2 hours should raise the temperature rapidly, the increase over the next 4 hours should be gradual.

T106-b-2 Eggplant

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Bactrocera cucurbitae* (melon fly)

Treatment: T106-b-2 Vapor heat

1. Raise temperature of article by saturated water vapor at 112 °F until approximate center of fruit reaches 112 °F within a time period designated by the PPQ officer.
2. Hold fruit temperature at 112 °F for 8.75 hours, then cool immediately.

Pretreatment conditioning is optional and is the responsibility of the shipper. Treatment is required for shipments from Hawaii.

Important

Commodities should be exposed at 112 °F to determine tolerance to the treatment before commercial shipments are attempted.

T106-a-2 Grapefruit from Mexico

Pest: *Anastrepha* spp. (includes Mexican fruit fly, *A. ludens*)

Treatment: T106-a-2 Vapor heat

Raise fruit pulp temperatures gradually to 110 °F until center of fruit reaches that temperature in 8 hours. Hold temperature at 110 °F for 6 hours.

T106-f Litchi from Hawaii

Pest: *Ceratitis capitata* (Mediterranean fruit fly), and *Bactrocera dorsalis* (Oriental fruit fly)

Treatment: T106-f Vapor heat

1. Place the temperature probes in the approximate center of the largest fruits at the seed surface.
2. Raise temperature of the fruit to 117 ° F (47.2 ° C). The total run-up time for all sensors must take at least 60 minutes.
3. Hold the fruit temperature at 117 ° F (47.2 ° C) or above for 20 minutes. During the treatment, the relative humidity must be maintained at 90 per cent or greater.
4. Hydrocool the fruit under a cool water spray until the fruit sensors reach ambient temperature.
5. Inspect the fruit for live species of quarantine significant pests. If live species of quarantine significant pests are found, reject the treatment.

Important

The inspector must perform a careful visual inspection of the treated fruit to confirm the absence of other live pest species of quarantine significance. If any of the following are found live, the inspector will reject the treatment: *Cryptophlebia illepida* (koa seedworm), *Cryptophlebia ombrodelta* (litchi fruit moth), *Epiphyas postvittana* (light brown apple moth), *Eriophyes litchi* (litchi rust mite).

T106-a-3 Mango* from Mexico

Pest: *Anastrepha* spp. (includes Mexican fruit fly, *A. ludens*)

Treatment: T106-a-3 Vapor heat

Raise fruit pulp temperatures gradually to 110 °F until center of fruit reaches that temperature in 8 hours. Hold temperature at 110 °F for 6 hours.

Important

* Manila variety only.

T106-d-1 Mango from the Philippines (the island of Guimaras only)

Pest: *Bactrocera* spp. (includes fruit flies *Bactrocera occipitalis* and *Bactrocera philippinesis*)

Treatment: T106-d-1 Vapor heat

1. Size the fruit before the treatment. Place temperature probes in the center of the large fruits.
2. Raise the temperature of the fruit by saturated water vapor to 114.8°F (46°C), measured at the center of the fruit, in a minimum of 4 hours. (The temperature of the saturated water vapor should be 117.5°F (47.5°C)
3. Hold fruit temperature at 114.8°F (46°C) for 10 minutes.

Important

During the run-up time, temperature should be recorded from each pulp sensor once every 5 minutes. During the 10 minute holding time, temperature should be recorded from each pulp sensor every minute.

During the last hour of treatment, which includes the 10 minute holding time, the relative humidity must be maintained at 90 percent of higher.

T106-d Mango from Taiwan*

Pest: *Bactrocera dorsalis* (Oriental fruit fly)

Treatment: **T106-d** Vapor heat

1. Size the fruit before the treatment. Place temperature probes in the center of the large fruits.
2. Raise the temperature of the fruit by saturated water vapor at 117.5°F until the pulp temperature near the seed reaches 115.7°F.
3. Hold pulp temperature at 115.7 °F or above for 30 minutes, then cool immediately.

T106-b-3 Mountain Papaya

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Bactrocera cucurbitae* (fly)

Treatment: T106-b-3 Vapor heat

1. Raise temperature of article by saturated water vapor at 112 °F until approximate center of fruit reaches 112 °F within a time period designated by the PPQ officer.
2. Hold fruit temperature at 112 °F for 8.75 hours, then cool immediately.

Pretreatment conditioning is optional and is the responsibility of the shipper. Treatment is required for shipments from Hawaii.

NOTICE

This schedule is not being used at the present time because Taiwan has no preclearance program in place.

Important

Commodities should be exposed at 112 °F to determine tolerance to the treatment before commercial shipments are attempted.

T106-a-4 Orange from Mexico

Pest: *Anastrepha* spp. (includes Mexican fruit fly, *A. ludens*)

Treatment: T106-a-4 Vapor heat

Raise fruit pulp temperatures gradually to 110 °F until center of fruit reaches that temperature in 8 hours. Hold temperature at 110 °F for 6 hours.

T106-b-4 Papaya

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Bactrocera cucurbitae* (melon fly)

Treatment: T106-b-4 Vapor heat

1. Raise temperature of article by saturated water vapor at 112 °F until approximate center of fruit reaches 112 °F within a time period designated by the PPQ officer.
2. Hold fruit temperature at 112 °F for 8.75 hours, then cool immediately.

Pretreatment conditioning is optional and is the responsibility of the shipper. Treatment is required for shipments from Hawaii.

Important

Commodities should be exposed at 112 °F to determine tolerance to the treatment before commercial shipments are attempted.

T106-c Papaya

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Bactrocera cucurbitae* (melon fly)

Treatment: T106-c Vapor heat (Quick run-up)

1. Raise temperature of article until approximate center of fruit reaches 117 ° F (47.2 ° C) in a time period of 4 hours or more. During the last hour of treatment, the relative humidity (RH) in the chamber must be maintained at 90 per cent or greater.

Important

Pretreatment conditioning is optional and is the responsibility of the shipper. Treatment is required for shipments from Hawaii.

T106-b-5 Pineapple (other than smooth Cayenne)

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Bactrocera cucurbitae* (melon fly)

Treatment: T106-b-5 Vapor heat

1. Raise temperature of article by saturated water vapor at 112 °F until approximate center of fruit reaches 112 °F within a time period designated by the PPQ officer.
2. Hold fruit temperature at 112 °F for 8.75 hours, then cool immediately.

Pretreatment conditioning is optional and is the responsibility of the shipper. Treatment is required for shipments from Hawaii.

Important

Commodities should be exposed at 112 °F to determine tolerance to the treatment before commercial shipments are attempted.

T106-e Yellow Pitaya (*Selenicereus megalanthus*) from Colombia

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Anastrepha fraterculus* (South American fruit fly)

Treatment: T106-e Vapor heat

1. Raise temperature of article by saturated water vapor at 116.6°F until approximate center of fruit reaches 114.8 °F within a minimum time period of 4 hours.
2. Hold fruit temperature at 114.8 °F or above for 20 minutes.

Important

Pretreatment conditioning and post-treatment cooling are optional and the responsibility of the shipper.

If post-treatment cooling is conducted, wait 30 minutes after the treatment to start the forced cooling process.

T106-g Rambutan from Hawaii

Pest: *Ceratitis capitata* (Mediterranean fruit fly), and *Bactrocera dorsalis* (Oriental fruit fly)

Treatment: T106-g Vapor heat

1. Raise the internal temperature of the fruit by saturated water vapor until the approximate center of fruit reaches 117 ° F (47.2 ° C) in a minimum time of 1 hour or longer.
2. Hold the fruit temperature at 117 ° F (47.2 ° C) or above for 20 minutes. During the treatment, the relative humidity must be maintained at 90 per cent or greater.
3. Cooling the fruit is optional

T106-b-6 Squash

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Bactrocera cucurbitae* (melon fly)

Treatment: T106-b-6 Vapor heat

1. Raise temperature of article by saturated water vapor at 112 °F until approximate center of fruit reaches 112 °F within a time period designated by the PPQ officer.
2. Hold fruit temperature at 112 °F for 8.75 hours, then cool immediately.

Pretreatment conditioning is optional and is the responsibility of the shipper. Treatment is required for shipments from Hawaii.

Important

Commodities should be exposed at 112 °F to determine tolerance to the treatment before commercial shipments are attempted.

T106-b-7 Tomato

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Bactrocera cucurbitae* (melon fly)

Treatment: T106-b-7 Vapor heat

1. Raise temperature of article by saturated water vapor at 112 °F until approximate center of fruit reaches 112 °F within a time period designated by the PPQ officer.
2. Hold fruit temperature at 112 °F for 8.75 hours, then cool immediately.

Pretreatment conditioning is optional and is the responsibility of the shipper. Treatment is required for shipments from Hawaii.

Important

Commodities should be exposed at 112 °F to determine tolerance to the treatment before commercial shipments are attempted.

T106-b-8 Zucchini

Pest: *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Bactrocera cucurbitae* (melon fly)

Treatment: T106-b-8 Vapor heat

1. Raise temperature of article by saturated water vapor at 112 °F until approximate center of fruit reaches 112 °F within a time period designated by the PPQ officer.
2. Hold fruit temperature at 112 °F for 8.75 hours, then cool immediately.

Pretreatment conditioning is optional and is the responsibility of the shipper. Treatment is required for shipments from Hawaii.

Important

Commodities should be exposed at 112 °F to determine tolerance to the treatment before commercial shipments are attempted.

T107—Cold Treatment

Pulp of the Fruit

The pulp of the fruit must be at or below the indicated temperature at time of beginning treatment for all cold treatments.

Fruits for Which Cold Treatment Is Authorized

The following cold treatment schedules are authorized by Plant Protection and Quarantine (PPQ) for the control of specific pests associated with shipments of fruit. The cold treatment schedule that must be used for a specific commodity from a specific country is listed in the Fruits and Vegetables Section of the PPQ Nonpropagative Manual. These cold treatment schedules indicate the specific pests for which they are designed to control.

Treatment upon arrival may be accomplished at authorized ports as named in the permits.

Treatment in transit may be authorized for specifically equipped and approved vessels or containers and from approved countries, for entry at ports named in the permits. Intransit cold treatment authorization must be preceded by a visit to the country of origin by a PPQ official to explain loading, inspection, and certification procedures to designated certifying officials of country of origin. Refrigerated compartments on carrying vessels and cold storage warehouse must have prior certification by PPQ. Authorization of cold treatments from countries with direct sailing time less than the number of days prescribed for intransit refrigeration treatment must be contingent on importer understanding that prescribed intransit refrigeration period must be met before arrival of vessel at the approved U.S. port.

Gaps in the cold treatment data print-out for pulp sensors and air sensors shall be allowed or disallowed on a case-by-case basis, taking into account the number of gaps, the length of each gap, and the temperatures before and after. Air temperatures may occasionally exceed treatment temperatures during defrost cycles; however, fruit temperatures should not rise appreciably during this time. During non-defrost times, the temperatures of the air sensors should never exceed the maximum allowable treatment temperature.

Important

Some commodities may require fumigation in addition to a T107 cold treatment. Check the PPQ Nonpropagative Manual to determine the required treatments for a commodity from a specific country.

Important

Cold treatment in *break-bulk* vessels must be initiated by an APHIS officer when shipments are from Italy, and Taiwan. However, cold treatment in *containers* may be initiated by treatment technicians from these countries only because they have been trained to initiate cold treatments for containers and not break-bulk vessels.

T107-a

Apple, Apricot, Avocado,Cape Gooseberry Cherry, Ethrog, Grape, Grapefruit, Kiwi, Loquat, Litchi (Lychee), Nectarine, Orange, Ortanique, Peach, Pear, Persimmon, Plum, Plumcot, Pomegranate, Pummelo, Quince, Sand Pear, Tangerine (includes Clementine)

Pest: *Ceratitis capitata* (Mediterranean fruit fly)

Treatment: T107-a Cold treatment

Temperature	Exposure Period
34 °F (1.11 °C) or below	14 days
35 °F (1.67 °C) or below	16 days
36 °F (2.22 °C) or below	18 days

Important

Pretreatment conditioning for avocado (heat shock or 100.4 °F (38.0 °C) for 10 to 12 hours) is optional and is the responsibility of the shipper. The pretreatment conditioning, which may improve fruit quality, is described in HortScence 29 (10): 1166-1168. 1994. and 30(5): 1052-1053 (1995)

T107-a-1

Apple, Apricot, Cherry, Grape, Grapefruit, Kiwi, Nectarine, Orange, Peach, Pear, Plum, Pomegranate, Quince, Tangerine (includes Clementine)

Pest: *Ceratitis capitata* (Mediterranean fruit fly) and species of *Anastrepha* (other than *Anastrepha ludens)*

Treatment: T107-a Cold treatment

Temperature	Exposure Period
34 °F (1.11 °C) or below	15 days
35 °F (1.67 °C) or below	17 days

T107-b Apple, Apricot, Cherry, Citron, Ethrog, Grapefruit, Litchi, Longan, Orange, Peach, Persimmon, Plum, Pomegranate, Tangerine (includes Clementine), White Zapote

Pest: *Anastrepha ludens* (Mexican fruit fly)

Treatment: **T107-b** Cold treatment

Temperature	Exposure Period
33 °F (0.56 °C) or below	18 days
34 °F (1.11 °C) or below	20 days
35 °F (1.67 °C) or below	22 days

T107-c Apple, Apricot, Carambola, Cherry, Grape, Grapefruit, Orange, Pomegranate, Tangerine (includes Clementine)

Pest: Species of *Anastrepha* (other than *Anastrepha ludens)*

Treatment: **T107-c** Cold treatment

Temperature	Exposure Period
32 °F (0 °C) or below	11 days
33 °F (0.56 °C) or below	13 days
34 °F (1.11 °C) or below	15 days
35 °F (1.67°C) or below	17 days

T107-d Apple, Grapefruit, Kiwi, Orange, Pear, Tangerine (includes Clementine)

Pest: *Bactrocera tryoni* (Queensland fruit fly)

Treatment: **T107-d** Cold treatment

Temperature	Exposure Period
32 °F (0 °C) or below	13 days
33 °F (0.56 °C) or below	14 days
34 °F (1.11 °C) or below	18 days
35 °F (1.67°C) or below	20 days
36 °F (2.22 °C) or below	22 days

T107-e Apricot, Citrus, Nectarine, Peach, Plum

Pest: *Cryptophlebia leucotreta* (false codling moth) and *Pterandrus rosa* (Natal fruit fly)

Treatment: **T107-e** Cold treatment

Temperature	Exposure Period
31 °F (-0.55°C) or below[1]	22 days

1 The treatment shall not commence until all sensors are reading 31°F (-0.55°C) or below. If the temperature exceeds 31.5°F (-0.27°C), the treatment shall be extended one-third of a day for each day or part of a day the temperature is above 31.5°F (-0.27°C). If the exposure period is extended, the temperature during the extension period must be 34° F (1.11°C) or below. If the temperature exceeds 34°F (1.11°C) at any time, the treatment is nullified. Also, some freeze damage to the fruit may occur if the pulp temperature is allowed to drop below approximately 29.5°F (-1.38°C) (This varies with the commodity.)

T107-f Carambola, Litchi (Lychee), Sand Pear, Ya pear

Pest: *Bactrocera cucurbitae* (Melon fly), *Bactrocera dorsalis* (Oriental fruit fly), and *Eutetranychus orientalis* (Oriental citrus mite)

Treatment: **T107-f** Cold treatment

Temperature	Exposure Period
32 °F (0 °C) or below	10 days
33 °F (0.56 °C) or below	11 days
34 °F (1.11 °C) or below	12 days
35 °F (1.67 °C) or below	14 days

Important

If the fruit is shipped froman area where Mediterranean fruit fly also occurs in combination with melon fly and/or Oriental fruit fly, use T107-a

T107-g Pecans and Hickory nuts

Pest: *Curculio caryae* (Pecan weevil)

Treatment: **T107-g** Cold treatment

Temperature	Exposure Period
32 °F (0 °C) or below	7 days

T107-h Longans, Litchi (Lychee)

Pest: *Bactrocera dorsalis* (Oriental fruit fly), *Bactrocera curcubitae* (melon fly) and *Conopomorpha sinensis* (lychee fruit borer)

Treatment: **T107-h** Cold treatment

Temperature	Exposure Period
33.4°F (0.77 °C) or below	13 days
33.8 °F (0.99 °C) or below	15 days
34.5 °F (1.38 °C) or below	18 days

T107-j Longans

Pest: *Bactrocera dorsalis* (Oriental fruit fly) and *Bactrocera curcubitae* (melon fly)

Treatment: **T107-j** Cold treatment

Temperature	Exposure Period
33.8 °F (0.99 °C) or below	13 days
34.5 °F (1.38 °C) or below	18 days

T108—Fumigation Plus Refrigeration of Fruits

Fruits for Which Fumigation Followed by Cold Treatment Is Authorized

The following treatment schedules (fumigation followed by cold treatment) are authorized by Plant Protection and Quarantine (PPQ) for the control of specific pests associated with shipments of fruit. The treatment schedule that must be used for a specific commodity from a specific country is listed in the Fruits and Vegetables Section of the PPQ Nonpropagative Manual. These treatment schedules indicate the specific pests for which they are designed to control.

Important

For Hawaiian-grown avocados, research has shown that, during the process of cold treatment (T108-a), a single transient heat spike of no greater than 39.6 °F (4.2 °C) and no longer than 2 hours, during or after 6 days of cold treatment, does not affect the efficacy of the treatment. However, in the absence of supporting research, such a tolerance for heat spikes shall not be extended to other fruits.

Important

Cold treatment in break-bulk vessels must be initiated by an APHIS officer when shipments are fromItaly, and Taiwan. However, cold treatment in containers may be initiated by treatment technicians from these countries only because they have been trained to initiate cold treatments for containers and not break-bulk vessels

NOTICE

Some varieties of fruit may be injured by exposure to MB. Importers should be encouraged to treat small samples of fruit to determine tolerance levels before shipping commercial quantities. The USDA is not liable for damages caused by quarantine.

T108-a Apple, Apricot, Avocado, Cherry, Grape, Kiwi, Nectarine, Peach, Pear, Plum, Plumcot, Quince

Pest: *Bactrocera cucurbitae* (melon fly), *Bactrocera dorsalis* (Oriental fruit fly), *Bactrocera tryoni* (Queensland fruit fly), *Brevipalpus chiliensis* (false red mite), *Ceratitis capitata* (Mediterranean fruit fly), *Lobesia botrana* (grapevine moth)

Treatment: **T108-a** Fumigation plus Cold treatment
Three alternative schedules based upon the fumigation exposure time

Important

Pretreatment conditioning for avocado (heat shock or 100.4 °F (38.0 °C) for 10 to 12 hours) is optional and is the responsibility of the shipper. The pretreatment conditioning, which may improve fruit quality, is described in HortScence 29 (10): 1166-1168. 1994. and 30(5): 1052-1053 (1995)

NOTICE

Check the PPQ Nonpropagative Manual to determin the required treatments for a commodity froma specific country.

Important

Some varieties of fruit may be injured by the 3 hour exposure. Importers should be encouraged to test treat small quantities to determine tolerance before shipping commercial quantities

Important

Time lapse between fumigation and start of cooling not to exceed 24 hours.

Some commodities may exceed label dosage. Check the label of the gas being used before you start the fumigation.

T108-a-1

Treatment: **T108-a-1** (2 hour schedule) MB at NAP—tarpaulin or chamber followed by cold treatment

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F (21.11°C) or above	2 lbs	25	18
Followed by cold treatment			

Refrigeration	
Temperature	**Exposure Period**
33 to 37 °F (0.56 to 2.77 °C)	4 days
OR 38 to 47 °F (3.33 to 8.33 °C)	11 days

T108-a-2

Treatment: **T108-a-2** (2.5 hour schedule) MB at NAP—tarpaulin or chamber followed by cold treatment

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	2.5 hrs
70 °F (21.11°C) or above	2 lbs	25	18	18
Followed by cold treatment				

Refrigeration	
Temperature	**Exposure Period**
34 to 40 °F (1.11 to 4.44 °C)	4 days
OR 41 to 47 °F (5.0 to 8.33 °C)	6 days
OR 48 to 56 °F (8.88 to 13.33 °C)	10 days

T108-a-3

Treatment: **T108-a-3** (3 hour schedule) MB at NAP—tarpaulin or chamber followed by cold treatment

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs*	2.5 hrs	3 hrs
70 °F (21.11°C) or above	2 lbs	25	18	18	17
Followed by cold treatment					

Refrigeration	
Temperature	**Exposure Period**
43 °F to 47 °F (6.11 to 8.33 °C)	3 days
OR 48 °F to 56 °F (8.88 to 13.33 °C)	6 days

T108-b Apple, Grape, and Pear

Pest: *Austrotortrix* spp. and *Epiphyas* spp. (light brown apple moth complex), *Bactrocera tryoni* (Queensland fruit fly), *Ceratitis capitata* (Mediterranean fruit fly) and other fruit flies

Treatment: T108-b MB at NAP—tarpaulin or chamber followed by cold treatment

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs*
50 °F (10 °C) or above	1.5 lbs	23	20
40-49 °F (4.44 to 9.44 °C)	2 lbs	30	25
Followed by cold treatment			

Temperature	Exposure Period
33 ° F (0.56 °C) or below	21 days
OR 48 ° to 56 °F (8.88 to 13.33 °C)	6 days

NOTICE

Alternate treatment for fumigation plus refrigeration of fruits (T108) is refrigeration plus fumigation of fruits (T109).

Important

Load not to exceed 80 percent of chamber capacity. Time lapse between fumigation and start of cooling not to exceed 24 hours.

T109—Cold Treatment Plus Fumigation of Fruits

T109-d-1 Apple, grape, and pear from Australia

Pest: *Austrotortrix* spp. and *Epiphyas* spp. (light brown apple moth complex), *Bactrocera tryoni* (Queensland fruit fly), *Ceratitis capitata* (Mediterranean fruit fly) and other fruit flies

Treatment: T109-d-1 Cold treatment followed by MB at NAP—tarpaulin or chamber

Temperature	Exposure Period
33 ° F (0.56 °C) or below	21 days
Followed by MB at NAP—tarpaulin or chamber	

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
70 °F (21.11 °C) or above	2 lbs	30	25
60 to 69 °F (15.55 to 20.55 °C)	2.5 lbs	36	28
40 to 59 °F (4.44 to 15.0 °C)	3 lbs	44	36

Alternate treatment for *Austrotortrix* and *Epiphyas* is fumigation plus refrigeration (**T108-b**).

Alternate treatment for grapes from Australia as a fruit fly precautionary treatment for *Bactrocera tryoni* and *Ceratitis capitata* is fumigation plus refrigeration (**T108-a** and **T108-b**).

NOTICE

Load not to exceed 80 percent of capacity.

T109a Apple ('Fuji' apple from Japan and Korea)

Pest: *Carposina niponensis* (peach fruit moth), *Conogethes punctiferalis* (yellow peach moth), *Tetranychus viennensis* (fruit tree spider mite), *Tetranychus kanzawai* (Kanzawa mite)

Two alternative schedules based on type of container

T109-a-1

Treatment: **T109-a-1** (apples in plastic field bins at maximum load factor 50 percent or less) Cold treatment followed by MB at NAP—tarpaulin or chamber

Temperature	Exposure Period
34 °F (1.11 °C) or below	40 days
Followed by MB at NAP—tarpaulin or chamber	

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
50 °F or (10.0 °C) above	3 lbs	44	36

T109-a-2

Treatment: **T109-a-2** (apples in only cardboard cartons at maximum load factor 40 percent or less) Cold treatment followed by MB at NAP—tarpaulin or chamber

Temperature	Exposure Period
34 °F (1.11 °C) or below	40 days
Followed by MB at NAP—tarpaulin or chamber	

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
59 °F (15.0 °C) above	2 lbs 6 oz	35	29

T110—Quick Freeze

Treatment: T110 Quick Freeze

1. Initially, lower the commodity's temperature to 0 °F (-17.77 °C) or below.
2. Hold the commodity's temperature at 20 °F (-6.66 °C)or below for at least 48 hours.

The commodity may be transported during the 48-hour treatment period, but at no time may the commodity's temperature rise above 20 °F (-6.66 °C) prior to release.

All fruits and vegetables* are enterable from all foreign countries after receiving the above treatment in accordance with 7CFR 319.56-2c. Also, interstate movement of all fruits and vegetables from offshore areas of the United States (except mango from Hawaii) is authorized in the frozen state after being quick frozen.

Important

Quick freeze may damage fruit.

Of course, freezing will ruin the market quality of most fresh fruits and vegetables, except for thick-skinned items such as durian and coconut. Generally, the Quick Freeze treatment is used on fruits and vegetables that will be processed into another form (e.g., for puree, juice, or mashed vegetables). Also, this treatment is considered an acceptable method of destroying most commodities in lieu of returning them to the country of origin, with the exceptions listed below.

Important

Exceptions*—Avocados with seeds** are prohibited from South America, Central America, or Mexico; however, avocados from certain areas of Mexico during specific times may enter the United States. **Citrus with peel** is prohibited from Afghanistan, Andaman Islands, Argentina, Bangladesh, Brazil, Caroline Islands, Cambodia, China (People's Republic of), Comoros, Côte d'Ivoire, Fiji Islands, Home Island in Cocos (keeling) Islands, Hong Kong, India, Indonesia, Japan and adjacent islands, Korea, Laos, Madagascar, Malaysia, Maldives, Mauritius, Mozambique, Myanmar, Nepal, Oman, Pakistan, Papua New Guinea, Paraguay, Philippines, Reunion Islands, Rodrigues Islands, Ryukyu Islands, Saudi Arabia, Seychelles, Sri Lanka, Taiwan, Thailand, Thursday Island, United Arab Emirates, Uruguay, Vietnam, Yemen, or Zaire. **Mangoes with seeds** are prohibited from Barbados, Dominica, French Guiana, Guadeloupe, Martinique, St. Lucia, and all countries outside of North, Central, and South America and their adjacent islands (which include the Caribbean Islands and Bermuda). **Black currants** are enterable only to areas specified in the import permit. **Corn-on-the-cob** is prohibited from Albania, Algeria, Bosnia and Hercegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Libya, Malta, Macadonia, Morocco, Sardinia, Slovenia, Spain, Syria, Tunisia, Turkey, or Yugoslavia (Serbia and Montenegro).

5

Treatment Manual

Treatment Schedules

T200 - Schedules for Propagative Plant Material

Contents

The following schedules of the T200 series are arranged by category such as a specifically named plant, type of plant, character of growth, or pest.

Important

Plant and plant parts treated under the T200 series schedules are not to be used for food or feed purposes.

T201—Plants

T201-a-1—Deciduous woody plants (dormant) **page-5-3-6**
T201-a-2—**Citrus whitefly hosts, see "T201-k-1" on page-5-3-10 Evergreens* broadleaved genera page-5-3-7**
T201-c-1—Greenhouse-grown plants, herbaceous plants and cuttings, and greenwood cuttings of woody plants **page-5-3-10**
T201-k-2—Orchids, plants, and cuttings **page-5-3-13**
T201-e-3-1—Bromeliads **page-5-3-4**
T201-j—Cacti and other succulents **page-5-3-4**
T201-g-1—Chrysanthemum spp., rooted and unrooted cuttings **page-5-3-5**
T201-l—Cycads—excluding Dioon edule (chestnut dioon) **page-5-3-6**
T201-i-1—Dieffenbachia spp., Dracaena spp., Philodendron spp. (plants and cuttings) **page-5-3-8**
T201-j—Pines (Pinus spp.) from Canada **page-5-3-16**
T201-k-1—**Foliated hosts plants of Dialeurodes citri (citrus whitefly), excluding Osmanthus americanus page-5-3-10**
Nonfoliated hosts plants of Dialeurodes citri (citrus whitefly), excluding Osmanthus americanus page-5-3-13
T201-l—Commodities infested with quarantine significant slugs **page-5-3-6**
T201-m-1—Plant cuttings (root cuttings)* **page-5-3-17**
T201-p—Host plants of Aleurocanthus woglumi (citrus blackfly) **page-5-3-12**
T201-o-1—Host plants of Omalomyx unguis and Succinea spp. (snails) **page-5-3-12**
T201-p—Plant material not tolerant to fumigation **page-5-3-18**
T202—Bulbs, Corms, Tubers, Rhizomes, and Roots—Aquatic plants infested with freshwater snails **page-5-3-3**

T202—Bulbs, Corms, Tubers, Rhizomes, and Roots

T202-b—Selaginella spp. (Resurrection plants) **page-5-3-25**
T202-d—Astilbe roots **page-5-3-20**
T202-c—Banana roots **page-5-3-21**
T202-d—Yams (Dioscorea spp.) and Sweet Potatoes (Ipomoea spp.) **page-5-3-26**
T203—Seeds—Gladiolus spp. **page-5-3-22**
T202-f—Horseradish roots **page-5-3-22**

T202-g—Lily bulbs packed in subsoil **page-5-3-23**
T202-h—**Lycoris** **page-5-3-23**
T202-i-1—**Narcissus** **page-5-3-24**
T202-j—Garlic **page-5-3-21**

T203—Seeds

T203-m—Seeds not specifically listed in the T203 Schedules **page-5-3-32**
T203-l—Seeds excluding seeds of Vicia spp. **page-5-3-31**
T203-l—Seeds of Leguminosae = Fabaceae, etc. **page-5-3-33**
T203-l—Seeds of Vicia spp. (vetch seeds) including seeds of Vicia faba
page-5-3-35)
—Chestnuts (does not include water chestnuts) and Acorns **page-5-3-27**
T203-i-1—Cottonseed—bagged, packaged, or in bulk **page-5-3-28**
T203-g-1—Pods and seed of Kenaf, Hibiscus, and Okra **page-5-3-30**
—Rosmarinus seeds **page-5-3-31**
—Conifer seeds (species with small seeds, such as Picea spp., Pinus sylvestris, and Pinus mugo) **page-5-3-27**
T203-j—Seeds of Hevea brasiliensis (rubber tree) **page-5-3-33**
T203-k—Macadamia nuts (as seeds) **page-5-3-31**)
T203-l—Seeds **page-5-3-31**
T203-m—Avocado (seeds only, without pulp) **page-5-3-26**)
T203-d-1—Seeds with infested pulp **page-5-3-35**
T203-b—Seeds infested with miscellaneous insects **page-5-3-32**

NOTICE

Plant Tolerance. In general, nursery stock should be fumigated in a normal atmospheric pressure (NAP) chamber. Damage may occur when treatment is performed under a tarpaulin. When selecting a treatment for a particular pest, consider the tolerance of the plant material to the treatment. Refer to the "Handbook of Plant Tolerances to Quarantine Treatments" to determine if a genus or species is tolerant to treatment.

The condition of the plants at the time of treatment may have a bearing on reaction to treatment.

Any new or unusual observations relating to treatment tolerance of treated material should be recorded and reported to the Center for Plant Health Science & Technology (CPHST), giving details of the treatment and the conditions of application. In appraising the effects of a particular treatment, take care to distinguish between the actual or apparent effects attributable to the treatment and those not related to the treatment.

NOTICE

Seeds for Propagation. Precautionary treatment for small lots of seeds (1 lb or less) is **not** required if you can inspect 100 percent of the seeds and you do not find any pests.

NOTICE

Containers. Give boxes, crates, and other propagative containers the same treatment as the propagative material with which they are associated. Exceptions are necessary, however, when significant pests are found infesting containers or packing materials that would not be controlled by the treatment required for the contents.

NOTICE

Dipping. In lieu of fumigation, an approved chemical dip may be recommended for those plants known to be intolerant to fumigants. Plants, including the roots, should be entirely submerged in the chemical dip for 30 seconds. Agitating the plants while immersed in the solution will eliminate air pockets and aid in obtaining complete coverage of the plants with the pesticide. For approved fungicidal dips, see the appropriate section in the T500 Treatment Schedules.

Important

Use fresh chemicals in preparing the dip solution for same day use. Wear rubber gloves while dipping plants to prevent pesticides from coming in contact with skin. Wash the gloves in soap and water before removing. Also, thoroughly wash hands and arms in soap and water after removing the gloves. Do **not** eat or smoke while working with pesticides.

T201—Plants

T201-q Aquatic plants infested with freshwater snails

Pest: Snails of the following families: Amphulariidae, Bulinidae, Limnaeidae, Planorbidae, Viviparidae

Treatment: T201-q Hot water treatment 112 °F for 10 minutes. *Elodea Danes* and *Cabomba caroliniana* plants not tolerant to this treatment. Inspection stations should refer to their reference report guide for host tolerances to the hot water treatment.

T201-e-1 Bromeliads

Pest: External feeders

Treatment: T201-e-1 MB (“Q” label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	1.5 hrs
80-89 °F	2 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs

T201-e-2 Bromeliads

Pest: Internal feeders such as borers and miners

Treatment: T201-e-2 MB ("Q" label only) at 15" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	1.5 hrs
80-89 °F	2 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs

T201-f-1 Cacti and other succulents

Two schedules based on type of pest

Pest: External feeders (other than soft scales) infesting collected dormat and nondormat plant material

Treatment: T201-f-1 MB ("Q" label only) at NAP—tarpaulin or chamber)

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

T201-f-2 Cacti and other succulents

Two schedules based on type of pest

Pest: Borers and soft scales

Treatment: T201-f-2 MB ("Q" label only) in 15" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

Important

Vacuum fumigation requires prior consent of the importer. If consent is denied, entry should be refused unless hand removal plus 100 percent inspection is feasible.

NOTICE

Obtain consent of the importer prior to treatment of the following plants since some damage may occur:

Bromeliads, see **T201-e-3-1**
Kalenchoe synsepala, see **T201-p**
Sedum adolphi, see**T201-p**

T201-g-1 *Chrysanthemum* spp., rooted and unrooted cuttings

NOTICE

Obtain consent of the importer prior to fumigation since some damage may occur.

Pest: Aphids

Treatment: T201-g-1 MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
70 °F or above	0.75 lb	2 hrs

T201-g-2 *Chrysanthemum* spp., rooted and unrooted cuttings

Pest: External feeders

Treatment: T201-g-2 Malathion-carbaryl chemical dip—Hand removal of pests of infested parts *plus* a malathion-carbaryl chemical dip. Solution prepared by adding 3 level tablespoons of 25 percent malathion wettable powder and 3 level tablespoons of 50 percent carbaryl wettable powder to each gallon of water. The addition of a sticker-spreader formulation may be required for hard to wet plants. Use fresh chemicals and prepare dip for the same day use. Plants, including the roots, should be entirely submerged in the chemical dip for 30 seconds.

T201-g-3 *Chrysanthemum* spp., rooted and unrooted cuttings

Pest: Leafminers, aphids, mites, etc.*

Treatment: T201-g-3 Hot water at 110-111 °F for 20 minutes

This treatment is marginal as to host tolerance.

Important

Chrysanthemum spp. from the Dominican Republic and Colombia when infested with Agromyzid leafminers requires no treatment unless destined to Florida.

T201-l Commodities infested with quarantine significant slugs

Pest: Quarantine significant slugs of the families Agriolimacidae, Arionidae, Limacidae, Milacidae, Philomycidae, and Veronicellidae, including the following genera:

Agriolimax	***Leidyula***	***Pseudoveronicella***
Arion	***Limax***	***Sarasinula***
Colosius	***Meghimatium***	***Semperula***
Deroceras	***Milax***	***Vaginulus***
Diplosolenodes	***Pallifera***	***Veronicella***

Treatment: T201-l MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
90-96 °F	1 lb	12	9
80-89 °F	1.25 lbs	15	12
70-79 °F	1.5 lbs	18	15
60-69 °F	1.75 lbs	22	19

T201-h-1 Cycads—excluding *Dioon edule* (chestnut dioon)

Pest: External feeders

Treatment: T201-h-1 MB ("Q" label only) in 15" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
60-79 °F	3 lbs	2 hrs
40-59 °F	3 lbs	2.5 hrs

T201-a-1 Deciduous woody plants (dormant)

Pest: External feeders

Treatment: T201-a-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

For gypsy moth egg masses, use T313-a or T313-b.

Important

If treating for mealybugs, use T305-c.

Important

Residue samples are not required on FIFRA Section 18 materials that are inedible.

NOTICE

This schedule is not entirely satisfactory for use against egg masses of *Yponomeuta malinellus* (apple ermine moth).

T201-a-2 Deciduous woody plants (dormant)

root cuttings, scion wood cuttings, and nonfoliated citrus whitefly host—such as *Acer, Berberis, Fraxinus, Philadelphus, Rosa, Spiraea,* and *Syringa*

Pest: Borers

Treatment: T201-a-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

Important

Citrus whitefly hosts, **see** "T201-k-1" on **page-5-3-10** Evergreens* broadleaved genera

T201-h-2 Dioon edule (chestnut dioon)

For other cycads see cycads

Pest: External feeders

Treatment: T201-h-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
60-79 °F	3 lbs	2 hrs
40-59 °F	3 lbs	2.5 hrs

T201-i-1 *Dieffenbachia* spp., *Dracaena* spp., *Philodendron* spp. (plants and cuttings)

Pest: External feeders

Treatment: T201-i-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	1.5 hrs
80-89 °F	2 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs

Important

This treatment may cause leaf tip burn in *Dieffenbachia* (dumbcane).

T201-i-2 *Dieffenbachia* spp., *Dracaena* spp., *Philodendron* spp. (plants and cuttings)

Pest: Internal feeders

Treatment: T201-i-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	1.5 hrs
80-89 °F	2 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs

Immature and tender plants and cuttings, and species and varieties known or considered to be affected by MB, should not be fumigated without consent of the importer. Without such consent, entry should be denied.

NOTICE

This schedule may cause leaf tip burn in *Dieffenbachia* (dumbcane).

T201-b-1 Evergreens*, (Broadleaved genera, such as *Azalea*, *Berberis*, *Camellia*, *Ilex*, and *Photinia*)

(Coniferous genera, such as *Cedrus, Cupressus, Juniperus, Podocarpus, Thuja,* and *Taxus)*

Pest: External feeder**

Treatment: T201-b-1 MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3):		Exposure Period:	
	Brachyrhinus larvae	All others	*Brachyrhinus* larvae	All others
90-96 °F	2 lbs	1.5 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	2.5 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	2.5 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	2.5 lbs	4 hrs	3.5 hrs

Important

*If treating for mealybugs, fumigate at 60 °F or above.

Exceptions:

Araucaria spp., **see** **"T201-c-1" on page-5-3-10**
Azalea indica, **see** **"T201-c-2" on page-5-3-11**
Cycads, **see** **"T201-l" on page-5-3-6**
Citrus whitefly hosts, **see** **"T201-k-1" on page-5-3-10**
Daphne spp., **see** **"T201-c-1" on page-5-3-10**
Lavandula spp., **see** **"T201-p-1" on page-5-3-19**
Osmanthus americanus, **see** **"T201-p-2" on page-5-3-19**
Pinus from Canada to certain States, **see** **"T201-j" on page-5-3-16**
Peanuts with gypsy moth egg masses, **see** **"T313—Christmas Trees" on page-5-4-26**

NOTICE

Some species and varieties of evergreens, particularly in *Azalea* and *Juniperus* have low tolerances and should be fumigated as in schedule T201-c; those known or believed to be intolerant should be handled under T201-p. For tolerance data, see Handbook of Plant Tolerances to Quarantine Treatments.

T201-k-1 Foliated hosts plants of *Dialeurodes citri* (citrus whitefly), excluding *Osmanthus americanus*

For Osmathus americanus, see T201-p

Pest: ***Dialeurodes citri*** (citrus whitefly)

Treatment: T201-k-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3):		Exposure Period:
	Brachyrhinus larvae	All others	
85-96 °F	1.5 lbs	1 lb	4 hrs
80-84 °F	2.5 lbs	2 lbs	2.5 hrs
70-79 °F	2 lbs	2 lbs	3.5 hrs

T201-c-1 Greenhouse-grown plants, herbaceous plants and cuttings, and greenwood cuttings of woody plants

For cut flowers and greenery, use T305-a, which is identical to this schedule).

Pest: External feeders, leaf miners, thrips*

Treatment: T201-c-1 MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80-90 °F	1.5 lbs	19	12
70-79 °F	2 lbs	24	16
60-69 °F	2.5 lbs	30	20
50-59 °F	3 lbs	36	24
40-49 °F	3.5 lbs	41	27

Important

If treating for mealybugs, fumigate at 60 °F or above.

T201-c-2 Greenhouse-grown plants, herbaceous plants and cuttings, and greenwood cuttings of woody plants

Pest: Borers, soft scales

Important

For cut flowers and greenery, use T305-b, which is identical to this schedule.

Treatment: T201-c-2 MB ("Q" label only) in 15" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-90 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

Vacuum fumigation requires prior consent of the importer. If consent is denied, refuse entry unless T201-c-1, plus hand removal of these pests is feasible. For shipments of a size to permit 100 percent inspection, plants with these pests may be handled separately. Vacuum fumigation is not required for soft scales known to be widely distributed in the United States.

Important

Exceptions to Schedules T201-c-1 and 2
- Bromeliads, see "T201-e-3-1" on **page-5-3-15**
- Cacti and other succulents, see "T201-j" on **page-5-3-16**
- *Chrysanthemum* spp., see"T201-g-1" on **page-5-3-5**
- Cycads, see "T201-l" on **page-5-3-6**
- Cyclamen mites, "T201-a-2" on **page-5-3-7**
- *Dieffenbachia* spp., *Dracaena* spp., and *Philodendron* spp., see "T201-i-1" on **page-5-3-8**
- *Kalanchoe synsepala*, see "T201-p-1" on **page-5-3-19**
- *Lavandula* spp., see "T201-p-2" on **page-5-3-19**
- Orchids, see "T201-k-2" on **page-5-3-13**6
- *Osmanthus americanus*, see "T201-p" on **page-5-3-18**
- *Pelargonium* spp., see "T201-p" on **page-5-3-18**
- *Sedum adolphi*, see "T201-p" on **page-5-3-18**
- Plants infested with *Succinea horticola*, see "T201-o-1" on **page-5-3-12**
- Plants infested with *Veronicella* or other slugs, see "T201-l" on **page-5-3-6**

T201-n Host plants of *Aleurocanthus woglumi* (citrus blackfly)

Pest: ***Aleurocanthus woglumi*** (citrus blackfly)

Treatment: T201-n MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
85 °F or above	1 lb	13	9
80-85 °F	1.25 lbs	16	12
70-79 °F	1.5 lbs	19	15
65-69 °F	1.75 lbs	23	17

Precautions within citrus blackfly quarantine areas:

- Conduct tarpaulin fumigations in shaded areas, if possible, to prevent the development of high space temperatures within the tarpaulin enclosure.
- Fumigate 4 to 5 days after plants are dug, balled, and burlapped, if possible.
- Roots and soil should be moist prior to fumigation. Watering should be deferred for 12 hours after fumigation unless there is wilting, in which case, water as needed.
- Avoid excessive air circulation during fumigation or during the post-treatment aeration period.
- Avoid placing plants in direct sunlight after fumigation.

T201-o-1 Host plants of *Omalomyx unguis* and *Succinea spp.* (snails)

Important

These treatments are for use on plants that may not tolerate fumigation. Use either of the following treatments.

Pest: ***Omalomyx unguis*** and ***Succinea spp. (snails)***

Treatment: T201-o-1 Water Spray—Use a high-pressure water spray on the foliage to flush snails from the plants. Care should be taken not to spray the root systems of conifers since they will be damaged. The run-off drain must be screened to catch snails before drainage into the sewer system. Reinspect plants after wash.

T201-o-2 Host plants of *Omalomyx unguis* and Succinea spp. (snails)

Treatment: **T201-o-2** Chemical Dip—Dip plants with a Malathion-carbaryl chemical dip. Solution prepared by adding 3 level tablespoons of 25 percent Malathion wettable powder and 6 level teaspoons of 50 percent carbaryl wettable powder per gallon of water with a sticker-spreader formulation.

T201-k-2 Nonfoliated hosts plants of *Dialeurodes citri* (citrus whitefly), excluding *Osmanthus americanus*

Pest: ***Dialeurodes citri*** (citrus whitefly)

Treatment: T201-k-2 MB ("Q" label at NAP)

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

T201-d-1 Orchids, plants, and cuttings

Pest: External feeders, other than soft scales

Collected: Dormant or nondormant

Treatment: T201-d-1 MB ("Q" label only) at NAP tarpaulin or chamber, **T201-a-1**

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

Important

If treating for mealybugs, use T305-c.

T201-d-2 Orchids, plants, and cuttings

Pest: External feeders (other than soft scales) infesting greenhouse grown plant material

Treatment: T201-d-2 MB ("Q" label only) at NAP tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	1 lb	2 hrs
80-89 °F	1.5 lbs	2 hrs
70-79 °F	2 lbs	2 hrs
60-69 °F	2.5 lbs	2 hrs
50-59 °F	3 lbs	2 hrs
40-49 °F	3.5 lbs	2 hrs

T201-d-3 Orchids, plants, and cuttings

Pest: Borers, cattleya fly, *Mordellistena* spp., soft scales, *Vinsonia* spp.

Treatment: T201-d-3 MB ("Q" label only) in 15" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	3 lbs	1 hr
80-89 °F	3 lbs	1.5 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

For nondormant plants, collected or greenhouse grown, vacuum fumigation requires prior consent of the importer. If consent denied, entry should be refused unless T201-a-1 plus hand removal of these pests is feasible. Plant shipments of a size to permit 100 percent inspection and pest removal may be handled separately.

T201-d-4 Orchids, plants, and cuttings

Pest: Cecidomyid galls

Treatment: **T201-d-4** Excised in all cases

T201-d-5 Orchids, plants, and cuttings

Pest: Leaf miner, *Eurytoma* spp., infesting *Rhynchostylis*

Treatment: T201-d-5 Hot water—118 °F for 0.5 hour followed by a cool water bath

NOTICE

Some varieties of Orchids may be sensitive to methyl bromide (MB) treatments. These varieties include *Cymbidium, Cypripedium,* and *Phalaenopis.* As an alternative to MB treatments that may damage orchids, **see "T201-p" on page-5-3-18**

T201-e-3-1 Pineapple slips

Two alternative schedules

Pest: Various

Treatment: T201-e-3-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	1.5 lbs	2 hrs
80-89 °F	2 lbs	2 hrs
70-79 °F	2.5 lbs	2 hrs
60-69 °F	3 lbs	2 hrs

T201-e-3-2 Pineapple slips

Alternative schedule

Treatment: T201-e-3-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate| (lb / 1,000 ft^3)	Exposure Period
90-96 °F	1.5 lbs	1.5 hrs
80-89 °F	2 lbs	1.5 hrs
70-79 °F	2.5 lbs	1.5 hrs
60-69 °F	3 lbs	1.5 hrs

NOTICE

Some varieties of bromeliads may be sensitive to methyl bromide (MB) treatments. These varieties include *Aechmea* spp., *Billbergia* spp., *Guzmania* spp., *Nidularium* spp., *Vriesia* spp., and other broad shiny-leafed types, and thin-leafed types. As an alternative to MB treatments that my damage bromeliads, **see T201-p.**

T201-j Pines (*Pinus* spp.) from Canada

Destined to California, Idaho, Oregon, and Utah

Pest: *Rhyacionia buoliana* (European pine shoot moth)

Treatment: T201-j MB ("Q" label only) at NAP

Dosage rate for all schedules is 4 lbs MB (51 oz. minimum concentration)

Temperature	Exposure Period	Temperature	Exposure Period
75 °F	2 hrs	59 °F	2 hrs 41 min
74 °F	2 hrs 1 min	58 °F	2 hrs 43 min
73 °F	2 hrs 2 min	57 °F	2 hrs 46 min
72 °F	2 hrs 4 min	56 °F	2 hrs 49 min
71 °F	2 hrs 7 min	55 °F	2 hrs 52 min
70 °F	2 hrs 9 min	54 °F	2 hrs 55 min
69 °F	2 hrs 11 min	53 °F	2 hrs 58 min
68 °F	2 hrs 14 min	52 °F	3 hrs 1 min
67 °F	2 hrs 16 min	51 °F	3 hrs 5 min
66 °F	2 hrs 19 min	50 °F	3 hrs 8 min
65 °F	2 hrs 22 min	49 °F	3 hrs 12 min
64 °F	2 hrs 25 min	48 °F	3 hrs 15 min
63 °F	2 hrs 28 min	47 °F	3 hrs 19 min
62 °F	2 hrs 31 min	46 °F	3 hrs 24 min
61 °F	2 hrs 35 min	45 °F	3 hrs 28 min
60 °F	2 hrs 38 min		

Important

This is a precautionary treatment for pine trees with or without roots and twigs and branches of all *Pinus* species except that Christmas trees and other pine decorative materials are exempt from the fumigation requirement during the period November 1 through December 31.

Prior consent of the importer is required for fumigation at temperatures above 65 °F or below 50 °F and also for all bare-rooted pines, since some damage may occur.

T201-m-1 Plant cuttings (Scion wood)*

Pest: External feeders

Treatment: T201-m-1 MB ("Q" label only) at NAP—tarpaulin or chamber

Important

* See exceptions to plant cuttings commodity

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

T201-m-2 Plant cuttings (greenwood cuttings of woody plants and herbaceous plant cuttings)*

Pest: External feeders

Treatment: T201-m-2 MB ("Q" label only) at NAP—tarpaulin or chamber

Important

* See exceptions to plant cuttings commodity.

Temperature	Dosage Rate (lb / 1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80-90 °F	1.5 lbs	19	12
70-79 °F	2 lbs	24	16
60-69 °F	2.5 lbs	30	20
50-59 °F	3 lbs	36	24
40-49 °F	3.5 lbs	41	27

T201-m-3 Plant cuttings (root cuttings)*

Pest: External feeders

Treatment: T201-m-3 MB ("Q" label only) at NAP—chamber

Important

* See exceptions to plant cuttings commodity.

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

T201-m-4 Plant cuttings (root cuttings)*

Pest: External feeders

Treatment: T201-m-4 MB ("Q" label only) at NAP—tarpaulin

Temperature	Dosage Rate (lb / 1000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2.5 hrs	3 hrs	3.5 hrs	4 hrs
90-96 °F	2 lbs	24	16	—	—	—
80-89 °F	2.5 lbs	30	20	—	—	—
70-79 °F	3 lbs	36	24	—	—	—
60-69 °F	3 lbs	36	—	24	—	—
50-59 °F	3 lbs	36	—	—	24	—
40-49 °F	3 lbs	36	—	—	—	24

Important

* See exceptions to plant cuttings commodity.

Important

Exceptions to Plant Cutting Commodities Treated with T201-m-1, T201-m-2, T201-m-3, and T201-m-4:

Avocado, see **T201-p**
Chrysanthemum, see **T201-g-1**
Dieffenbachia, see **T201-i-1**
Dracaena, see **T201-i-2**
Lavandula, see **T201-p**
Orchids, see **T201-k-2**
Philodendron, see **T201-i-1**

T201-p Plant material not tolerant to fumigation

Three treatments based on pest

Propagative material known to be sensitive to fumigation (see Handbook of Plant Tolerance to Quarantine Treatments) should be handled by the following methods for "quarantine action" pests. The selection of the method will depend upon the character of the plant material and the type of pests that may be found.

T201-p-1 Plant material not tolerant to fumigation

Pest: Actionable Pests Excluding Scale Insects

Treatment: **T201-p-1** Hand removal—With the exception of scale insects, hand removal of pests or infested parts and detailed inspection to ensure plants are pest free. If the characteristics of the plant growth, volume, or the type of pest are such that hand removal plus inspection may not provide a pest free shipment, then see **T201-p-2** or **T201-p-3**, which follows.

T201-p-2 Plant material not tolerant to fumigation

Pest: Actionable Pests

Treatment: **T201-p-2** Hand removal plus chemical dip—Hand removal of pests of infested parts *plus* a malathion-carbaryl chemical dip. Solution prepared by adding 3 level tablespoons of 25 percent malathion wettable powder and 3 level tablespoons of 50 percent carbaryl wettable powder to each gallon of water. The addition of a sticker-spreader formulation may be required for hard to wet plants. Use fresh chemicals and prepare dip for the same day use. Plants, including the roots, should be entirely submerged in the chemical dip for 30 seconds.

Important

When the actionable pests are scale insects or their immature crawlers, prepare the solution by adding 4 level tablespoons of 25 percent malathion wettable powder (if the label allows) and 3 level tablespoons of 50 percent carbaryl wettable power to each gallon of water. Labels registered for this concentration are currently available from the following companies:

Micro-Flo Company LLC
Memphis, TN
Product: Malathion 25-WP
EPA Registration No. 051036-00033
(Tel 901-432-5131)

Cheminova Inc.
Oak Hill Park
1700 Route 23, Suite 210
Wayne, NJ 07470
Product Fyfanon 25 WP
EPA Registration No. 067760-00016
(Tel 201-305-6600)

NOTICE

Methoxychlor (50 percent wettable powder) may be substituted for carbaryl. Do *not* use methoxychlor on chrysanthemums. Other formulations of malathion, carbaryl, and methoxychlor may be substituted for the ones mentioned in this treatment, provided that the final dilution of the acting ingredients in the dip are the same, by weight. For example, you would need to use twice as much carbaryl wettable powder if the active ingredient were 25% instead of 50%.

T201-p-3 Plant material not tolerant to fumigation

Pest: Actionable Pests

Treatment: **T201-p-3** Hot water treatment—Hot water at 112 °F for 20 minutes. Not effective against all insects. Some plants may not be tolerant.

Important

This treatment is authorized in lieu of fumigation as a precautionary treatment following the hand removal of the visible "action" pests or infected plant parts. This alternative treatment is not recommended for mature scale insects. (Schedule **T201-c-1** is recommended for armored scales and schedule **T201-c-2** is recommended for soft scales.) If hand removal is not feasible or complete, or insecticidal coverage cannot be assured because of volume or nature of the plant material, the importer should be given the options of either fumigating at his own risk or returning shipment to origin.

T202—Bulbs, Corms, Tubers, Rhizomes, and Roots

T202-b Astilbe roots

Pest: *Brachyrhinus* larvae

Treatment: T202-b MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70-96 °F	4 lbs	2 hrs
60-69 °F	4 lbs	2.5 hrs
50-59 °F	4 lbs	3 hrs
40-49 °F	4 lbs	4 hrs

For roots received in large cases packed in peat moss, temperatures apply to packing materials, if lower than root temperatures.

T202-c Banana roots

Pest: External feeders

Treatment: T202-c Hot water 110 °F for 30 minutes as pretreatment followed by 120 °F for 60 minutes. Requires consent of importer. Deny entry without consent unless 100 percent inspection plus pest removal is feasible.

T202-j Garlic

For shipments from Algeria, Armenia, Austria, Azerbaijan, Belarus, Bosnia and Hercegovina, Croatia, Czech Republic, Egypt, Estonia, France, Germany, Georgia, Greece, Hungary, Iran, Israel, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lebanon, Lithuania, Macedonia, Moldova, Morocco, Portugal, Slovakia, Slovenia, Republic of South Africa, Russia, Spain, Switzerland, Syria, Tajikistan, Turkey, Turkmenistan, Ukraine, Uzbekistan, and Yugoslavia.

Pest: ***Brachycerus*** spp. (garlic beetles) and ***Dyspeea ulula*** (Bkh.) (onion/garlic carpenterworm)

Treatment: T202-j MB (“Q” label only) at 15" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	1.5 hrs
80-89 °F	2 lbs	2 hrs
70-79 °F	2.5 lbs	2 hrs
60-69 °F	3 lbs	2 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	4 hrs

Important

Load limit not to exceed 80 percent of chamber)

Important

This treatment is a precautionary requirement for *Brachycerus* spp. (garlic beetles) and *Dyspessa ulula* (Bkh.) (onion/garlic carpenterworm).

T202-e-1 *Gladiolus* spp.

Two alternative schedules

Pest: *Taeniothrips simplex* (gladiolus thrips)

Treatment: T202-e-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	3 hrs
80-89 °F	2.5 lbs	3 hrs
70-79 °F	3 lbs	3 hrs
60-69 °F	3 lbs	3.5 hrs
50-59 °F	3 lbs	4 hrs
40-49 °F	3 lbs	4.5 hrs

T202-e-2 *Gladiolus* spp.

Pest: *Taeniothrips simplex* (gladiolus thrips)

Treatment: T202-e-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

T202-f Horseradish roots

Mandatory from the following countries:
Armenia, Azerbaijan, Belarus, Bosnia and Hercegovina, Croatia, Czech Republic, Estonia, Georgia, Germany, Hungary, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Poland, Russia, Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, and Yugoslavia

Pest: External feeders

Treatment: T202-f MB in 15" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

T202-g Lily bulbs packed in subsoil

Pest: Internal feeders

Treatment: T202-g MB (“Q” label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	3 hrs
80-89 °F	2.5 lbs	3 hrs
70-79 °F	3 lbs	3 hrs
60-69 °F	3 lbs	3.5 hrs
50-59 °F	3 lbs	4 hrs
40-49 °F	3 lbs	4.5 hrs

Load limit 50 percent of chamber volume. Remove all wooden case covers. Overnight or longer aeration advisable.

T202-h Lycoris

Pest: *Taeniothrips eucharii*

Treatment: T202-h MB in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

T202-i-1 Narcissus

Pest: *Steneotarsonemus laticeps* (bulb scale mite)

Treatment: T202-i-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	3 lbs	2 hrs
80-89 °F	3.5 lbs	2 hrs
70-79 °F	4 lbs	2 hrs
60-69 °F	4 lbs	2.5 hrs
50-59 °F	4 lbs	3 hrs
40-49 °F	4 lbs	3.5 hrs

T202-i-2 *Narcissus*

Pest: *Steneotarsonemus laticeps* (bulb scale mite)

Treatment: T202-i-2 MB ("Q" label only) in 26" vacuum chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	2 hrs
80-89 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

T202-i-3 *Narcissus*

Pest: *Steneotarsonemus laticeps* (bulb scale mite)

Treatment: T202-i-3 Hot water, 110-111 °F for 1 hour

Important

Exposure measured from time bulbs reach 110 °F pulp temperature. Hot water should be applied *within 1 month after normal harvest,* or flower bud injury may develop.

T202-a-1 *Selaginella* spp. (Resurrection plants)

Pest: External feeders

Treatment: T202-a-1 MB ("Q" label only) at NAP—Chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

T202-a-2 *Selaginella* spp. (Resurrection plants)

Pest: External feeders

Treatment: T202-a-2 MB ("Q" label only) at NAP—Tarpaulin

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2.5 hrs	3 hrs	3.5 hrs	4 hrs
90-96 °F	2 lbs	24	16	—	—	—
80-89 °F	2.5 lbs	30	20	—	—	—
70-79 °F	3 lbs	36	24	—	—	—
60-69 °F	3 lbs	36	—	24	—	—
50-59 °F	3 lbs	36	—	—	24	—
40-49 °F	3 lbs	36	—	—	—	24

T202-a-3 Selaginella spp. (Resurrection plants)

Pest: Internal feeders

Treatment: T202-a-3 MB ("Q" label only) in 26" vacuum—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period:	
		Brachyrhinus larvae	All others
90-96 °F	2 lbs	2.5 hrs	2 hrs
80-89 °F	2.5 lbs	2.5 hrs	2 hrs
70-79 °F	3 lbs	2.5 hrs	2 hrs
60-69 °F	3 lbs	3 hrs	2.5 hrs
50-59 °F	3 lbs	3.5 hrs	3 hrs
40-49 °F	3 lbs	4 hrs	3.5 hrs

T202-d Yams (*Dioscorea* spp.) and Sweet Potatoes (*Ipomoea* spp.)

Pest:

Treatment: T202-d MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2.5 lbs	4 hrs
80-89 °F	3 lbs	4 hrs
70-79 °F	3.5 lbs	4 hrs
60-69 °F	4 lbs	4 hrs

NOTICE

Temperatures below 70°F may cause injury to yams. Fumigations below 70 °F should only be made with consent of importer. The tuberous roots should be cured, free from surface moisture, and held at fumigation temperatures for 24 hours following treatment. Mandatory for yams for all foreign countries except Japan, Dominican Republic into Puerto Rico, and all of the West Indies into the U.S. Virgin Islands. Also, for interstate movement of sweet potatoes from Hawaii.

T203—Seeds

T203-m Avocado (seeds only, without pulp)

Pest: Avocado seed weevils (*Conotrachelus* spp., *Heilipus lauri*, and *Caulophilus latinasus*); avocado stem weevil (*Copturus aguacatae*), and avocado seed moth (*Stenoma catenifer*)

Treatment: T203-m MB ("Q" label only) at 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2 lbs	2 hrs
80-89 °F	3 lbs	2 hrs
70-79 °F	4 lbs	2 hrs
60-69 °F	4 lbs	3 hrs
50-59 °F	4 lbs	4 hrs
40-49 °F	4 lbs	5 hrs

T203-e

Chestnuts (does not include water chestnuts) and Acorns

From all countries except Canada and Mexico

Pest: Internal feeders

Treatment: T203-e (mandatory treatment) MB (“Q” label only) at 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-96 °F	3 lbs	2 hrs
70-79 °F	4 lbs	2 hrs
60-69 °F	4 lbs	3 hrs
50-59 °F	4 lbs	4 hrs
40-49 °F	4 lbs	5 hrs

T203-i-1

Conifer seeds (species with small seeds, such as *Picea* spp., *Pinus sylvestris*, and *Pinus mugo*)

Two schedules based on type of pest

For species with small seeds, such as *Picea* spp., *Pinus sylvestris*, and *Pinus mugo*, in bags containing 75 lbs. draw an initial vacuum of at least 24 inches. Once the MB is introduced, then reduce the vacuum to NAP. This procedure is necessary for efficient penetration and distribution of the fumigant. Conifer seeds in bags of more than 75 lbs. each should be aerated in a well ventilated area for 24 hours, small seeds should be aerated for 48 hours.

Pest: External feeders

Treatment: T203-i-1 MB (“Q” label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-96 °F	2.5 lbs	2.5 hrs
70-79 °F	3 lbs	2.5 hrs
60-69 °F	3 lbs	3 hrs
50-59 °F	3 lbs	3.5 hrs
40-49 °F	3 lbs	4 hrs

Important

Load limit is 30 percent of chamber space. Moisture should not be added in fumigation of dry seeds.

T203-i-2 Conifer seeds (species with small seeds, such as *Picea* spp., *Pinus sylvestris*, and *Pinus mugo*)

Pest: Internal feeders, nutlike seeds, or when seeds are tightly packed so as to make fumigant penetration questionable.

Treatment: T203-i-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-96 °F	2.5 lbs	2.5 hrs
70-79 °F	3 lbs	2.5 hrs
60-69 °F	3 lbs	3 hrs
50-59 °F	3 lbs	3.5 hrs
40-49 °F	3 lbs	4 hrs

Important

Load limit is 50 percent of chamber space. Plastic or impermeable liners should be removed or well perforated. This schedule is not entirely effective against some species of Chalcid wasps.

T203-f-1 Cottonseed—bagged, packaged, or in bulk

Four alternative schedules

Pest: External feeders

Treatment: T203-f-1 MB ("Q" label only) at NAP—chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
60 °F or above	6 lbs	12 hrs
OR	3 lbs	24 hrs
40-59 °F	7 lbs	12 hrs
OR	4 lbs	24 hrs

Important

Load limit is 50 percent of chamber volume.

T203-f-2 Cottonseed—bagged, packaged, or in bulk

Pest: External feeders

Treatment: T203-f-2 MB ("Q" label only) at NAP—tarpaulin

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	12 hrs	24 hrs
60 °F or above	7 lbs	54	56	27	—
OR	5 lbs	40	40	—	20
40-59 °F	8 lbs	64	64	32	—
OR	6 lbs	48	48	—	24

T203-f-3 Cottonseed—bagged, packaged, or in bulk

Pest: External feeders

Treatment: T203-f-3 MB ("Q" label only) at 26" vacuum—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
40 °F or above	4 lbs	2 hrs

Important

Load limit is 50 percent of chamber volume.

T203-f-4 Cottonseed—bagged, packaged, or in bulk

Pest: External feeders

Treatment: T203-f-4 Phosphine at NAP

Temperature	Dosage Rate (gms/cu meter)	Minimum Concentration Readings (ppm) At:	
		72 hrs	120 hrs
50 °F or above	2.1 g	225[1]	50 or above

1 An average reading with no reading less than 50 ppm.

Relative humidity must be 40 percent or higher when commodity enclosed.

Aerate minimum of 24 hours.

T203-g-1 Pods and seed of Kenaf, Hibiscus, and Okra

Three alternative schedules

Pest: Internal feeders

Treatment: T203-g-1 MB (“Q” label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	12 hrs	24 hrs
60-96 °F	2 lbs	24	12	—
OR	1 lb	12	—	5
40-59 °F	3 lbs	36	17	—
OR	2 lbs	24	—	10

T203-g-2 Pods and seed of Kenaf, Hibiscus,and Okra

Pest: Internal feeders

Treatment: T203-g-2 MB (“Q” label only) in 26" vacuum—chamber (kenaf and okra seed only)

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
40 °F or above	4 lbs	2 hrs

Important

Load limit is 50 percent of chamber volume.

T203-g-3 Pods and seed of Kenaf, Hibiscus, and Okra

Pest: Internal feeders

Treatment: T203-g-3 Phosphine at NAP

Temperature	Dosage Rate (gms / cu meter)	Minimum Concentration Readings (ppm) At:	
		72 hrs	120 hrs
50 °F or above	2.1 g	225*	50

Important

*An average reading with no reading less than 50 ppm.

Relative humidity must be 40 percent or higher when commodity enclosed.

Aerate minimum of 24 hours.

T203-k Macadamia nuts (as seeds)

Pest: *Cryptophlebia illepida* (koa seedworm)

Treatment: T203-k MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
70 °F or above	2 lbs	2 hrs
60-69 °F	2.5 lbs	2 hrs
50-59 °F	3 lbs	2 hrs
40-49 °F	3.5 lbs	2 hrs

T203-h *Rosmarinus* seeds

Pest: Juvenile *Helicella* spp. (snails) or Internal Feeders

Treatment: T203-h MB ("Q" label only) at 26" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
70 °F or above	4 lbs	4 hrs

T203-l Seeds

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T203-l MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	4 hrs	12 hrs
90 °F or above	2.5 lbs	30	20	20	15
80-89 °F	3.5 lbs	42	30	30	20

NOTICE

If seed is intended for propagation, this dosage rate may damage seed by sterilization.

T203-b Seeds excluding seeds of *Vicia* spp.

Pest: Bruchidae (seed beetles) excluding the beetles of *Caryedon* spp. at NAP

Treatment: T203-b MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3):		Exposure Period:	
	Caryedon spp.	All others	*Caryedon* spp.	All others
70-96 °F	5 lbs	3 lbs	2 hrs	2.5 hrs
60-69 °F	—	3 lbs	—	3 hrs
50-59 °F	—	3 lbs	—	3.5 hrs
40-49 °F	—	3 lbs	—	4 hrs

T203-o Seeds infested with miscellaneous insects

T203-a-1 Seeds not specifically listed in the T203 Schedules

Pest: External feeders

Treatment: T203-a-1 MB (“Q” label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-96 °F	2.5 lbs	2.5 hrs
70-79 °F	3 lbs	2.5 hrs
60-69 °F	3 lbs	3 hrs
50-59 °F	3 lbs	3.5 hrs
40-49 °F	3 lbs	4 hrs

NOTICE

Load limit is 30 percent of chamber space. Moisture should *not* be added in fumigation of dry seeds. Normally, dry seed shipments arriving in wet or damp condition may be injured. This schedule may scald coconut husks. (Some tropical or nutlike seeds are usually shipped damp.)

T203-a-2 Seeds not specifically listed in the T203 Schedules

Pest: Internal feeders

Treatment: T203-a-2 MB (“Q” label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-96 °F	2.5 lbs	2.5 hrs
70-79 °F	3 lbs	2.5 hrs
60-69 °F	3 lbs	3 hrs
50-59 °F	3 lbs	3.5 hrs
40-49 °F	3 lbs	4 hrs

Important

Load limit is 50 percent of chamber space. Plastic or impermeable liners should be removed or well perforated.

T203-o-1 Seeds of *Casuarina*

Pest: *Bootanomyia* spp. (in *Casuarina*)

Treatment: T203-o-1 MB (“Q” label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70 °F or above	3.5 lbs	6 hrs

T203-j Seeds of *Hevea brasiliensis* (rubber tree)

Pest: Seed boring insects

Treatment: T203-j MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-96 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs

T203-o-3 Seeds of *Leguminosae = Fabaceae*

Pest: *Bruchophagus* spp., *Eurytoma* spp.

Treatment: T203-o-3 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70 °F or above	4 lbs	4 hrs

Two alternative schedules

T203-c Seeds of Leguminosae = Fabaceae, etc.

Pest: *Caryedon* spp.

Treatment: T203-c MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
50 °F or above	2 lbs	24 hrs

Alternative treatment: T203-a-2 (under 26" vacuum)

T203-o-4-1 Seeds of Leguminosae = Fabaceae

Pest: *Caryedon* spp. (in or with, etc.)

Treatment: T203-o-4-1 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
50 °F or above	2 lbs	24 hrs

T203-o-4-2 Seeds of Leguminosae = Fabaceae

Pest: *Caryedon* spp. (in or with, etc.)

Treatment: T203-o-4-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70 °F or above	3.5 lbs*	3 hrs

T203-o-5 Seeds of *Lonicera* and Other Seeds

Pest: *Rhagoletis cerasi* (European cherry fruit fly) pupae (Diptera: Tephritidae)

Treatment: T203-o-5 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70 °F or above	4 lbs*	8 hrs

NOTICE

* If seed is intended for propagation, the dosage rate may damage seed by sterilization.

T203-p Seeds of Citrus (Rutaceae family)

Pest: Citrus Canker (*Xanthomonas citri*)

Treatment: T203-p Hot water plus Chemical Dip

1. Wash the seed if any mucilaginous material, such as pulp, is adhering to the seed.
2. Immerse the seed in water heated to 125°F (51.6°C) or higher for 10 minutes.
3. Then, immerse the seed in a solution containing 200 parts per million sodium hypochlorite at a pH of 6.0 to 7.5 for at least 2 minutes.

T203-o-2 Seeds of *Umbelliferae*

Pest: *Systole* spp. (in Umbelliferae)

Treatment: T203-o-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-86 °F	2.5 lbs	3.5 hrs
70-79 °F	3 lbs	3.5 hrs
60-69 °F	3 lbs	4 hrs
50-59 °F	3 lbs	4.5 hrs
40-49 °F	3 lbs	5 hrs

T203-d-1 Seeds of *Vicia* spp. (vetch seeds) excluding seeds of *Vicia faba*

Pest: Bruchidae (seed beetles)

Treatment: T203-d-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	11 hrs	12 hrs	13 hrs	14 hrs
70 °F or above	3.5 lbs	46	28	27	—	—	—
60-69 °F	3.5 lbs	46	28	—	27	—	—
50-59 °F	3.5 lbs	46	28	—	—	27	—
40-49 °F	3.5 lbs	46	28	—	—	—	27

T203-d-2 Seeds of *Vicia* spp. (vetch seeds) including seeds of *Vicia faba*

Pest: Bruchidae (seed beetles)

Treatment: T203-d-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period:	
		Vicia faba	All others
70-96 °F	3 lbs	3.5 hrs	2.5 hrs
60-69 °F	3 lbs	4 hrs	3 hrs
50-59 °F	3 lbs	4.5 hrs	3.5 hrs
40-49 °F	3 lbs	5 hrs	4 hrs

NOTICE

Seed shipments arriving wet or damp may be injured.

T203-n Seeds with infested pulp

Pest: Fruit flies and other pulp infesting insects

Treatment: T203-n Depulping

1. Place seed in wire basket.
2. Immerse in water at 118-125 °F for 25 minutes.
3. Remove pulp from seed under running tap water.

Important

This treatment is effective only for fruit flies, as well as some other pulp infesting insects. Fumigation may also be required for seed weevils and other internal and external feeding insects.

5

Treatment Manual

Treatment Schedules

T300 - Schedules for Miscellaneous Plant Products

Contents

The following schedules are listed by product.

T301—Cotton and Cotton Products **page-5-4-2**
T302—Grains and Seeds Not Intended for Propagation **page-5-4-7**
T303—Rice Straw and Hulls **page-5-4-12**
T304—Alpha (alfa) Grass and Handicrafts (Stipa tenacissima, Ampelodesma mauriticus) **page-5-4-14**
T305—Cut Flowers and Greenery **page-5-4-15**
T306—Bags and Bagging Material, Covers **page-5-4-16**
T307—Khapra Beetle Infested Material **page-5-4-19**
T308—Tobacco, for Export **page-5-4-19**
T309—Broomcorn and Broomcorn Articles **page-5-4-23**
T310—Tick-infested Materials (Non-food) **page-5-4-24**
T311—Hay, Baled **page-5-4-25**
T312—Oak Logs and Lumber **page-5-4-25**
T313—Christmas Trees **page-5-4-26**

Important

Exposure period may be extended for any commodity which *cannot* be used for food or propagation. This extension is only a matter of convenience for the importer and is intended only for the purpose of reducing treatment costs. The request for extension must come from the importer or his authorized representative and should be confirmed in writing. A letter is not required for each treatment. A single blanket request should be considered as acceptable and renewed each year as required.

During the extended exposure period, the concentrations must remain stable and the prescribed minimums be met at the end of the extension. Otherwise, the treatment may be voided and retreatment required. Examples of commodities for which extended exposure periods may be approved include: cotton piece goods, baled cotton, bagging, wood, marble, soil as such, etc. Examples of commodities for which *no* extension may be approved include: cottonseed, grain, tobacco, etc. An extension of exposure period for other purposes is not permitted except as may be prescribed in various schedules for concentration readings below minimum.

Additional safety precautions, including additional aeration, may be required because of the extended exposure period. The PPQ officer or the commercial fumigator will specify any needed precautions.

T301—Cotton and Cotton Products

T301-a-3 Baled lint or linters

Pest: ***Pectinophora*** spp.

Treatment: T301-a-3 MB ("Q" label only) at NAP—tarpaulin

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	12 hrs	24 hrs
40 °F or above	7 lbs	84	60	30	—
OR	4 lbs	60	40	—	20

T301-b-1-1 Baled lint, linters, waste, piece goods, gin trash

Two alternative treatments

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T301-a-3 MB ("Q" label only) at NAP—tarpaulin

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	24 hrs*
60 °F or above	8 lbs	96	64	35
40-59 °F	11 lbs	132	88	50

* In addition to the space concentration readings, you must take a commodity concentration reading. The minimum concentration reading for commodity reading is as follows: For 60 °F or above—25 oz.; for 40-59 °F—30 oz.

Important

Load limit is 50 percent of chamber volume. Concentration readings may be omitted for chamber fumigations.

T301-b-1-2 Baled lint, linters, waste, piece goods, gin trash

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T301-a-3 MB ("Q" label only) at NAP—tarpaulin

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
60 °F or above	8 lbs	3 hrs
40-59 °F	9 lbs	3 hrs

T301-a-7 Cottonseed (samples and bulk)

Pest: ***Pectinophora*** spp.

Treatment: T301-a-7 Acid delinting and heat treatment (alternative treatment)

Cottonseed delinting is primarily intended for the elimination of surface-borne disease organisms. It is also effective against insects. To be completely effective against insects, this treatment must be carried out at approximately 145 °F (by the application of sufficient heat to the seed, or acid, or both) or by raising the temperature of the delinted seed during the subsequent drying process to 145 °F for a period of not less than 45 seconds or at least 140 °F for a period of not less than 8 minutes.

Important

This treatment schedule is not applicable to cottonseed infested with boll weevil.

Also, this treatment largely destroys the cottonseed's ability to germinate.

T301-b-2 Cottonseed, cottonseed products, or samples

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T301-a-3 MB ("Q" label only) at NAP—tarpaulin

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	12 hrs
90 °F or above	2.5 lbs	30	20	15
80-89 °F	3.5 lbs	42	30	20

The sorptive rates of commodities vary. When a commodity is known or suspected to be sorptive (see T307-b), take more T/C readings than normal. Additional fumigant is added as prescribed on **page-2-4-28**.

Important

Items known to be sorptive or items whose sorptive properties are unknown are not to be fumigated in chambers at NAP unless T/C readings are taken.

When both woodborers and khapra beetles are involved, use schedule T404-d.

Important

Cottonseed products (other than cottonseed) treated under this schedule are not to be used for food or feed.

T301-b-3 Cottonseed meal

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T301-b-3 MB ("Q" label only) at NAP

Important

Concentration readings should be obtained within the commodity. Concentration readings not required for chamber fumigations.

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	24* hrs	28* hrs	32* hrs
90 °F or above	4 lbs	48	32	25	—	—
89-89 °F	6 lbs	72	48	30	—	—
70-79 °F	8 lbs	96	64	35	—	—

*In addition to the space concentration readings, you must take a commodity concentration reading. The minimum concentration reading for commodity reading is as follows: For 90-96 °F—10 oz.; for 80-89 °F—15 oz.; and for 70-79 °F—20 oz.

**Optional

Important

Cottonseed meal treated with this schedule is not to be used for food or feed.

T301-c Cotton and cotton products

Pest: *Globodera rostochiensis* (golden nematode)

Treatment: T301-a-3 MB ("Q" label) at NAP—tarpaulin

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
40 °F or above	8 lbs	16 hrs
	10.5 lbs	12 hrs

T301-d-1-1 Cotton and cotton products

Two alternative treatments

Pest: *Anthonomus grandis* (boll weevil)

Treatment: T301-a-3 MB ("Q" label only) at NAP—tarpaulin

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	3 hrs	4 hrs	8 hrs
90 °F or above	2.5 lbs	30	20	—	—	—
80-89 °F	3 lbs	36	28	—	—	—
70-79 °F	4 lbs	48	36	—	—	—
60-69 °F	4 lbs	50	—	34	—	—
55-59 °F	5 lbs	64	—	48	—	—
50-54 °F	5.5 lbs	70	—	—	50	—
40-49 °F	6 lbs	80	—	—	54	40

T301-d-1-2 Cotton and cotton products

Pest: *Anthonomus grandis* (boll weevil)

Treatment: T301-d-1-2 Phosphine at NAP—tarpaulin or chamber

Temperature	Dosage Rate (g/1,000 ft^3)	Minimum Concentration Readings (ppm) At 72 hours:
50 °F or above	36 g*	225**

*36g/1,000ft^3 (28.3m^3) is equivalent to 1.27 g/m^3.
**An average reading with no reading less than 50 ppm.

Important

Refer to the Equipment Section for a description of the MityVac pump and the Port-a-sens phosphine detector.

Important

See Table 5-4-52 for data on amount of phosphine liberated by various products.

T301-a-1-1 Lint, linters, cottonseed, cottonseed hulls, gin trash, waste, cottonseed meal, or other baled or bulk commodities (except samples)

Pest: ***Pectinophora*** spp.

Treatment: T301-a-1-1 MB (“Q” label only) at NAP—chamber

Temperature	Dosage Rate (lb/1,000 ft^3) for:		Exposure Period
	Bulk shipments	Other than bulk shipments	
60 °F or above	6 lbs	6 lbs	12 hrs
OR	4 lbs	3 lbs	24 hrs
40-59 °F	7 lbs	7 lbs	12 hrs
OR	5 lbs	4 lbs	24 hrs

T301-a-1-2 Lint, linters, cottonseed, cottonseed hulls, gin trash, waste, cottonseed meal, or other baled or bulk commodities (except samples)

Pest: ***Pectinophora*** spp.

Treatment: T301-a-1-2 MB (“Q” label only) in 26" vacuum—chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
60 °F or above	8 lbs	3 hrs
40-59 °F	9 lbs	3 hrs

NOTICE

For seed cotton, refer to T203-c-5-a.

T301-a-6 Lint, linters, and cottonseed (bulk, sacked, or packaged cottonseed, lint or linters, cottonseed hulls, gin trash, and all other baled or bulk cotton commodities)

Pest: ***Pectinophora*** spp.

Treatment: T301-a-6 Phosphine at NAP

Temperature	Dosage Rate (g/1,000 ft^3)	Minimum Concentration Readings (ppm) At:	
		72 hrs	120 hrs
50 °F or above	60 g*	225**	50***

* 60 g/1,000ft^3 (28.3m^3) is equivalent to 2.1g/m^3.
** An average reading with no reading less than 50 ppm.
***An average of 50 PPM or more.

Aerate commodity 24 hours and/or make appropriate tests for presence of gas.

Important

See Table 5-4-52 at the end of this section for data on amount of phosphine liberated by various products.
Refer to the Equipment Section for a description of the MityVac pump and the Port-a-sens phosphine detector.

T301-a-2 Lint (except baled lint or linters), cottonseed (except packaged cottonseed), cottonseed hulls, gin trash, waste, cottonseed meal, or other baled or bulk commodities (excluding samples)

Pest: ***Pectinophora*** spp.

Treatment: T301-a-2 MB (“Q” label only) at NAP—tarpaulin

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	12 hrs	24 hrs
40 °F or above	7 lbs	84	60	30	—
OR	5 lbs	60	40	—	20

T301-a-4 Packaged cottonseed

Pest: ***Pectinophora*** spp.

Treatment: T301-a-3 MB ("Q" label only) at NAP—tarpaulin

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	12 hrs	24 hrs
40 °F or above	7 lbs	84	60	30	—
OR	5 lbs	60	40	—	20

T301-a-5-1 Samples of cotton and cotton products

Two alternative treatments

Pest: ***Pectinophora*** spp.

Treatment: T301-a-5-1 MB at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
40 °F or above	3 lbs	24 hrs

T301-a-5-2 Samples of cotton and cotton products

Pest: ***Pectinophora*** spp.

Treatment: T301-a-5-2 MB in 26" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
40 °F or above	4 lbs	2 hrs

T302—Grains and Seeds Not Intended for Propagation

Important

If Grain and seeds for propagation, use appropriate treatment in T203 schedules

T302-g-1 Acorns not intended for propagation

Two alternative treatments

Pest: *Cydia splendana* (nut fruit tortrix) and *Curculio* spp. (weevils)

Treatment: T302-g-1 MB at NAP—tarpaulin, chamber, or van container

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs
90-95 °F	4 lbs	58	32	34	—	—	—
80-89 °F	4 lbs	58	32	—	34	—	—
70-79 °F	5 lbs	72	40	—	42	—	—
60-69 °F	5 lbs	72	40	—	—	40	—
50-59 °F	6 lbs	85	48	—	—	50	—
40-49 °F	6 lbs	85	48	—	—	—	48

T302-g-2 Acorns not intended for propagation

Pest: *Cydia splendana* (nut fruit tortrix) and *Curculio* spp. (weevils)

Treatment: T302-g-2 MB in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-96 °F	3 lbs	2 hrs
70-79 °F	4 lbs	2 hrs
60-69 °F	4 lbs	3 hrs
50-59 °F	4 lbs	4 hrs
40-49 °F	4 lbs	5 hrs

Important

Either T302-g-1 or T302-g-2 required from all countries except Canada and Mexico. Treated commodity not to be used for food or feed.

T302-a-1-1 Ear corn

Two alternative treatments

Pest: Borers

Treatment: T302-a-1-1 MB at NAP—chamber only

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70 °F or above	2 lbs	6 hrs

T302-a-1-2 Ear corn

Pest: Borers

Treatment: T302-a-1-2 Dry heat

168 °F minimum air temperature for not less than 2 hours; ears spread in single layers on slats or wire shelves.

T302-c-1 Grains and seeds not intended for propagation (e.g., guar "gum")

Pest: *Trogoderma granarium* (Khapra beetle)

Treatment: MB ("Q" gas only) at NAP -- tarpaulin.

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	12 hrs
90 °F or above	2.5 lbs	30	20	15
80-89 °F	3.5 lbs	42	30	20
70-79 F	4.5 lbs	54	40	25
60-69 F	6 lbs	72	50	30
50-59 F	7.5 lbs	90	60	35
40-49 F	9 lbs	108	70	40

The sorptive rates of commodities vary. When a commodity is known or suspected to be sorptive (see **T307-a**), take more T/C readings than normal. Additional fumigant is added as prescribed on **page-2-4-38**.

Important

Items known to be sorptive or items whose sorptive properties are unknown are not to be fumigated in chambers at NAP unless T/C readings are taken.

When both woodborers and khapra beetles are involved, use schedule T404-d.

T302-c-2 Grains and Seeds not intended for propagation

NOTE: Load limit is 75 percent of chamber volume.

Pest: *Trogoderma granarium* (Khapra beetle)

Treatment: MB ("Q" label gas) in 26" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
60 °F or above	8 lbs	3 hrs
40-59 °F	9 lbs	3 hrs

T302-c-3 Grains and seeds not intended for propagation (e.g., guar "gum")

Pest: ***Trogoderma granarium*** (Khapra beetle)

Treatment: MB ("Q" gas only) in 26" vacuum- chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96 °F	2.5 lbs	12 hrs
80-89 °F	3.5 lbs	12 hrs
70-79 °F	4.5 lbs	12 hrs
60-69 °F	6 lbs	12 hrs
50-59 °F	10 lbs	12 hrs
40-49 °F	12 lbs	12 hrs

The sorptive rates of commodities vary. When a commodity is known or suspected to be sorptive (see **T307-a**), take more T/C readings than normal. Additional fumigant is added as prescribed on **page-5-4-19**.

Important

Items known to be sorptive or items whose sorptive properties are unknown are not to be fumigated in chambers at NAP unless T/C readings are taken.

When both woodborers and khapra beetles are involved, use schedule **T404—Wood Products Including Containers as Such**.

T302-d Grains and seeds not intended for propagation and contaminated with cotton seed

Pest: ***Pectinophora spp.***

Treatment: See Cotton and Cotton Products, **T301-a-1-1** or **T301-a-1-2**

Important

Alternate method—screening for removal of cotton seed contamination.

T302-e-1 Grains and seeds not intended for propagation

Two alternative treatments

Pest: Insects other than ***Trogoderma granarium*** (khapra beetle)

Treatment: T302-e-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-96 °F	2.5 lbs	2.5 hrs
70-79 °F	3 lbs	2.5 hrs
60-69 °F	3 lbs	3 hrs
50-59 °F	3 lbs	3.5 hrs
40-49 °F	3 lbs	4 hrs

T302-e-2 Grains and seeds not intended for propagation

Pest: Insects other than ***Trogoderma granarium*** (khapra beetle)

Treatment: T302-e-2 MB ("Q" label only) at 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80-96 °F	2.5 lbs	2.5 hrs
70-79 °F	3 lbs	2.5 hrs
60-69 °F	3 lbs	3 hrs
50-59 °F	3 lbs	3.5 hrs
40-49 °F	3 lbs	4 hrs

Important

Load limit is 50 percent of chamber volume. This vacuum treatment primarily for material so packed or packaged as to make fumigant penetration questionable.

T302-f Grains and seeds (excluding Rosmarinus seed) not intended for propagation

Pest: Snails

Treatment: T302-f Mechanical separation by screening or hand removal. If not feasible, entry should be denied when snails are of agricultural or public health significance, or treat using appropriate schedule as listed in T403-a under Section 18 Exemption.

Important

For *Rosmarinus* seed use T203-h

T302-b-1-1 Shelled corn

Treatment: T302-b-1-1 ***Reserved***

T302-b-1-2 Shelled corn contaminated with cottonseed

Pest: ***Pectinophora spp.***

Treatment: T302-b-1-2

Important

See **T301-a-1-1** or **T301-a-1-2**

Important

Shelled corn treated with T301 is not to be used for food or feed.

T303—Rice Straw and Hulls

T303-d-1 Articles made with rice straw

Two alternative treatments

Pest: Fungous diseases of rice or internal feeders

Treatment: T303-d-1 Dry heat at 180-200 °F for 2 hours

T303-d-2 Articles made with rice straw

Pest: Fungous diseases of rice or internal feeders

Treatment: T303-d-2 Steam sterilization

Temperature	Pressure	Exposure Period
260 °F	20 lbs	15 minutes
250 °F	15 lbs	20 minutes

T303-d-2-1 Articles made with rice straw

Pest: Fungous diseases of rice or internal feeders

Treatment: T303-e Steam sterilization, **use T303-b-1**

T303-d-2-3 Articles made with rice straw for indoor use only

Pest: Internal feeders

Treatment: T303-a-1 MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	4 hrs	24 hrs
60 °F or above	2.5 lbs	30	20	20	15
50-59 °F	3 lbs	36	25	24	20
40-49 °F	4 lbs	48	35	32	25

T303-d-2-2 Articles made with rice straw for indoor use only

Pest: Internal feeders

Treatment: T303-a-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
60 °F or above	2.5 lbs	2.5 hrs
50-59 °F	3.5 lbs	2.5 hrs
40-49 °F	5 lbs	2.5 hrs

T303-b-1 Rice straw and hulls imported for purposes other than approved processing

Two alternative treatments based on how commodity is packed

Pest: Fungous diseases of rice

Treatment: For closely-packed commodity T303-b-1 steam sterilization

Introduce the live steam into a 28" vacuum until pressure reaches 10 lbs and hold for 20 minutes. (Steam sterilization is not practical for the treatment of bales having a density greater than 30 lbs per cubic foot.)

T303-b-2 Rice straw and hulls imported for purposes other than approved processing

Pest: Fungous diseases of rice

Treatment: For commodity packed as loose masses T303-b-2 steam sterilization

As *T303-b-1* or, if without initial vacuum, bleed air until steam vapor escapes.

T303-c-1 Rice straw and hulls imported in small lots of 25 pounds or less

Two alternative treatments

Pest: Fungous diseases of rice

Treatment: T303-c-1 Dry heat at 212 °F for 1 hour

T304—Alpha (alfa) Grass and Handicrafts (Stipa tenacissima, Ampelodesma mauriticus)

T304-a Alpha (alfa) grass and handicrafts (*Stipa tenacissima*, *Ampelodesma mauriticus*)

Two alternative treatments

Pest: Infested with *Harmolita* spp. (jointworms)

Treatment: T303-a MB at NAP—chamber only

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
60 °F or above	2.5 lbs	32 hrs
50-59 °F	3.5 lbs	32 hrs
40-49 °F	4.5 lbs	32 hrs

T304-b Alpha (alfa) grass and handicrafts (*Stipa tenacissima*, *Ampelodesma mauriticus*)

Treatment: T303-b MB in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
60 °F or above	2.5 lbs	2.5 hrs
50-59 °F	3.5 lbs	2.5 hrs
40-49 °F	5 lbs	2.5 hrs

T305—Cut Flowers and Greenery

T305-a Cut flowers and greenery

Important

The "external pests" controlled by this schedule do not include snails and slugs. Refer to T201-o-1 through T201-p-3.

Pest: External feeders, leafminers, hitch-hikers, surface pests

Treatment: T305-a MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80-89 °F	1.5 lbs	19	12
70-79 °F	2 lbs	24	16
60-69 °F	2.5 lbs	30	20
50-59 °F	3 lbs	36	24
40-49 °F*	3.5 lbs	41	27

* For leafminers, use the initial dosage rate of 4 lbs/1,000 ft^3.

T305-b Cut flowers and greenery

Pest: Borers or Soft Scales

Treatment: T305-b MB ("Q" label only) in 15" vacuum

Important

Vacuum fumigation requires prior consent of the importer. If consent denied, refuse entry unless T305-a plus hand removal of these pests is feasible. Vacuum fumigation is not required for soft scales known to be widely distributed in the United States.

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
80-90 °F	2.5 lbs	2 hrs
70-79 °F	3 lbs	2 hrs
60-69 °F	3 lbs	2.5 hrs
50-59 °F	3 lbs	3 hrs
40-49 °F	3 lbs	3.5 hrs

T305-c Cut flowers and greenery

Pest: Mealybugs

Treatment: T305-c MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
80 °F or above	2.5 lbs	32	24
70-79 °F	3 lbs	38	29
60-69 °F	4 lbs	48	38

T306—Bags and Bagging Material, Covers

T306-a Bags and bagging material or covers used to contain root crops

Pest: *Globodera rostochiensis* (golden nematode)

Treatment: T306-a MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
40 °F or above	8 lbs	16 hrs
	10.5 lbs	12 hrs
	16 lbs	8 hrs

T306-b Bags and bagging material or covers used for cotton only

Pest: ***Pectinophora spp.***

Treatment: T306-b MB at NAP—chamber

Temperature	Dosage Rate (lb/1,000 ft^3) for:		Exposure Period
	Bulk shipments	Other than bulk shipments	
60 °F or above	6 lbs	6 lbs	12 hrs
60 °F or above	4 lbs	3 lbs	24 hrs
40-59 °F	7 lbs	7 lbs	12 hrs
40-59 °F	5 lbs	4 lbs	24 hrs

T306-c-1 Bags and bagging material or covers

Two alternative treatments

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T306-c-1 MB ("Q" label only) at NAP

Important

Concentration readings should be obtained within the commodity.
Concentration readings not required for chamber fumigations.

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	24[1] hrs	28[1] hrs	32[1] hrs
90 °F or above	4 lbs	48	32	25	—	—
89-89 °F	6 lbs	72	48	30	—	—
70-79 °F	8 lbs	96	64	35	—	—
60-69 °F	12 lbs	144	96	50	—	—
50-59 °F	12 lbs	144	96	50	50	—
40-49 °F	12 lbs	144	96	50	50[2]	50

1 In addition to the space concentration readings, you must take a commodity concentration reading. The minimum concentration reading for commodity reading is as follows: For 90-96 °F—10 oz.; for 80-89 °F—15 oz.; and for 70-79 °F—20 oz.

2 Optional

T306-c-2 Bags and bagging material or covers

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T306-c-2 MB (“Q” label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
60 °F or above	8 lbs	3 hrs
40-59 °F	9 lbs	3 hrs

T306-d-1 Bagging from unroasted coffee beans

Two alternative treatments

Pest: Various

Treatment: T306-d-1 MB (“Q” label only) at NAP

Important

Concentration readings should be obtained within the commodity.
Concentration readings not required for chamber fumigations.

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	24* hrs	28* hrs	32* hrs
90 °F or above	4 lbs	48	32	25	—	—
89-89 °F	6 lbs	72	48	30	—	—
70-79 °F	8 lbs	96	64	35	—	—
60-69 °F	12 lbs	144	96	50	—	—
50-59 °F	12 lbs	144	96	50	50	—
40-49 °F	12 lbs	144	96	50	50	50

* In addition to the space concentration readings, you must take a commodity concentration reading. The minimum concentration reading for commodity reading is as follows: For 90-96 °F—10 oz.; for 80-89 °F—15 oz.; and for 70-79 °F—20 oz.

T306-d-2 Bagging from unroasted coffee beans

Two alternative treatments

Pest: Various

Treatment: T306-d-2 MB (“Q” label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
60 °F or above	8 lbs	3 hrs
40-59 °F	9 lbs	3 hrs

Important

Load limit maximum 75 percent of chamber volume.

T307—Khapra Beetle Infested Material

T307-a Feeds and milled products heated as a part of the processing procedure, or other commodities that can be subjected to heat

Pest: Khapra beetle

Treatment: T307-a Heat treatment

Important

This treatment should not be used except when specifically authorized in each case by the Quarantine Policy, Analysis and Support (QPAS), Riverdale, MD, office.

180 °F in any part of a processing procedure or at 150 °F for a total of 7 minutes, the commodity being moved through or manipulated in the heated area in a manner to ensure that all parts meet the time and temperature requirements.

Miscellaneous products infested with Khapra beetle

Pest: Khapra beetle

Treatment: Summary of fumigation treatments for infested material

Important

Bags and bagging, see "T306-c-1" on **page-5-4-16**
Cotton products, see "T301-b-1-1" on **page-5-4-2**
Finely ground oily meals, see "T306-c-1" on **page-5-4-16**
Grains and seeds, see "T301-c" on **page-5-4-4**
Flour, see "T306-c-1" on **page-5-4-16**
Sorptive materials, see "T302-g-1" on **page-5-4-8**.
Goatskins, lambskins, sheepskins (skins and hides), see "T416" on **page-5-5-45**

Important

The following commodities have shown relatively high sorption:
Carpet backing, Cinnamon quill, Cocoa mats, Cocoa powder, Lumber, Myrobalan, Pistachio nuts, Polymide waste, Potato starch, Rubber (crepe or crude) Vermiculite, Wool (raw, except pulled)

All other commodities, see "T302-g-1" on **page-5-4-8**

T308—Tobacco, for Export

T308-e Blended strip tobacco for export

Pest: *Lasioderma serricorne* (Cigarette beetle) and *Ephestia elutella* (Tobacco moth)

Treatment: T308-e Vacuum-steam flow method

1. Evacuate the chamber to the wet bulb temperature of 35 °F (0.2 in. Hg. absolute or 29.8 in. Hg. vacuum) to remove air from the tobacco mass and facilitate steam penetration.
2. Introduce steam until 160 °F is reached while maintaining vacuum to evacuate gases pushed ahead of the steam. Hold at 160 °F for 3 minutes to allow the steam to condense within the tobacco mass for the temperature to equilibrate.
3. Re-evacuate to 110 °F.
4. Introduce steam to 135 °F for 3 minutes to allow the steam to condense within the tobacco mass and for the temperature to equilibrate.

T308-c Leaf tobacco for export

Pest: *Lasioderma serricorne* (Cigarette beetle) and *Ephestia elutella* (Tobacco moth)

Treatment: T308-c Vacuum-steam flow process followed by reconditioning

For leaf tobacco—flowing steam at 170 °F for 15 minutes in 23" vacuum. Followed by reconditioning of the tobacco to 12 to 13 percent moisture content.

T308-d Stored tobacco for export

Pest: *Lasioderma serricorne (*Cigarette beetle) and *Ephestia elutella (*Tobacco moth)

Treatment: T308-d Kabat® (active ingredient—methoprene) is an insect growth regulator applied at the rate of 0.2 pounds (3.9 fluid ounces) per 1,000 pounds of tobacco.

Application should be made directly to tobacco immediately prior to compaction in hogsheads. Assure complete coverage by using multi-directional sprays and tumbling. Kabat® may be applied by use of a proportional dilution apparatus or by preparation of a dilute spray solution. Follow mixing and application instructions on the label. Zoecon Corporation will be responsible for ensuring that receivers in foreign countries will accept this treatment in lieu of fumigation.

In most cases, indication of Kabat® treatment need not be shown on the phytosanitary certificate. PPQ prefers that tobacco exporting firms utilize the letterhead certification of treatment rather than relying on the phytosanitary certificate to convey this information to foreign receivers. However, if requested, an additional declaration may be made showing application rates as supplied by the exporter if it has been determined through periodic inspection of a firm's facilities that application of the protectant is an integral part of the processing procedure.

T308-a-1 Tobacco for export (flue-cured and burley in hogshead and cases; turkish in bales; cigar filler/binder in cases or bales; and cigar wrappers in bales)

Four alternative treatments

Pest: *Lasioderma serricorne* (Cigarette beetle) and *Ephestia elutella* (Tobacco moth)

Treatment: T308-a-1 MB in 28" vacuum

Flue-cured and burley in hogshead and cases; Turkish in bales; cigar filler/binder in cases or bales; and cigar wrappers in bales

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
70 °F or above	4 lbs	4 hrs

T308-a-2 Tobacco for export (flue-cured and burley in hogshead and cases; turkish in bales; cigar filler/binder in cases or bales; and cigar wrappers in bales)

Treatment: T308-a-2 MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
70 °F or above	1.25 lbs	72 hours
45-69 °F	2 lbs	72 hrs

T308-b-1 Tobacco for export (flue-cured and burley in hogshead and cases; turkish in bales; cigar filler/binder in cases or bales; and cigar wrappers in bales)

Treatment: T308-b-1 Phosphine at NAP—Tarpaulin or freight containers

Temperature	Dosage Rate (g/1,000 ft^3)	Minimum Concentration Readings (ppm) At:	
		96 hrs	144 hours
Greater than 68 °F	33 g*	200	—
61-68 °F	33 g*	—	300

* 33g/1,000 ft^3 is equivalent to 1.17 g/m^3.

Important

The tobacco industry's Sanitation Committee wants to consider “starting time” as the time when the minimum concentration reading is reached. It is recommended that concentration monitoring be done every 6 hours leading up to “starting time,” then again at completion (96 or 120 hours later). [Note that this concept differs from the “starting time” in other phosphine fumigation schedules. In•those cases, “starting time” starts when the aluminum phosphide or magnesium phosphide are first introduced.].

NOTICE

Gas concentration readings and temperature readings must be taken in the middle of a tightly packed bale.The fumigation does not begin until the gas concentration readings reach minimum required levels.

Important

Refer to the Equipment Section of this manual for a discussion of the MityVac hand-operated gas sampling pump and the Port-a-sens phosphine monitor. See Table 5-4-52 for data on amount of phosphine liberated by various products.

T308-b-2 Tobacco for export (flue-cured and burley in hogshead and cases; turkish in bales; cigar filler/binder in cases or bales; and cigar wrappers in bales)

Treatment: T308-b-2 Phosphine at NAP—Warehouses

Temperature	Dosage Rate (g/1,000 ft^3)	Minimum Concentration Readings (ppm) At:	
		96 hrs	144 hours
Greater than 68 °F	20 g*	200	—
61-68 °F	20 g*	—	300

* 20g/1,000 ft^3 is equivalent to 0.71 g/m^3.

Important

The tobacco industry's Sanitation Committee wants to consider “starting time” as the time when the minimum concentration reading is reached. It is recommended that concentration monitoring be done every 6 hours leading up to “starting time,” then again at completion (96 or 120 hours later). [Note that this concept differs from the “starting time” in other phosphine fumigation schedules. In those cases, “starting time” starts when the aluminum phosphide or magnesium phosphide are first introduced.].

NOTICE

Gas concentration readings and temperature readings must be taken in the middle of a tightly packed bale.The fumigation does not begin until the gas concentration readings reach minimum required levels.

Important

See Table 5.4.1 for data on amount of phosphine liberated by various products.

T309—Broomcorn and Broomcorn Articles

T309-a Broomcorn and broomcorn articles

Four alternative schedules

Pest: *Ostrinia nubilalis* (European corn borers), ticks, and saw flies)

Treatment: T309-a MB in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period for:	
		Sawflies	Other than sawflies
60 °F or above	2.5 lbs	5 hrs	2.5 hrs
50-59 °F	3.5 lbs	5 hrs	2.5 hrs
40-49 °F	5 lbs	5 hrs	2.5 hrs

T309-b-1 Broomcorn and broomcorn articles

Pest: *Ostrinia nubilalis* (European corn borers), ticks, and saw flies)

Treatment: T309-b-1 MB at NAP—chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
60 °F or above	2.5 lbs	16 hrs
50-59 °F	3.5 lbs	16 hrs
40-49 °F	4.5 lbs	16 hrs

T309-b-2 Broomcorn and broomcorn articles

Pest: *Ostrinia nubilalis* (European corn borers), ticks, and saw flies)

Treatment: T309-b-2 MB at NAP—Railroad car, reefer, highway van, tarpaulin

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	4 hrs	24 hrs
60 °F or above	3 lbs	36	24	20	15
50-59 °F	5 lbs	60	40	30	20
40-49 °F	7 lbs	84	56	40	25

T309-c Broomcorn and broomcorn articles

Pest: *Ostrinia nubilalis* (European corn borers), ticks, and saw flies)

Treatment: T309-c Steam sterilization (alternate treatment)

Introduce live steam into 25" vacuum until pressure reaches 10 psi and 240 °F, then hold for 20 minutes.

T310—Tick-infested Materials (Non-food)

T310-a Non-food materials

Three alternative treatments

Pest: Ticks

Treatment: T310-a MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:							
		0.5 hr	2 hrs	3 hrs	4 hrs	5 hrs	7 hrs	8 hrs	16 hrs
90 °F or above	4 lbs	55	32	45	—	—	—	—	—
80-89 °F	5 lbs	65	40	52	—	—	—	—	—
70-79 °F	6 lbs	75	48	—	50	—	—	—	—
60-69 °F	7 lbs	88	56	—	—	60	—	—	—
50-59 °F	8 lbs	100	64	—	—	—	70	—	—
40-49°F	8 lbs	100	—	—	—	—	—	65	50

NOTICE

Always check the fumigant label for the proper dosage used on the commodity being treated.

T310-b Non-food materials

Treatment: T310-b MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
80 °F or above	3 lbs	2.5 hrs
70-79 °F	3 lbs	3.5 hrs
60-69 °F	4 lbs	4 hrs
50-59 °F	5.5 lbs	5 hrs

Important

For all fumigations with MB, if commodity temperature is known or considered to have been below the temperature range during the previous 48 hours, use the next lower range to calculate dosage.

T310-c Non-food materials

Treatment: T310-c ***(Vacant)***

T310-d

Non-food materials

Treatment: T310-d Sulfuryl fluoride at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	24 hrs
70 °F or above	2 lbs	25	16	20
50-69 °F	2.5 lbs	32	20	24
40-49 °F	3 lbs	40	24	28

Important

Fumigations below 50 °F to be used only on an emergency basis and specifically authorized by Quarantine Policy, Analysis and Support (QPAS) in Riverdale MD.

T311—Hay, Baled

T311

Baled hay

Pest: *Mayetiola destructor* (Hessian fly), *Oulema melanopus* (cereal leaf beetle)

Treatment: T311 Phosphine at NAP

Temperature	Dosage Rate (g/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	24 hrs	168 hrs
50 °F or above	60	45	30	15	15

Aerate 24 hours or until a level at or below 0.3 ppm is determined.

See Table 5-4-52 at the end of this section for data on amount of phosphine liberated by various products.

T312—Oak Logs and Lumber

T312-a

Oak logs

Pest: Oak Wilt Disease

Treatment T312-a MB (“Q” label only) at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:						
		0.5 hr	2 hrs	12 hrs	24* hrs	36 hrs	48 hrs	72 hrs
40 °F or above	15 lbs	240	240	200	120	160	120	80

Important

* After 24 hours, add enough fumigant to bring concentration up to 240 oz. Aerate for 48 hours after treatment. (**See "Special Procedures for Adding Gas and Extending Exposure Period" on page-2-4-23** MB, tarpaulin fumigation.)

Use an Ascarite filter when taking readings.

T312-b Oak lumber

Pest: Oak Wilt Disease

Treatment T312-b MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hrs	2 hrs	12 hrs	24* hrs	36 hrs	48 hrs
40 °F or above	15 lbs	200	160	100	40	120	80

Important

* After 24 hours, add enough fumigant to bring concentration up to 240 oz. Aerate for 48 hours after treatment. (**See "Special Procedures for Adding Gas to Oak Logs and Lumber Using T312 or Equivalent" on page-2-4-28** MB, tarpaulin fumigation.)

Use an Ascarite filter when taking readings.

T313—Christmas Trees

NOTICE

To reduce possible damage by the fumigant to the trees, they should be cut at least 2 weeks prior to treatment.

T313-a Cut conifer Christmas trees

Pest: *Lymantria dispar* (gypsy moth) egg masses

Treatment: T313-a MB ("Q" label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2.5 hrs	3 hrs	4 hrs	4.5 hrs
75 °F or above	1.5 lbs	18	12	—	—	—
70-74 °F	2 lbs	24	16	—	—	—
60-69 °F	2.5 lbs	30	—	24	—	—
60-69 °F	3 lbs	36	24	—	—	—
50-59 °F	3 lbs	36	—	—	24	—
50-59 °F	4 lbs	48	32	—	—	—
40-49 °F	3.5 lbs	42	—	—	—	28
40-49 °F	5 lbs	60	40	—	—	—

T313-b Cut pine Christmas trees and pine logs

Pest: *Tomicus piniperda* (pine shoot beetle)

Treatment: T313-b MB ("Q" label only) at NAP—chamber or tarpaulin

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		2 hrs	3 hrs	3.5 hrs	4 hrs
60 °F or above	3 lbs	43	—	—	36
60 °F or above	4 lbs	57	48	—	—
50-59 °F	3.5 lbs	50	—	—	42
50-59 °F	4 lbs	57	—	48	—
40-49 °F	4 lbs	57	—	—	48

Important

If treating pine Christmas trees for both gypsy moth egg masses and the pine shoot beetle, use the schedule for the pine shoot beetle since it is more potent.

TABLE 5-4-1: Amount of Phosphine Liberated by various Products. Calculate amount of product needed by using the amount of phosphine released as shown in the right column.

Product	Type	Unit and weight in grams	Grams of phosphine*
Degesch Fumi-Cel®	MP	1 plate; 117.0	33.0
Degesch Fumi-Strip®	MP	16 plates; 1872.0	528.0
Degesch Phostoxin®	AP	1 tablet; 3.0	1.0
Degesch Phostoxin® Tablet Prepac Rope	AP	1 prepac; 99.0 (strip or rope of 33 tablets)	33.0
Detia	AP	1 tablet; 3.0	1.0
Detia Rotox AP	AP	1 pellet; 0.6	0.2
Detia Gas EX-B	AP	1 bag or sachet; 34.0	11.4
Fumiphos tablets	AP	1 tablet; 3.0	1.0
Fumiphos pellets	AP	1 pellet; 0.6	0.2
Fumiphos bags	AP	1 bag; 34.0	11.0
Fumitoxin	AP	1 tablet; 3.0	1.0
Fumitoxin	AP	1 pellet; 0.6	0.2
Fumitoxin	AP	1 bag; 34.0	11.0
Gastoxin	AP	1 tablet; 3.0	1.0
Gastoxin	AP	1 pellet; 0.6	0.2
“L” Fume	AP AP	1 pellet; 0.5 1 pellet; 0.6	0.18 0.22
Phos-Kill	AP	1 tablet; 3.0	1.1
Phos-Kill	AP	1 pellet; 0.6	0.22
Phos-Kill	AP	1 bag; 34.0	12.0

* Reacts with moisture in the air to yield grams of phosphine.

5

Treatment Manual

Treatment Schedules

T400 - Schedules for Miscellaneous Products

Contents

Commodities treated with the following schedules are not to be used for food or feed.

T401—Railroad Cars (empty) **page-5-5-2**
T402—Ships, Containers and Surrounding Area **page-5-5-3**
T403—Miscellaneous Cargo (non-food, non-feed commodities) **page-5-5-7**
T404—Wood Products Including Containers as Such **page-5-5-13**
T405—Bags and Bagging Materials **page-5-5-19**
T406—Golden Nematode Contaminations **page-5-5-19**
T407—Mechanical Cotton Pickers and Other Cotton Equipment **page-5-5-22**
T408—Soil as Such **page-5-5-23**
T409—Aircraft **page-5-5-25**
T410—Tick Infestations **page-5-5-40**
T411—Ant Infestations—Nonplant Products **page-5-5-40**
T412—Noxious Weed Seeds (Devitalization Treatment) **page-5-5-40**
T413—Brassware from Bombay (Mumbai), India **page-5-5-41**
T415— Garbage (Two Alternative Treatments) **page-5-5-43**
T416—Goatskins, lambskins, sheepskins (skins and hides) (three alternative treatments)." **page-5-5-45**

Important

Exposure period may be extended for any commodity which *cannot* be used for food or propagation. This extension is only a matter of convenience for the importer and is intended only for the purpose of reducing treatment costs. The request for extension must come from the importer or his authorized representative and should be confirmed in writing. A letter is not required for each treatment. A single blanket request should be considered as acceptable and renewed each year as required.

During the extended exposure period, the concentrations must remain stable and the prescribed minimums be met at the end of the extension. Otherwise, the treatment may be voided and retreatment required. Examples of commodities for which extended exposure periods may be approved include cotton piece goods, baled cotton, bagging, wood, marble, soil as such, etc. Examples of commodities for which *no* extension may be approved include cottonseed, grain, tobacco, etc. An extension of exposure period for other purposes is not permitted except as may be prescribed in various schedules for concentration readings below minimum.

Additional safety precautions, including additional aeration, may be required because of the extended exposure period. The PPQ officer or the commercial fumigator will specify any needed safety precautions.

T401—Railroad Cars (empty)

T401-a Railroad Cars (empty)

Pest: *Pectinophora gossypiella* (pink bollworm) and fruit flies

Treatment: T401-a MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
40°F or above	4 lbs	12 hrs
OR	8 lbs	3 hrs

T401-b Railroad Cars (empty)

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T401-b MB ("Q" label only) at NAP—tarpaulin covered car

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	12 hrs
90°F or above	2.5 lbs	30	20	15
80-89°F	3.5 lbs	42	30	20
70-79°F	4.5 lbs	54	40	25
60-69°F	6 lbs	72	50	30
50-59°F	7.5 lbs	90	60	35
40-49°F	9 lbs	108	70	40

T401-c Railroad Cars (empty)

Pest: For nematode cysts

Treatment: T401-c High pressure steam cleaning *or* formaldehyde wetting spray (1 part 40 percent commercial formalin to 9 parts water).

Important

Under FIFRA Section 2(ee), it is permissable to use a method of application not prohibited by the labeling unless the labeling specifically states that the product may be applied only by the methods specified on the labeling. Therefore, a wetting spray may be used in this case if the label refers to the application of formaldehyde as a fumigant and does not specifically restrict the method of application to fumigation."

The debris and/or runoff from the cleaning procedure must be handled in a manner approved by local and port authority guidelines.

T402—Ships, Containers and Surrounding Area

T402-b-3-2 Asphalt surfaces and asphalt-base painted surfaces

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T402-b-3-2 Malathion spray at 2 gal/1,000 ft^2 or to the point of runoff.

Asphalt surface, asphalt-base paint—3 percent spray prepared by adding 1 pound of 25 percent malathion wettable powder to each gallon of water.

T402-c Empty holds (precautionary treatment for grain exports)

Pest: Without khapra beetle infestation

Treatment: T402-c MB at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
60°F or above	1 lb	10 hrs
50-59°F	1 lb	12 hrs
40-59°F	1.5 lbs	12 hrs

Important

Operate fans during gas introduction and for 30 minutes thereafter. During exposure period, operate fans for 30 minutes every 3 hours.

Important

If khapra beetle is present, see **T401-b**.

T402-b-3-1 Metal and wood surfaces such as decks, bulkheads, piers, and other areas not subject to fumigation

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T402-b-3-1 Malathion spray at 2 gal/1,000 ft^2 or to the point of runoff.

Metal and wood surfaces—3 percent spray prepared by mixing 1/2 pint emulsifiable concentrate (57 percent premium grade malathion) per gallon of water.

Malathion is toxic to fish, birds, and other wildlife. Keep out of lakes, streams, ponds, tidal marshes, and estuaries. Do **not** apply where fish and other aquatic life are important resources or where water is used for irrigational purposes, recreational purposes, or domestic purposes. Do **not** apply where runoff is likely to occur.

T402-d Ship decks (metal, concrete, asphalt, or wood)

Pest: Miscellaneous hitchhiking insects (e.g., crickets, scarab beetles, ants, Africanized honey bee swarms)

Treatment: T402-d Residual insecticidal spray (1% to 5% strength, according to label directions), using malathion, chlorpyrifos, or cyfluthrin (Tempo)

Apply the insecticide to dry surfaces as a fine spray or mist, according to the manufacturer's label. Direct the spray to areas on the decks where the insects congregate, with special attention to corners, cracks, and crevices.

Important

Do not treat freshly painted surfaces.

Avoid pooling or runoff. If rain is imminent, use a spreader-sticker in the spray mixture, or postpone spraying weather-exposed decks until the storm has passed and the decks have thoroughly dried. Submarines are exempt from treatment.

Important

Do not release the ship from quarantine until the application has dried, and no live inspects are seen.

If the insects are capable of flight (e.g., scarab beetles), the ship must move offshore for at least one mile (which is beyond the normal flight range of most insects) while the insecticide is being applied.

T402-a-1 Ship holds and any nonplant cargo material within holds

Pest: Quarantine significant snails of the family Achatinidea, including the following genera:

Achatina ***Lignus***
Archachatina ***Limicolaria***

Treatment: T402-a-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	24 hrs
55°F or above	8 lbs	96	65	35

T402-a-2 Ship holds and any nonplant cargo material within holds

Pest: Quarantine significant snails of the family Hygromiidae, including the following genera:

Canidula ***Monacha*** ***Xeropicta***
Cernuella ***Platytheba*** ***Xerosecta***
Cochlicella ***Pseudotrichia*** ***Xerotricha***
Helicella ***Trochoidea***
Helicopsis ***Xerolenta***

Treatment: T402-a-2 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	24 hrs	48 hrs	72 hrs
55°F or above	8 lbs	95	64	62	60	40

T402-a-3 Ship holds and any nonplant cargo material within holds

Pest: Quarantine significant snails of the families Helicidae and Succineidae, including the following genera:

Caracollina ***Omalonyx***
Cepaea ***Otala***
Cryptomphalus ***Succinea***
Helix ***Theba***

Treatment: T402-a-3 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	10 hrs	12 hrs	16 hrs	24 hrs
80°F or above	6 lbs	70	48	40	—	—	—
55-79°F	6 lbs	70	48	—	—	40	—
40-54°F	8 lbs	96	64	—	—	—	39

T402-b-1 Ship holds and storerooms that do not contain finely milled products such as flour or appreciable quantities of tightly packed cargo such as baled materials

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T402-b-1 MB ("Q" label only) at NAP–tarpaulin covered car

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	12 hrs
90°F or above	2.5 lbs	30	20	15
80-89°F	3.5 lbs	42	30	20
70-79°F	4.5 lbs	54	40	25
60-69°F	6 lbs	72	50	30
50-59°F	7.5 lbs	90	60	35
40-49°F	9 lbs	108	70	40

T402-b-2 Ship holds and storerooms that contain milled products, or with appreciable quantities of tightly packed or baled material

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T402-b-2 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	4 hrs	24* hrs	28* hrs	32* hrs
90-96°F	4 lbs	48	35	25	—	—
80-89°F	6 lbs	72	50	30	—	—
70-79°F	8 lbs	96	65	35	—	—

* In addition to the space concentration readings, you must take a commodity concentration reading. The minimum concentration reading for commodity reading is as follows: For 90-96°F—10 oz.; for 80-89°F—15 oz.; for 70-79°F—20 oz.; for 60-69°F—30 oz; for 50-59°F—30 oz; and 40-49°F—
30 oz.

Important

Concentration readings not required for chamber fumigation.

Important

Some ships' masters or agents prefer to abandon flour or other finely milled products to qualify for the 12 hours schedule (T401-b). This practice should not be discouraged if PPQ approved incineration or steam sterilization facilities are available within the port city. Small quantities may be burned or boiled on board the vessel, but in no case should the material be removed from treatment in PPQ facilities. Such articles must be left in the storeroom during the 12 hour fumigation and then removed under PPQ safeguards. This will serve to reduce the possibility of pest dispersal when the articles are removed under PPQ supervision.

T403—Miscellaneous Cargo (non-food, non-feed commodities)

T403-a-1 Miscellaneous Cargo (non-food, non-feed commodities)

Pest: Quarantine significant snails of the family Achatinidae, including the following genera:

Achatina ***Lignus***
Archachatina ***Limicolaria***

Treatment: T403-a-1 use T402-a-1 for temperatures of 55°F and above, use T403-a-6 for temperatures below 55°F

Important

Commodity or product temperature must reach treatment temperature before exposure time begins.

T403-a-2-1 Miscellaneous Cargo (non-food, non-feed commodities)

Three alternative treatments

Pest: Quarantine significant snails of the family Hygromiidae, including the following genera:

Candidula ***Monacha*** ***Xeropicta***
Cernuella ***Platytheba*** ***Xerosecta***
Cochlicella ***Pseudotrichia*** ***Xerotricha***
Helicella ***Trochoidea***
Helicopsis ***Xerolenta***

Treatment: T403-a-2-1 MB (“Q” label only) at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	48 hrs	72 hrs
55°F or above	8 lbs	95	64	60	40

T403-a-2-2 Miscellaneous Cargo (non-food, non-feed commodities)

Treatment: T403-a-2-2 MB in 26" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
70°F or above	8 lbs	16 hrs

T403-a-2-3 Miscellaneous Cargo (non-food, non-feed commodities)

Treatment: T403-a-2-3 Cold treatment (for temperatures below 55°F)

Temperature	Exposure Period
0°F	48 hrs

T403-a-3 Miscellaneous Cargo (non-food, non-feed commodities)

Pest: Quarantine significant slugs of the families Agriolimacidae, Arionidae, Limacidae, Milacidae, Philomycidae, and Veronicellidae, including the following genera:

Agriolimax	***Leidyula***	***Pseudoveronicella***
Arion	***Limax***	***Sarasinula***
Colosius	***Meghimatium***	***Semperula***
Deroceras	***Milax***	***Vaginulus***
Diplosolenodes	***Pallifera***	***Veronicella***

Treatment: T403-a-3 MB at NAP

Temperature	Dosage Rate (lb/1000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	2 hrs
90-96°F	1 lb	12	9
80-89°F	1.25 lbs	15	12
70-79°F	1.5 lbs	18	15
60-69°F	1.75 lbs	22	19

T403-a-4-1 Miscellaneous Cargo (non-food, non-feed commodities)

Three alternative schedules

Pest: Quarantine significant snails of the family Helicidae, including the following genera:

Caracollina	***Helix***
Cepaea	***Otala***
Cryptomphalus	***Theba***

Treatment: T403-a-4-1 MB at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:					
		0.5 hr	2 hrs	10 hrs	12 hrs	16 hrs	24 hrs
80°F or above	6 lbs	70	48	40	—	—	—
55-79°F	6 lbs	70	48	—	—	40	—
40-54°F	8 lbs	96	64	—	—	—	39

Important

If the fumigation is done at a temperature range of 40 to 54o F, use Methyl Bromide Q gas only.

T403-a-4-2 Miscellaneous Cargo (non-food, non-feed commodities)

Treatment: T403-a-4-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70°F or above	6 lbs	6 hrs

T403-a-4-3 Miscellaneous Cargo (non-food, non-feed commodities)

Treatment: T403-a-4-3 Cold treatment, use **T403-a-6-1** for temperatures below 55°F

T403-a-5-1 Miscellaneous Cargo (non-food, non-feed commodities)

Three alternative treatments

Pest: Quarantine significant snails of the families Bradybaenidae and Succineidae, including the following genera:

Bradybaena ***Omalonyx***
Cathaica ***Succinea***
Helicostyla ***Trishoplita***

Treatment: T403-a-5-1 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	10 hrs	16 hrs
80°F or above	6 lbs	72	48	40	—
40-79°F	6 lbs	70	48	—	40

T403-a-5-2 Miscellaneous Cargo (non-food, non-feed commodities)

Treatment: T403-a-5-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
40°F or above	6 lbs	6 hrs

T403-a-5-3 Miscellaneous Cargo (non-food, non-feed commodities)

Treatment: T403-a-5-3 Cold Treatment, use **T403-a-6-1** for temperatures below 40°F

Important

Commodity or product must reach treatment temperature before exposure time begins.

T403-a-6-1 Miscellaneous Cargo (non-food, non-feed commodities)

Three alternative schedules based on genera

Pest: Quarantine significant snails sensitive to Cold Treatment, members of the families Bradybaenidae, Helicidae, Helicellidae, Hygromiidae, and Succineidae, including the following genera:

Bradybaena	***Cochlicella***	***Trochoidea***
Candidula	***Helicella***	***Xerolenta***
Cepaea	***Helicostyla***	***Xeropicta***
Cathaica	***Theba***	***Xerosecta***
Cernuella	***Trishoplita***	***Xerotricha***

Treatment: T403-a-6-1 Cold Treatment

Temperature	Exposure Period
0°F	48 hrs

T403-a-6-2 Miscellaneous Cargo (non-food, non-feed commodities)

Pest: Quarantine significant snails sensitive to Cold Treatment, certain members of the family Helicidae, including the following genera:

Helix	***Otala***

Treatment: T403-a-6-2 Cold Treatment

Temperature	Exposure Period
0°F	32 hrs
10°F	48 hrs

T403-a-6-3 Miscellaneous Cargo (non-food, non-feed commodities)

Pest: Quarantine significant snails sensitive to Cold Treatment, of the family Achatinidae, including the following genera:

Achatina	***Lignus***
Archachatina	***Limicolaria***

Treatment: T403-a-6-3 Cold Treatment

Temperature	Exposure Period
0°F	8 hrs
10°F	16 hrs
20°F	24 hrs

T403-b Miscellaneous Cargo (non-food, non-feed commodities)

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T403-b MB at NAP, use T401-b or T402-b-2

T403-c Miscellaneous Cargo (non-food, non-feed commodities)

Pest: *Globodera rostochiensis* (golden nematode)

Treatment: T403-c MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
40°F or above	8 lbs	16 hrs
	10.5 lbs	12 hrs
	16 lbs	8 hrs

T403-d Miscellaneous Cargo (non-food, non-feed commodities)

Pest: Wood Borers or Termites

Treatment: T403-d see T404 schedules

T403-e-1-1 Miscellaneous cargo (non-food, non-feed commodities) that is not sorptive or difficult to penetrate

Pest: Quarantine significant insects not specifically provided for elsewhere in non-food or non-feed commodities

Treatment: T403-e-1-1 MB ("Q" label only) at NAP—tarpaulin

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	12 hrs
90°F or above	2.5 lbs	30	20	15
80-89°F	3.5 lbs	42	30	20
70-79°F	4.5 lbs	54	40	25
60-69°F	6 lbs	72	50	30
50-59°F	7.5 lbs	90	60	35
40-49°F	9 lbs	108	70	40

T403-e-1-2 Miscellaneous cargo (non-food, non-feed commodities) that is sorptive or difficult to penetrate

Pest: Quarantine significant insects not specifically provided for elsewhere in non-food or non-feed commodities

Treatment: T403-e-1-2 MB ("Q" label only) at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	4 hrs	24 hrs	28 hrs	32 hrs
90-96°F	4 lbs	48	35	25*	—	—
80-89°F	6 lbs	72	50	30*	—	—
70-79°F	8 lbs	96	65	35*	—	—
60-69°F	12 lbs	144	95	50*	—	—
50-59°F	12 lbs	144	95	—	50*	—
40-49°F	12 lbs	144	95	—	—	50*

* In addition to the space concentration readings, you must take a commodity concentration reading. The minimum concentration reading for commodity reading is as follows: For 90-96°F—10 oz.; for 80-89°F—15 oz.; for 70-79°F—20 oz.; for 60-69°F—30 oz; for 50-59°F—30 oz; and 40-49°F—
30 oz.

This fumigation schedule may be used, for exapmle, on finely miled products and on material that is tightly packed or baled.

T403-e-2 Miscellaneous cargo (non-food, non-feed commodities) that is not sorptive or difficult to penetrate

Pest: Quarantine significant pests other than insects

Important

This would include quarantine significant snails of the families Helicarionidae, Streptacidae, Subulinidae, and Zontidae, as well as other non-insect pests.

Treatment: T403-e-2 MB ("Q" label only) at NAP tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:			
		0.5 hr	2 hrs	24 hrs	48 hrs
40°F or above	10 lbs	140	130	120	80

T403-f Miscellaneous cargo (non-food, non-feed commodities)

Pest: *Pieris* spp. (cabbageworms—all life stages) and all other *Lepidoptera**. Also hitchiking insects, including non-Lepidoptera.

Treatment: T403-f MB at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:	
		0.5 hr	3 hrs
70°F or above	3 lbs	36	16
60-69°F	3.5 lbs	40	19
50-59°F	4 lbs	45	21
45-49°F	4.5 lbs	49	24
40-44°F	5 lbs	54	27

Important

* A 3-hour exposure easily kills all Lepidopterous hitchhikers, including gypsy moth, and is preferred over using the much longer schedules that are aimed more at khapra beetles (T104-b-1 and T402-b-2). This schedule should not be used for mollusks (snails and slugs) or for any insect with cryptic habits (e.g., ants or borers), or for insects in diapause.

T404—Wood Products Including Containers as Such

T404-b-5-1 Metal, wood, concrete, or other surfaces not subject to fumigation

Pest: Borers (wood wasps, Cerambycids and Dinoderus)

Treatment: T404-b-5-1 Chlorpyrifos spray

Use Dursban 4E as a 1 percent chlorpyrifos spray using suitable hand- or power-operated ground spray equipment. To be applied only by or under the supervision of pest control operators or other trained personnel responsible for inspect control programs.

To prepare the spray, thoroughly mix 79 ml (2-2/3 fl oz) of Dursban 4E with water to make up a total of 1 gallon of mixture (equivalent to 2.1 gallons in 100 gallons of water) and spray to the point of runoff.

T404-c-2 Wood Products Including Containers as Such

Pest: Termites (for borers see T404-b-1-1 and T404-b-1-2

Treatment: T404-c-2 SF at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At: 0.5 hr	2 hrs	16 hrs	24 hrs
70°F or above	1 lb	12	8	8	—
60-69°F	1.5 lbs	18	12	—	8
50-59°F	2.5 lbs	32	20	—	20

Do not use filters containing soda asbestos (Ascarite®) with this fumigant.

T404-a Wood Products Including Containers as Such

Pest: ***Globodera rostochiensis*** (golden nematode)

Treatment: T404-a MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
40°F or above	8 lbs	16 hrs
	10.5 lbs	12 hrs
	16 lbs	8 hrs

T404-b-1-1 Wood Products Including Containers as Such

Four alternative treatments

Pest: See following pest list for T404-b-1-1, T404-b-1-2, and T404-b-4

Treatment: T404-b-1-1 MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At: 0.5 hr	2 hrs	4 hrs	16 hrs
70°F or above	3 lbs	36	30	27	25
40-69°F	5 lbs	60	51	46	42

Important

For termites use T404-c schedules

Important

1. Minimum concentration must be met in chamber fumigations of sorptive materials. (See Section I, Part 2, I for list of sorptive materials.)
2. For fumigating of hardboard (Masonite), an initial dosage of 10 lb/1,000 ft^3 is recommended. Inspector should be prepared to provide extra attention to maintaining minimum concentrations when fumigating this commodity.
3. If both termites and borers are present at 40-69°F, use the schedule for borers with exposure extended to 20 hours. Use same minimum concentrations.
4. Use an Ascarite filter (in addition to a Drierite filter) if either of the following conditions apply:
   The wood is uncured ("green").
   The wood is manifested as guatamba wood.
   In the two cases above, water vapor or other gases may be evolved during the fumigation, which give false (additive) readings on the T/C gas analyzer.
5. If the final reading would occur outside of normal working hours, then the fumigation may be extended to a total of 24 hours, instead of 16. In that case, the 24-hr minimum concentration reading would be 15 (for the initial 3-lb dosage), or 25 (for the initial 5-lb dosage). When fumigating bamboo, always use a 24-hr exposure, rather than 16 hr.
6. Resume use of fans anytime a difference of 4 ounces or more occurs between the highest and lowest reading.
7. Readings more than 5 ounces below minimum at end of exposure negates treatment. For readings less than 5 ounces below minimum at the end of exposure period, add 2 oz/1,000ft^3 for each ounce below minimum and extend exposure for 4 hours.
8. A reduction in dosage is allowed when fumigating nonsorptive commodities such as marble, shells, metal containers, etc., which have infested crating associated with them providing the following additional conditions are met:
   Use only new 4-mil or 6-mil tarpaulins.
   No truck trailer, van, or railroad car fumigations are permitted unless the carrier is covered with a 6-mil tarpaulin which is then sealed to the ground.
   Use five or more sampling leads to determine minimum concentrations.
9. When fumigating wood commodities (e.g., dunnage, crating, logs) the proper fumigation temperature may be determined by inserting the tip of a dial thermometer or other temperature probe in a hole in the wood. A hole can be made with an electric or hand-powered drill or an awl. The hole diameter should be just large enough to insert the probe shaft (to lessen the influence of surrounding air). The depth should be 2 inches or half the thickness of the wood. Different areas of the load should be probed and the lowest temperature used in determining fumigation temperature. Determine the wood temperature 5 to 10 minutes after drilling the hole to allow the heat generated during drilling to dissipate.

T404-b-1-2 Wood Products Including Containers as Such

Pest: See following pest list for T404-b-1-1, T404-b-1-2, and T404-b-4

Treatment: T404-b-1-2 MB in 26" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
70°F or above	4 lbs	4 hrs
40-69°F	4 lbs	5 hrs

T404-b-2 Wood Products Including Containers as Such

Pest: Borers (wood wasps, carpenter ants, carpenter bees, and termites)

Treatment: T404-b-2 SF at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:						
		0.5 hr	2 hrs	4 hrs	12 hrs	16 hrs	24 hrs	32 hrs
70°F or above	4 lbs	48	45	40	—	32	—	—
60-69°F	4 lbs	48	45	40	36	—	32	—
50-59°F	5 lbs	60	56	52	48	—	40	—
40-49°F	6.5 lbs	76	71	66	60	—	52	—
OR	5 lbs	60	57	53	49	—	44	40

Important

Do not use a filter containing soda asbestos (Ascarite®) with this fumigant.

Sulfuryl Fluoride (SF) is **NOT** an approved quarantine treatment for wood-boring beetles because SF has difficulty in penetrating insect eggs; therefore, many eggs will still hatch following fumigation. SF treatment of wood should be authorized only for brood-tending species of insects such as termites, bees, wasps, and ants. Even if all eggs are not killed, the hatching larvae will die of starvation, due to lack of care.

T404-b-4 Wood Products Including Containers as Such

Pest: See following pest list for T404-b-1-1, T404-b-1-2, and T404-b-4

Treatment: T404-b-4 Kiln Sterilization

Dry bulb temperature	Wet bulb depression	Relative humidity	Moisture content	Thickness of lumber	Expo-sure*
140°F	7°F	82%	13.8%	1 inch 2 inches 3 inches	3 hrs 5 hrs 7 hrs
130°F	16°F	60%	9.4%	1 inch 2 inches 3 inches	10 hrs 12 hrs 14 hrs
125°F	15°F	61%	9.7%	1 inch 2 inches 3 inches	46 hrs 48 hrs 50 hrs

Important

The source of this schedule is: Simpson, W.T. 1991. **Dry Kiln Operator's Manual**. USDA Forest Service, Forest Products Laboratory, Madison, WI, Agriculture Handbook No. 188, Table No. 7-31, page 176. Kiln-dried lumbar is defined as wood dried with heat in a kiln so that its moisture is less than 20 percent of the dry matter, achieved through an appropriate time/temperature schedule.

Important

Use this pest list for T404-b-1-1, T404-b-1-2, and T404-b-4

Coleoptera (beetles):

Bostrichidae (branch and twig borers)
Buprestidae (metallic or flat-headed borers)
Cerambycidae (long-horned or round-headed borers)
Curculionidae (wood-boring and root-feeding weevils)
Lyctidae (powder-post beetles)
Lymexylonidae (ship timber beetles)
Passalidae (bess beetles)
Platypodidae (pin-hole borers)
Rhyzophagidae (root-eating beetles)
Salpingidae (narrow-wasted bark beetles)
Scolytidae (bark/engraver beetles; also ambrosia/timber beetles)
Trogositidae (bark-gnawing beetles)

Hymenoptera (bees, wasps and ants):

Formicidae (carpenter ants)
Orussidae (parasitic wood wasps)
Siricidae (wood wasps)
Syntexicae (incense-cedar wood wasps)
Xylocopidae (carpenter bees)
Xyphydriidae (wood wasps)

Isoptera (termites)

Lepidoptera (moths):

Cossidae (carpenterworms)
Sesiidae (clear-winged moths)

T404-c-1-1 Wood Products Including Containers as Such

Three alternative treatments

Pest: Termites

Important

For borers, see **T404-b-1-1** schedules

Treatment: T404-c-1-1 MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	4 hrs	16 hrs	24 hrs
40°F or above	3 lbs	36	30	27	25	24

Important

1. Minimum concentration must be met in NAP chamber fumigations of sorptive materials. (See page-2-3-5 for list of sorptive materials.)
2. If both termites and borers are present at 40°F–60°F, use the schedule for borers with exposure extended to 20 hours. Use same minimum concentrations.
3. Guatamba wood squares and green wood may emit a gas which gives a reading additive to MB on the fumiscope. Use of a filter containing soda asbestos (Ascarite®) will eliminate this contaminative gas.

T404-c-1-2 Wood Products Including Containers as Such

Treatment: T404-c-1-2 MB in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
70°F or above	4 lbs	3 hrs
40-69°F	4 lbs	4 hrs

T404-d Wood Products including Containers as Such

Pest: Borers and *Trogoderma granarium* (khapra beetle)

Treatment: T404-d MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	4 hrs	16 hrs	24 hrs[1]
80°F or above	3.5 lbs	36	33	30	25	17
70-79°F	4.5 lbs	50	45	40	25	22
60-69°F[2]	6 lbs	65	55	50	42	29
50-59°F	7.5 lbs	80	70	60	42	36
40-49°F[3]	9 lbs	85	76	70	42	42

1 Extend the normal 16 hour exposure time to 24 hours for poles and garden stakes made of bamboo.

2 Use 100 gas at 60°F or above

3 Use Q-gas at 40°F or above

T405—Bags and Bagging Materials

See T306 schedules

T406—Golden Nematode Contaminations

T406-a Miscellaneous cargo (non-food, non-feed commodities)

Pest: ***Globodera rostochiensis*** (golden nematode)

Treatment: T406-a MB in 26" vacuum, use T403-c

T406-c Piers, barges, railroad cars, automobiles, used farm equipment, etc.

Pest: ***Globodera rostochiensis*** (golden nematode)

Treatment: T406-c Steam Cleaning

Steam at high pressure until all soil is removed. Treated surfaces should be thoroughly wet and heated. The debris and/or runoff from the cleaning procedure must be handled in a manner approved by local and port authority guidelines.

T406-b Used farm equipment, construction equipment, containers, etc.

Pest: ***Globodera rostochiensis*** (golden nematode)

Treatment: T406-b MB (“Q” label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/ 1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	24 hrs
60°F or above	15 lbs	180	120	120

NOTICE

Soil should be easily crumbled but not wet. The soil should not exceed 12 inches in the smallest dimension.

T406-d Used farm equipment (without cabs), construction equipment (without cabs), and used containers

Pest: ***Globodera rostochiensis*** (golden nematode)

Treatment: T406-d Steam at NAP—tarpaulin, or tent

Steam heat for 60 minutes after all temperature sensors reach 140°F (60°C). (See sensor placement and other requirements below)

Important

This treatment must be conducted under the following minimum ambient air temperatures, which will vary with the volume of the treatment enclosure:

—For treatment enclosures of 4,000 ft^3 or less, the minimum air temperature is 40°F.

—For treatment enclosures greater than 4,000 ft^3 and less than or equal to 6,000 ft^3, the minimum air temperature is 60°F.

This treatment is not recommended for treatment enclosures greater than 6,000 ft^3.

Step 1— Determine if the temperature and volume requirements can be met

If you cannot meet the temperature and enclosure volume requirements, do not use this treatment.

Step 2— Assemble articles to be treated

Articles to be treated should be placed as close together as possible. Arrange articles to allow space for placement of the steam distribution manifold.

Step 3— Place the steam distribution manifold pipe beneath articles to be treated

The steam distribution manifold should be assembled and placed beneath the articles to be treated in order to facilitate steam distribution. A flexible steam introduction hose, approximately 20 feet in length, connects the steam generator to a 10 foot long U-shaped pipe capped at the ends, with 0.5 inch holes every 12 inches. This pipe serves as the steam distribution manifold.

Step 4— Place temperature recording sensors on the article to be treated

Enclosures of 4,000 ft^3 or less

When the treatment is being conducted in enclosures 4,000 ft^3 or less, use at least four temperature recording sensors in addition to the sensor on the steam generator. Place sensors in hard-to-treat cracks or crevices on the equipment or containers. Position sensors in the following locations:

1. Front high--near the top of the front of the equipment or load
2. Center middle--midway from the top and bottom of the center of the equipment or load

3. Center bottom--bottom of the center of the equipment or load, but at least 3 inches above the floor if the equipment is flush with the floor
4. Rear bottom--bottom of the rear of the equipment, but at least 3 inches above the floor if the equipment is flush with the floor

Enclosures greater than 4,000 ft^3 and less than or equal to 6,000 ft^3

When the treatment is being conducted in enclosures greater than 4,000 ft^3 and less than or equal to 6,000 ft^3, use at least eight temperature recording sensors in addition to the sensor on the steam generator. Again, place sensors in hard-to-treat cracks or crevices on the equipment or containers. Position probes in the following locations:

1. Front high--near the top of the left side of the front of the equipment or load
2. Front low--bottom of the right side of the front of the equipment or load, but at least 3 inches above the floor if the equipment is flush with the floor
3. Center high--near the top of the center of the equipment or load on the right side
4. Center middle--midway from the top and bottom of the center of the equipment or load
5. Center low--bottom of the center of the equipment or load on the left side, but at least 3 inches above the floor if the equipment is flush with the floor
6. Rear high--near the top of the rear of the equipment on the right side
7. Rear middle--midway from the top and bottom of the rear of the equipment
8. Rear low--bottom of the rear of the equipment or load on the left side, but at least 3 inches above the floor if the equipment is flush with the floor.

Step 5— Enclose the article to be treated with a trapaulin or tent

If a tarpaulin (6 mil plastic) is used instead of a tent, pad sharp edges of the equipment or containers before covering with the tarp.

If the equipment or containers will be moved into an enclosure, such as a tent, it may be more practical to place the temperature sensors after this step. In either case, the front of the equipment or load and the front of the enclosure should face in the same direction.

Step 6— Place the steam generator at an open end of the enclosure and seal the enclosure

The steam generator is placed approximately 20 feet from the front of the enclosure and connected to a steam introduction line (hose.) The steam introduction line is connected to the steam distribution manifold pipe which is situated under the articles to be treated. The enclosure is sealed at the base including the point at which the introduction line enters the enclosure. An airtight seal is not essential for steam treatment; therefore small pinholes are acceptable.

Step 7— Steam heat the enclosure for 60 minutes after all temperature sensors reach a minimum 140°F (60°C)

Important

Use only a steam generator approved by APHIS

The maximum temperature in the enclosure should not exceed 160°F (71°C).

The temperature should be recorded once every two minutes during the treatment.

T407—Mechanical Cotton Pickers and Other Cotton Equipment

T407 Mechanical Cotton Pickers and Other Cotton Equipment

Pest: *Pectinophora gossypiella* (pink bollworm)

Treatment: T407 MB ("Q" label only) at NAP—tarpaulin, chamber, railroad car, or van

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	2 hrs	3 hrs	4 hrs	12 hrs
40°F or above	4 lbs	48	—	—	—	21
	8 lbs	96	—	64	—	—

Important

This treatment is designed to kill exposed larvae, larvae within green cotton bolls or single locks of seed cotton, or loose trash. Any materials such as sacked or bulked seed, cotton waste, lint, linters, or any packaged commodity shall be treated in accordance with T301.

T408—Soil as Such

T408-e-1 Herbarium specimens of mosses and liverworts in soil and originating in golden nematode free countries

Pest: (Precautionary)

Treatment: T408-e-1 MB ("Q" label only) in 26" vacuum (Precautionary fumigation)

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
70°F or above	2 lbs	3.5 hrs

T408-e-2 Herbarium specimens of mosses and liverworts in soil and originating in golden nematode free countries

Pest: ***Globodera rostochiensis*** (golden nematode)

Treatment: T408-e-2 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
40°F or above	8 lbs	16 hrs
	10.5 lbs	12 hrs
	16 lbs	8 hrs

T408-a Soil as Such

Two alternative treatments

Pest: Various Pests and Pathogens Found in Soil (including Striga)

Treatment: T408-a Dry heat—

Temperature	Exposure Period
230°F to 249°F	16 hours
250°F to 309°F	2 hours
310°F to 379°F	30 minutes
380°F to 429°F	4 minutes
430°F to 450°F	2 minutes

Soil to be spread in layers 0.5 inches in depth to ensure uniform heat penetration. The exposure period does not begin until the entire mass reaches 250°F.

T408-b Soil as Such

Pest: Various Pests and Pathogens Found in Soil

Treatment: T408-b Steam—250°F at 15 lbs pressure (p.s.i.) for 0.5 hour

Preheat laboratory autoclaves. Restrict soil depth to 2 inches when treating quantities of soil in trays. Restrict each package weight to 5 pounds or less when treating individual packages. Load with adequate spacing. Large commercial steam facilities which operate at pressures up to 60 pounds psi will permit treatment of greater soil depth.

T408-b-1 Soil as Such on Equipment

Pest: Various Pests and Pathogens Found in Soil

Treatment: Steam Cleaning

Steam at high pressure until all soil is removed. Treated surfaces should be thoroughly wet and heated. The debris and/or runoff from the cleaning procedure must be handled in a manner approved by local and port authority guidelines.

T408-c-1 Soil as Such

Two alternative treatments

Pest: *Globodera rostochiensis* (golden nematode)

Treatment: T408-c-1 MB (“Q” label only) in 26" vacuum,
see T403-c—for loose and friable material only.

Soil to be fumigated in containers—no dimensions of which can exceed 24 inches.

T408-c-2 Soil as Such

Pest: *Globodera rostochiensis* (golden nematode)

Treatment: T408-c-2 MB (“Q” label only) at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/ 1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	24 hrs
60°F or above	15 lbs	180	120	72

Important

Soil should be friable, moist, but not wet. Soil must not be more than 12 inches in depth. If stacked in containers, 12 inches of space must be left between levels.

T408-d-1 Soil as Such

Two alternative treatments

Pest: Insects

Treatment: T408-d-1 Screening through 16 mesh screens will remove most larvae and pupae, except smaller types.

T408-d-2

Treatment: T408-d-2 Freezing—0°F for 5 days

T408-f Soil contaminated equipment (precautionary treatment)

Pest: Soil fungi, nematodes, and certain soil insects

Treatment: T408-f Steam Cleaning

Steam at high pressure until all soil is removed. Treated surfaces should be thoroughly wet and heated.

The debris and/or runoff from the cleaning procedure must be handled in a manner approved by local and port authority guidelines.

T408-g-1 Soil contaminated non-food or non-feed commodities

Two alternative treatments

Pest: *Striga* spp. (witchweed)

Treatment: T408-g-1 MB ("Q" label only) (chamber)

Temperature	Dosage Rate (lb/1,000 ft^3)	Exposure Period
60°F or above	10 lbs	24 hrs
	20 lbs	15.5 hrs

T408-g-2 Soil contaminated non-food or non-feed commodities

Treatment: T408-g-2 MB ("Q" label only) (tarpaulin)

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	24 hrs
60°F or above	15 lbs	164	120	72

Important

Soil must be friable, moist, but not wet. The soil shall not exceed 12 inches in least dimension.

T409—Aircraft

T409-a Aircraft

Pest: *Trogoderma granarium* (khapra beetle)

Treatment: T409-a

Important

Contact Regional Director for specific instructions

T409-b

Aircraft

Pest: Hitchhiking pests other than khapra beetle, fruit flies, and soft-bodied insects

Treatment: T409-b, d-phenothrin aerosols (10 percent)—apply at rate of 8g/1,000 ft^3

Important

Aerosol disinfestation of U.S. military aircraft must conform to requirements in the latest edition of "Quarantine Regulations of the Armed Forces" (Army Reg. 40-12; SECNAVINST 6210.2A; AFR 161-4).

Currently, d-phenothrin aerosol (10 percent) is available from Sumitomo Chemical Company LTD, 5-33, Kitahama 4-Chrome, Chuo-ku, Osaka 541-8550, Japan (EPA Reg. No. 10308-21)

T409-c-1

Aircraft

Two alternative treatments

Pest: Fruit flies and soft-bodied insects

Treatment: T409-c-1 Resmethrin aerosol (2 percent)—apply at rate of 10 g/1,000 ft^3

Important

Because of lingering odor, aerosols containing Resmethrin should not be used on military aircraft or in the passenger or crew areas of commercial aircraft. Particularly if Resmethrin is used, an aeration period should be added—10 minutes if fan-assisted, and 20 minutes if no fans are used (passive aeration).

T409-c-3

Aircraft

Treatment: T409-c-2 Resmethrin (1.2 percent)—apply at rate of 16.66 g/1,000 ft^3

CAUTION

Do not apply in presence of passengers or crew. Hold plane for 10 minutes following treatment for aeration.

Important

Because of lingering odor, aerosols containing Resmethrin should not be used on military aircraft or in the passenger or crew areas of commercial aircraft. Particularly if Resmethrin is used, an aeration period should be added—10 minutes if fan-assisted, and 20 minutes if no fans are used (passive aeration).

Determine the Number of Seconds to Spray the Aerosal

The time needed to spray the aerosol is a function the following three things:

- Volume of the Aircraft (in 1000 cubic feet)
- Spray Rate of the Nozzle (in grams per second)

- Required Application Rate for the Pesticide (in grams per 1000 cubic feet)

This relationship is shown in the following formula:

$$Volume\ of\ Aircraft \times \left(\frac{Required\ Application\ Rate}{Spray\ Rate\ of\ Nozzel}\right) = Time\ Needed\ to\ Spray\ Aersol$$

Use **Table 5-5-1** - **Table 5-5-23** to determine the spray time when using 10 percent d-phenothrin, which requires an application rate of 8 grams per 1000 cubic feet, and a nozzle with a spray rate of 5 gram per second.

CAUTION

Currently, d-phenothrin aerosol (10 percent) is available from Sumitomo Chemical Company LTD, 5-33, Kitahama 4-Chrome, Chuo-ku, Osaka 541-8550, Japan (EPA Reg. No. 10308-21). The labeled application rate is 8 grams per 1000 cubic feet, and the spray rate of the aerosol can is 5 grams per second. Calculations for spray times beginning with **Table 5-5-1** are based on the spray rate of 5 gram per second. To have better control of spray times of one second or less, you can use an extender tube on the nozzle of the aerosol can. The extender tube can cut the spray rate in half. For example, if a can of d-phenothrin normally sprays at a rate of 5 grams per second, the extender tube would reduce this rate to 2.5 grams per second and the correct spraying time would then be twice the time listed beginning with **Table 5-5-1**.

If you are using a pesticide with a different required application rate or a nozzle with a different spray rate, use the following formula to determine the time (in seconds) needed to spray the aerosol.

$$\frac{Aircraft\ Volume\ in\ Cubic\ Feet}{1000} \times \left(\frac{\left(\frac{grams}{1000\ cubic\ feet}\right)}{\left(\frac{grams}{second}\right)}\right) = Seconds\ Needed\ to\ Spray\ Aersol$$

Also, the aircraft volumes in Table 5-5-1 represent standard configurations of aircraft. Check with the captain or contact the follow manufacturers to determine if the aircraft has been modified from the standard configuration, and determine the actual volume.

Airbus Industries of North America, Inc.

593 Herndon Parkway
Herndon, VA 20170
Telephone: (703) 834-3400
Fax: (703) 834-3550
Website: http://www.airbus.com/body.html

Boeing Commercial Aeroplane Group

P.O. Box 3707, Mail Stop 74-31
Seattle, WA 98124-2207
Telephone: (425) 237-3657
Website: http://www.boeing.com/commercial.com

Fairchild Aerospace Corp.

P.O. Box 790490
San Antonio, TX 78279-0490
Telephone: (210) 824-2313

McDonald-Douglas Corporation

Military Aircraft Section
P.O. Box 516
St. Louis, MO 63166
Telephone: (314) 233-5360
Fax: (314) 232-7528

Aerospatiale

Website: http://www.aerospatiale.fr/products/avions

Casa

Website: http://www.casa.es252

Determine the Spray Time for 10% d-phenothrin with a labeled application rate of 8 grams per 1000 cu. ft. and nozzle dispersion rate of 5 grams per second

TABLE 5-5-1: Airbus Industries

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations		
			1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
A300	Cabin	27,100	27.1	8	43.5
	Pit-#1	3,722	3.7	8	6.0
	Pit-#2	1,265	1.3	8	2.0
	Pit-#3	565	.6	8	1.0
A300-600R (passenger) (long-range)	Cabin	?			?
	Forward	1,134	1.1	8	2.0
	Aft	1,134	1.1	8	2.0
	Bulk	400	.4	8	0.5
A300-600 (freighter)	Main	9,950	10.0	8	16.0
	Pit-Fwd	1,900	1.9	8	3.0
	Pit-Aft	2,250	2.2	8	3.5
A300-600 (FEDEX)	Main	19,069	19.1	8	30.5
	Pit-Fwd	2,684	2.7	8	4.5
	Pit-Aft	2,154	2.2	8	3.5
	Pit-Back	742	.7	8	1.0
A300 (convertible)	Main	11,943	11.9	8	19.0
A300B4 (freighter)	Main	9,950	10.0	8	16.0
	Pit-Fwd	1,900	1.9	8	3.0
	Pit-Aft	1,850	1.9	8	3.0
A310 (freighter)	Main	7,950	8.0	8	13.0
	Pit-Fwd	1,260	1.3	8	2.0
	Pit-Aft	1,550	1.6	8	2.5
A310 (FEDEX)	Main	14,650	14.7	8	23.5
	Pit-Fwd	1,942	1.9	8	3.0
	Pit-Aft	1,271	1.3	8	2.0
	Pit-Back	742	.7	8	1.0
A320-200 (passenger)	N/A	982	.9	8	1.5

TABLE 5-5-2: Antonov

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations		
			1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
AN 124 and 126	N/A	26,485	26.5	8	42.5

TABLE 5-5-3: ATR

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
ATR 42 (CTO) (Container Transport Option)	Bulk	890	.9	8	1.5
ATR 72 (CTO)	Bulk	1,285	1.3	8	2.0

TABLE 5-5-4: BAC (British Aircraft Corp)

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
111-200, 300, and 400	Cabin	4,056	4.1	8	6.5
	Pit-Fwd	380	.4	8	0.5
	Pit-Aft	154	.2	8	0.5
111-500	Cabin	5,094	5.1	8	8.0
	Pit-Fwd	451	.5	8	1.0
	Pit-Aft	260	.3	8	0.5
VC 10	Cabin	6,750	6.8	8	11.0
	Pit-Fwd	744	.7	8	1.0
	Pit-Aft	820	.8	8	1.5
Super VC 10	Cabin	7,850	7.9	8	12.5
	Pit-Fwd	744	.7	8	1.0
	Pit-Aft	820	.8	8	1.5

TABLE 5-5-5: BAC (Aerospatiale)

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
Concorde	Cabin	5,100	5.1	8	8.0
	Pit-Fwd	241	.2	8	0.5
	Pit-Aft	468	.5	8	1.0

TABLE 5-5-6: Boeing

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
707-120, 120B, and 220	Cabin	7,484	7.5	8	12.0
	Pit-Fwd	755	.8	8	1.5
	Pit-Aft	910	.9	8	1.5
	Fl.Deck	451	.5		1.0
707-320C	Bulk	7,548	7.5	8	12.0

TABLE 5-5-6: Boeing (continued)

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
707-320, 420	Cabin	8,074	8.0	8	13.0
	Pit-Fwd	870	.9	8	1.5
	Pit-Aft	905	.9	8	1.5
	Fl. Deck	451	.5	8	1.0
720	Cabin	6,860	6.9	8	11.0
	Pit-Fwd	688	.7	8	1.0
	Pit-Aft	690	.7	8	1.0
	Fl. Deck	451	.5	8	1.0
727-100C	Bulk	4,168	4.2	8	7.0
727-100 (passenger)	Cabin	4,560	4.6	8	7.5
	Pit-Fwd	900	.9	8	1.5
	Pit-Aft	425	.4	8	0.5
	Fl. Deck	451	.5	8	1.0
727-200C	Bulk	8,032	8.0	8	13.0
727-200 (passenger)	Cabin	6,561	6.6	8	10.5
	Pit-Fwd	690	.7	8	1.0
	Pit-Aft	760	.8	8	1.5
	Fl. Deck	451	.5	8	1.0
737-100	Cabin	4,636	4.6	8	7.5
	Pit-Fwd	280	.3	8	0.5
	Pit-Aft	406	.4	8	0.5
737-200 (passenger)	Cabin	4,636	4.6	8	7.5
	Pit-Fwd	370	.4	8	0.5
	Pit-Aft	505	.5	8	1.0
737-200C	Bulk	3,602	3.6	8	6.0
737-300	Cabin	4,900	4.9	8	8.0
	Pit-Fwd	425	.4	8	1.0
	Pit-Aft	650	.7	8	1.0
	Fl. Deck	225	.3	8	0.5
737-400	Cabin	5,600	5.6	8	9.0
	Pit-Fwd	600	0.6	8	1.0
	Pit-Aft	770	0.8	8	1.5
	Fl. Deck	225	0.2	8	0.5
737-500	Cabin	4,340	4.3	8	7.0
	Pit-Fwd	290	.3	8	0.5
	Pit-Aft	535	.5	8	1.0
	Fl. Deck	255	.3	8	0.5
747 Combi	—	6,886	6.9	8	11.0
747F	—	22,952	23.0	8	37.0
747-100, 200	Cabin	27,650	27.7	8	44.5
	Pit-Fwd	3,485	3.5	8	6.0
	Pit-Aft	3,015	3.0	8	5.0
	Fl. Deck	920	.9	8	1.5
	U. Deck	1,370	1.4	8	2.0
	Belly	1,000	1.0	8	1.5

TABLE 5-5-6: Boeing (continued)

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
747-300,400	Cabin	27,650	27.7	8	44.5
	Pit-Fwd	3,485	3.5	8	5.5
	Pit-Aft	3,015	3.0	8	5.0
	Fl. Deck	920	.9	8	1.5
	U. Deck	2,800	2.8	8	4.5
	Belly	1,000	1.0	8	1.5
757-200 (passenger)	Pit-Fwd	652	.6	8	1.0
	Pit-Aft	1,086	1.1	8	2.0
757-200PF	Bulk	8,405	8.4	8	13.5
767-200	Main	14,255	14.3	8	23.0
	Pit-Fwd	1,470	1.5	8	2.5
	Pit-Aft	1,470	1.5	8	2.5
767-300 (passenger)	Cabin	10,497	10.5	8	17.0
	Pit-Fwd	1,920	1.9	8	3.0
	Pit-Aft	1,680	1.7	8	2.5
	Aft+Bulk	430	.4	8	0.5
777-200	Cabin	20,700	20.7	8	33.0
	Pit-Fwd	280	.3	8	0.5
	Pit-Aft	4,630	4.6	8	7.5
	Aft+Bulk	4,220	4.2	8	6.5

TABLE 5-5-7: Canadair

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
CL-44	Bulk	6,235	6.2	8	10.0
CL-440	Bulk	13,798	13.8	8	22.0

TABLE 5-5-8: Casa

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
C-212	N/A	777	.8	8	1.5
ATR 72 (CTO)	N/A	1,528	1.5	8	2.5

TABLE 5-5-9: Cessna

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft_3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
Caravan	N/A	452	.5	8	1.0

TABLE 5-5-10: Convair

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations		
			1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
240	Cabin	1,650	1.7	8	2.5
	Pit-Fwd	193	.2	8	0.5
	Belly	88	.1	8	---[1]
340 & 44-	Cabin	1,816	1.8	8	3.0
	Pit-Fwd	158	.2	8	0.5
	Pit-Aft	193	.2	8	0.5
	Belly	78	.1	8	----[1]
880 & 800M	Cabin	5,802	5.8	8	9.5
	Pit-Fwd	415	.4	8	0.5
	Pit-Aft	488	.5	8	1.0
990	Cabin	6,336	6.3	8	10.0
	Pit-Fwd	488	.5	8	1.0
	Pit-Aft	497	.5	8	1.0

1 In these small volume spaces, use the extender and calulate the application time using a rate of 2.5 grams per second. At a rate of 2.5 grams per second, the following table will give the spray time:

1,000 ft^3 Units	Spray TIme in Seconds
0.1	0.5
0.2	0.5
0.3	1.0
0.4	1.5

TABLE 5-5-11: de Havilland

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations		
			1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
Dash 7, Series 100 (all cargo)	N/A	240	.2	8	0.5
DHC-6 Twin Otter, Series 300 (cargo version)	Fwd Aft Bulk	38 88 384	.1 .1 .4	8 8 8	---[1] ---[1] 0.5
Dash 7, Series 100, Combi (50 passengers)	N/A	240	.2	8	0.5
Dash 7, Series 100, Combi (18 passengers)	N/A	240	.2	8	0.5
Dash 8, Series 300, Combi (49 passengers)	N/A	400	.4	8	0.5
Dash 8, Series 100, Combi (37 passengers)	N/A	300	.3	8	0.5
Dash 8, Series 100, Combi (20 passengers)	N/A	775	.8	8	1.5

1 In these small volume spaces, use the extender and calulate the application time using a rate of 2.5 grams per second. At a rate of 2.5 grams per second, the following table will give the spray time:

1,000 ft^3 Units	Spray TIme in Seconds
0.1	0.5
0.2	0.5
0.3	1.0
0.4	1.5

TABLE 5-5-12: Dornier

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations		
			1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
228-212	N/A	642	.6	8	1.0

TABLE 5-5-13: Embraer

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
EMB-120 Brasilia	N/A	1,193	1.2	8	2.0
EMB-110 Brasilia	N/A	523	.5	8	1.0

TABLE 5-5-14: Fairchild

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
Expediter	NA	580	.6	8	1.0
Metro II & IIA	NA	580	.6	8	1.0
F27	Cabin	2,900	2.9	8	4.5
	Pit	192	.2	8	0.5
FH11227	Cabin	3,200	3.2	8	5.0
	Pit	192	.2	8	0.5

TABLE 5-5-15: Fokker

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
F27	N/A	198	.2	8	0.5
F28	N/A	290	.3	8	0.5
F100C	Bulk	2,070	2.0	8	3.0

TABLE 5-5-16: Lockheed

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
Electra	Cabin	5,160	5.2	8	8.5
	Pit-Fwd	254	.3	8	0.5
	Pit-Aft	274	.3	8	0.5
L1011	Cabin	23,100	23.1	8	37.0
(100)	Pit-Fwd	1,600	1.6	8	2.5
(200)	Pit-Ctr	1,600	1.6	8	2.5
(250)	Pit-Aft	700	.7	8	1.0
	Galley	1,380	1.4	8	2.0
L-1011-1	Cargo Holds	3,900	3.9	8	6.0
L-100-30	N/A	6,057	6.1	8	10.0

TABLE 5-5-17: McDonnel-Douglas

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
DC-3	Bulk	1,300	1.3	8	2.0
DC-6 (cargo)	Bulk	3,354	3.4	8	5.5
DC-6 (passengers)	Cabin	4,332	1.3	8	7.0
	Pit-Fwd	200	.2	8	0.5
	Pit-Aft	173	.2	8	0.5
DC-6A	Cabin	4,375	4.4	8	7.0
	Pit-Fwd	267	.3	8	0.5
	Pit-Aft	300	.3	8	0.5
DC-6B	Cabin	4,375	4.4	8	7.0
	Pit-Fwd	276	.3	8	0.5
	Pit-Aft	242	.2	8	0.5
DC-7B	Cabin	4,612	4.6	8	7.0
	Pit-Fwd	267	.3	8	0.5
	Pit-Aft	364	.4	8	0.5
DC-7C	Cabin	4,778	4.8	8	7.5
	Pit-Fwd	312	.3	8	0.5
	Pit-Aft	339	.3	8	0.5
DC-8-50	Cabin	12,911	12.9	8	20.5
	Pit-Fwd	690	.7	8	1.0
	Pit-Aft	700	.7	8	1.0
DC-8-54F	Main	5,984	6.0	8	9.5
	Pit-Fwd	690	.7	8	1.0
	Pit-Aft	700	.7	8	1.0
DC-8-55F	Main	5,878	5.9	8	9.5
	Pit-Fwd	690	.7	8	1.0
	Pit-Aft	700	.7	8	1.0
DC-8-61 & 63	Cabin	15,955	16.0	8	25.5
	Pit-Fwd	1,290	1.3	8	2.0
	Pit-Aft	1,210	1.2	8	2.0
DC-8-62	Cabin	13,739	13.7	8	22.0
	Pit-Fwd	799	.8	8	1.5
	Pit-Aft	816	.8	8	1.5
DC-8-62CF	Main	6,442	6.4	8	10.0
	Pit-Fwd	800	.8	8	1.5
	Pit-Aft	815	.8	8	1.5
DC-8-63F and DC-8-73F	Main	10,350	10.4	8	16.5
	Pit-Fwd	1,290	1.3	8	2.0
	Pit-Aft	1,210	1.2	8	2.0
DC-8-71CF	Main	8,148	8.1	8	13.0
	Pit-Fwd	1,290	1.3	8	2.0
	Pit-Aft	1,210	1.2	8	2.0
DC-8-61CF & 71CF	Main	15,472	15.5	8	25.0
	Pit-Fwd	1,290	1.3	8	2.0
	Pit-Aft	1,210	1.2	8	2.0

TABLE 5-5-17: McDonnel-Douglas (continued)

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
DC-9-10	Cabin	4,056	4.1	8	6.5
	Pit-Fwd	1,000	1.0	8	1.5
	Pit-Aft	619	0.6	8	1.0
DC-9-10AF	Main	2,386	2.4	8	4.0
	Pit-Fwd	373	.4	8	0.5
	Pit-Aft	327	.3	8	0.5
DC-9-30	Cabin	5,094	5.1	8	8.0
	Pit-Fwd	1,386	1.4	8	2.0
	Pit-Aft	832	.8	8	1.5
DC-9-32AF	Main	3,300	3.3	8	5.5
	Pit-Fwd	562	.6	8	1.0
	Pit-Aft	333	.3	8	0.5
DC-9-33CF	Main	2,944	2.9	8	4.5
	Pit-Fwd	562	.6	8	1.0
	Pit-Aft	333	.3	8	0.5
DC-40	Cabin	5,535	5.5	8	9.0
	Pit-Fwd	1,290	1.3	8	2.0
	Pit-Aft	1,040	1.0	8	1.5
DC-10-10CF & 10F, also DC-10-30CF & 30F	Main	12,236	12.2	8	19.5
	Pit-Fwd	3,020	3.0	8	5.0
	Pit-Ctr	1,935	1.9	8	3.0
	Pit-Aft	510	.5	8	1.0
	Fl. Deck	400	.4	8	0.5
MD 8-61/63	Main	11,173	11.2	8	18.0
	Pit-Fwd	1,290	1.3	8	2.0
	Pit-Aft	1,210	1.2	8	2.0
MD8-62	Main	8,862	8.9	8	14.0
	Pit-Fwd	800	.8	8	1.5
	Pit-Aft	815	.8	8	1.5
MD9-10	Main	3,582	3.6	8	6.0
	Pit-Fwd	393	.4	8	0.5
	Pit-Aft	254	.3	8	0.5
MD9-30	Main	4,525	4.5	8	7.0
	Pit-Fwd	562	.6	8	1.0
	Pit-Aft	333	.3	8	0.5
MD9-40	Main	4,926	4.9	8	8.0
	Pit-Fwd	618	.6	8	1.0
	Pit-Aft	350	.4	8	0.5
MD-11F	Main Deck	15,530	15.5	8	25.0
	Lower Deck	4,976	5.0	8	8.0
MD-11 Combi	Main	5,822	5.8	8	9.5
	Pit-Fwd	3,655	3.7	8	6.0
	Pit-Ctr	2,685	2.7	8	4.5
	Pit-Aft	510	.5		1.0

TABLE 5-5-17: McDonnel-Douglas (continued)

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
MD-80 JT8D-217	Lower Hold	1,253	1.3	8	2.0
MD-80 JT8D-219	Lower Hold	1,013	1.0	8	1.5
MD 81 & 82	Cargo	1,253	1.3	8	2.0
MD-83	Cargo	1,013	1.0	8	1.5
MD-87	Cargo	938 or 697	.9 .7	8 8	1.5 1.0
MD-88	Cargo	1,013 or 1,253	1.0 1.3	8 8	1.5 2.0

TABLE 5-5-18: SAAB

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
340 B/QC	N/A	1,303	1.3	8	2.0

TABLE 5-5-19: Shorts

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
330	N/A	1,230	1.2	8	2.0
360 and 360-F	N/A	1,450	1.5	8	2.5

TABLE 5-5-20: Sidely

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations 1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
Carvelle	Cabin Pit-Fwd Pit-Aft	5,600 258 116	5.6 .3 .1	8 8 8	9.0 0.5 ---[1]

1 In these small volume spaces, use the extender and calulate the application time using a rate of 2.5 grams per second. At a rate of 2.5 grams per second, the following table will give the spray time:

1,000 ft^3 Units	Spray TIme in Seconds
0.1	0.5
0.2	0.5
0.3	1.0
0.4	1.5

TABLE 5-5-21: Tupolev

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations		
			1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
TU-154	Bulk	5,000	5.0	8	8.0

TABLE 5-5-22: Vickers

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations		
			1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
Merchantman	Bulk	5,040	5.0	8	8.0
Viscount	Bulk	3,000	3.0	8	5.0

TABLE 5-5-23: Military Aircraft

Aircraft, model, and series	Area	Volume ft^3	Aerosol Calculations		
			1,000 ft^3 Units	Grams / 1,000 ft^3	Spray Time in Seconds
C-5A	Main	46,651	46.7	8	74.5
	U. Deck	6,147	6.1	8	10.0
	Fwd. &			8	
	Fl. Deck	5,147	5.1	8	8.0
	U. Floor	6,294	6.3	8	10.0
C-17	Main	20,875	20.9	8	33.5
C-26	Cabin	500	.5	8	1.0
	Pit	198	.2	8	0.5
C-130	Main	8,340	8.3	8	13.5
C-130 LG382		4,737	4.7	8	7.5
C-130 LG385-G		6,057	6.1	8	10.0
C-135	Cabin	6,000	6.0	8	9.5
C-141	Main	12,000	12.0	8	19.0
C-141B	Main	13,701	13.7	8	22.0
KC-10	Cabin	4,056	4.1	8	6.5
	Pit-Fwd	1,000	1.0	8	1.5
	Pit-Aft	619	.6	8	1.0

T410—Tick Infestations

Nonplant articles (i.e., bat guano, fence posts, etc.)

Pest: Ticks

Treatment: use T310 schedules, Tick infested materials (non-food)

T411—Ant Infestations—Nonplant Products

T411

Pest: Ants

Treatment: T411 MB at NAP

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At: 0.5 hr	2.5 hrs	3 hrs	3.5 hrs	4 hrs
90-96°F	2 lbs	24	16	—	—	—
80-89°F	2.5 lbs	30	24	—	—	—
70-79°F	3 lbs	36	24	—	—	—
60-69°F	3 lbs	36	—	24	—	—
50-59°F	3 lbs	36	—	—	24	—
40-49°F	3 lbs	36	—	—	—	24

T412—Noxious Weed Seeds (Devitalization Treatment)

T412-a *Guizotia abyssinica* (niger seed)

Pest: Weed seeds of the following genera:
Asphodelus fistulosus (onionweed)
Digitaria spp. (includes African couchgrass)
Oryza spp. (red rice)
Paspalum scrobiculatum (Kodo-millet)
Prosopis spp. (includes mesquites)
Solanum viarum (tropical soda apple)
Striga spp. (witchweed)
Urochloa panicoides (liver-seed grass)

Treatment: T412-a Heat Treatment at 248°F (120°C) for 15 minutes

Important

For *Guizotia abyssinica* (niger seed) use (T412-a). Do not start counting time until the entire mass reaches the required temperature.

T412-b-1 Noxious Weed Seeds (Devitalization Treatment)

Pest: *Cuscuta* spp.

Two alternative treatments

Treatment: T412-b-1 Dry heat—commodity heated to 212°F (100°C) for 15 minutes

T412-b-2 Noxious Weed Seeds (Devitalization Treatment)

Pest: *Cuscuta* spp.

Treatment: T412-b-2 Steam heat—commodity heated to 212°F (100°C) for 15 minutes

T412-b-3 Noxious Weed Seeds (Devitalization Treatment)

Pest: Weed seeds of the following genera:
Asphodelus fistulosus (onionweed)
Rottboellia cochinchinensis (itchgrass)
Orobanche aegyptiaca (branched broomrape)
Orobanche crenata (crenate broomrape)
Orobanche cernua (broomrape)
Striga asiatica (witchweed)
Cuscuta sp. (dodder)
*Oryza sp. (*red rice)

Treatment: T412-b-3- Irradiation treatment for spices contaminated with noxious weed seeds.

A minimum dosage of 15 kilograys. Irradiation dosage shall not exceed 30 kilogray limit imposed by Food and Drug Administration for spices.

Important

T412-b-3 is **not** authorized by APHIS for use until it is published in the Federal Register as a "Final Rule." This note will be removed when the "FInal Rule" is published.

T413—Brassware from Bombay (Mumbai), India

T413-a Brassware from Bombay (Mumbai), India

Two alternative treatments

Pest: ***Trogoderma granarium*** (khapra beetle)

Treatment: T413-a MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	12 hrs
90°F or above	2.5 lbs	30	20	15
80-89°F	3.5 lbs	42	30	20
70-79°F	4.5 lbs	54	40	25
60-69°F[1]	6 lbs	72	50	30
50-59°F	7.5 lbs	90	60	35
40-49°F[2]	9 lbs	108	70	40

1 Use MB 100 gas at 60°F or above

2 Use MB “Q” gas at 40°F or above

Important

When both woodborers and khapra beetles are involved, use schedule T404-d.

T413-b Brassware from Bombay (Mumbai), India

Treatment: T413-b MB in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
60°F or above[1]	8 lbs	3 hrs
40-59°F[2]	9 lbs	3 hrs

1 Use MB 100 gas at 60°F or above

2 Use MB “Q” gas at 40°F or above

Load limit is 75 percent of chamber volume.

T414—Inanimate, Nonfood Articles with Gypsy Moth Egg Masses

T414 Inanimate, Nonfood Articles with Gypsy Moth Egg Masses

Pest: Gypsy Moth egg masses

Treatment: T414 MB at NAP—tarpaulin or chamber

Temperature	Dosage Rate (lb/1,000 ft^3)	Minimum Concentration Readings (ounces) At:				
		0.5 hr	4 hrs	8 hrs	12 hrs	16 hrs
50°F or above	3.5 lbs	42	28	—	—	—
	2.5 lbs	30	20	14	—	—
	2 lbs	24	16	12	12	10
40-49°F	4.5 lbs	54	36	—	—	—
	3.25 lbs	38	26	18	—	—
	2.25 lbs	30	20	14	14	12

Important

For *Lymantria dispar* (gypsy moth) egg masses on such items as outdoor household articles, quarry products, lumber, logs, and timber products.

T415— Garbage (Two Alternative Treatments)

T415-a Garbage

Pest: Insect Pest and Pathogens

Treatment: T415-a Heat Treatment- Incinerate to ash.

Important

Caterers under compliance agreement using an incinerator for garbage must comply with the following conditions:

-Incinerator must be capable of reducing garbage to ash

-Incinerator must be maintained adequately to assure continued operation

T415-b Garbage

Pest: Insect Pest and Pathogens

Treatment: T415-b Dry heat or Steam- commonly heated to internal temperature of 212°F (100°C) for 30 minutes folllowed by burial in a landfill.

Important

Caterers under compliance agreement using a sterilizer must comply with the following conditions:

-The sterilizer must be capable of heating garbage to an internal temperature of 212° F and maintaining it at that temperature for a minimum of 30 minutes.

-Re-evaluate and adjust the sterilization cycle twice a year using a thermocouple to recalibrate the temperature recording device. Adjusting the sterilization cycle semiannually will assure that all garbage processed is heated to a minimum internal temperature of 212° F for at least 30 minutes, and that the temperature recording device accurately reflects the internal temperature of the sterilizer.

NOTICE

Observe all reevaluations and adjustments.

-The operator is to date and initial time/temperature records for each batch of garbage sterilized. The supervisor is to review and sign each time/temperature record. The facility must retain records for 6 months for review by PPQ.

-Clean the drain in the bottom of the sterilizer between each cycle to assure proper heat circulation

T415-C Garbage

Pest: Insect Pest and Pathogens

Treatment: T415-c Grinding and discharge into an approved sewage system

Important

Grinding and discharging is allowed into an approved sewage system. An approved sewage system means a sewage system approved by the Administrator of APHIS upon his determination that the system is designed and operated in such a way as to preclude the discharge of sewage effluents onto land surfaces or into lagoons or other stationary waters, and otherwise is adequate to prevent the dissemination of plant pests and livestock or poultry diseases, and that it is certified by an appropriate government official as currently complying with the applicable laws for environmental protection.

T416—Goatskins, lambskins, sheepskins (skins and hides) (three alternative treatments)."

T416-a-1 Goatskins, lambskins, sheepskins (skins and hides)

Pest *Trogoderma granarium* (Khapra beetle)

Treatment MB ("Q" gas only) at NAP--tarpaulin

Temperature	Dosage Rate (lb/ 1,000 ft^3)	Minimum Concentration Readings (ounces) At:		
		0.5 hr	2 hrs	12 hrs
90°F or above	2.5 lbs	30	20	15
80-89°F	3.5 lbs	42	30	20
70-79°F	4.5 lbs	54	40	25
60-69°F	6 lbs	72	50	30
50-59°F	7.5 lbs	908	60	35
40-49°F	9 lbs	108	70	40

The sorptive rates of commodities vary. When a commodity is known or suspected to be sorptive (see **T307-a**), take more T/C readings than normal. Additional fumigant is added as prescribed on **page-2-4-22**.

Important

Items known to be sorptive or items whose sorptive properties are unknown are not to be fumigated in chambers at NAP unless T/C readings are taken.

Important

Fur, horsehair articles, and leather goods (skins and hides), may cause off-odors that may be unacceptable when exposed to methyl bromide (MB).

When both woodborers and khapra beetles are involved, use schedule **T404-d**.

T416-a-2 Goatskins, lambskins, sheepskins (skins and hides)

NOTICE

Load limit is 75 percent of chamber volume.

Pest *Trogoderma granarium* (Khapra beetle)

Treatment MB ("Q" label gas) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
60°F or above	8 lbs	3 hrs
40-59°F	9 lbs	3 hrs

Important

Fur, horsehair articles, and leather goods (skins and hides), may cause off-odors that may be unacceptable when exposed to methyl bromide (MB).

T416-a-3 Goatskins, lambskins, sheepskins (skins and hides) (three alternative treatments).

Pest *Trogoderma granarium* (Khapra beetle)

Treatment MB (“Q” gas only) in 26" vacuum--chamber

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
90-96°F	2.5 lbs	12 hrs
80-89°F	3.5 lbs	12 hrs
70-79°F	4.5 lbs	12 hrs
60-69°F	6 lbs	12 hrs
50-59°F	10 lbs	12 hrs
40-49°F	12 lbs	12 hrs

The sorptive rates of commodities vary. When a commodity is known or suspected to be sorptive (see **T307-a**), take more T/C readings than normal. Additional fumigant is added as prescribed on page 2.2.34.

Important

Items known to be sorptive or items whose sorptive properties are unknown are not to be fumigated in chambers at NAP unless T/C readings are taken.

Important

Fur, horsehair articles, and leather goods (skins and hides), may cause off-odors that may be unacceptable when exposed to methyl bromide (MB).

When both woodborers and khapra beetles are involved, use schedule **T406-c**.

Amount of Phosphine Liberated by Various Products

Calculate amount of product needed by using the amount of phosphine released as shown in the right column.

TABLE 5-5-24: Amount of Phosphine Liberated by Various Products

Product	Type	Unit and weight in grams	Grams of phosphine*
Degesch Fumi-Cel®	MP	1 plate; 117.0	33.0
Degesch Fumi-Strip®	MP	16 plates; 1872.0	528.0
Degesch Phostoxin®	AP	1 tablet; 3.0	1.0
Degesch Phostoxin® Tablet Prepac Rope	AP	1 prepac; 99.0 (strip or rope of 33 tablets)	33.0
Detia	AP	1 tablet; 3.0	1.0
Detia Rotox AP	AP	1 pellet; 0.6	0.2
Detia Gas EX-B	AP	1 bag or sachet; 34.0	11.4
Fumiphos tablets	AP	1 tablet; 3.0	1.0
Fumiphos pellets	AP	1 pellet; 0.6	0.2
Fumiphos bags	AP	1 bag; 34.0	11.0
Fumitoxin	AP	1 tablet; 3.0	1.0
Fumitoxin	AP	1 pellet; 0.6	0.2
Fumitoxin	AP	1 bag; 34.0	11.0
Gastoxin	AP	1 tablet; 3.0	1.0
Gastoxin	AP	1 pellet; 0.6	0.2
“L” Fume	AP AP	1 pellet; 0.5 1 pellet; 0.6	0.18 0.22
Phos-Kill	AP	1 tablet; 3.0	1.1
Phos-Kill	AP	1 pellet; 0.6	0.22
Phos-Kill	AP	1 bag; 34.0	12.0

* Reacts with moisture in the air to yield grams of phosphine.

5

Treatment Manual

Treatment Schedules

T500 - Schedules for Plant Pests or Pathogens

Contents

The following Schedules are listed by plant pest or pathogen

General Schedules

T501—Pest: Chrysomyxa spp. **page-5-6-3**
Pest: Cercospora spp. **page-5-6-3**.
Pest: Phoma chrysanthemi **page-5-6-3**
T502—Pest: Potato cyst nematode **page-5-6-4**
T503—Pest: Diseases listed in 7CFR 319.24: Downy Mildews and Physoderma diseases of Maize **page-5-6-5**
T504—Pest: Flag smut **page-5-6-5**
T505—T505—Treatment for Infestation of Chrysomyxa spp. on various commodities **page-5-6-6**
T506—Pest: Potato cyst nematode **page-5-6-7**
T507—Pest: Phyllosticta bromeliae Uredo spp. (when destined to Florida, refuse entry) **page-5-6-8**.
Pest: Septoria gentinae **page-5-6-8**
T508—Pest: Rusts **page-5-6-9**
T509—**Pest: Cylindrosporium camalliae page-5-6-9**
Pest: Hemileia spp. Leptosphaeria spp. Mycosphaerella spp. Opiodothella orchidearum Phomopsis orchidophilia Phyllachora spp. Phyllosticta spp. Sphenospora spp. Sphaerodothis spp. Uredo spp. (except U. scabies) page-5-6-9
T510—Pest: Various corn-related diseases **page-5-6-10**
T511—Pest: Xanthomonas axonopodis, pv. citri (citrus canker) **page-5-6-10**
T512—(Deleted) **page-5-6-11**
T513—Pest: Ascochyta spp. **page-5-6-11**
T514—**Pest: Xanthomonas albilineans and X. vasculorum page-5-6-11**
T515—Pest: Various sugarcane-related diseases **page-5-6-12**
T516 (Deleted) **page-5-6-12**)
TT517 (Deleted) **page-5-6-12**)
T518—Pest: Various rice-related diseases **page-5-6-12**
T519—Pest: Various rice-related diseases **page-5-6-12**
T520—**Pest: Verticillium albo-atrum page-5-6-14**

Hot Water Treatments

T551—**Pest: Globodera rostochiensis, G. pallida page-5-6-14**
T552—**Pest: Bulb nematodes: Ditylenchus dipsaci, D. destructor page-5-6-14**
T553—Pest: Root-knot nematodes (Meloidogyne spp.) **page-5-6-15**)
Pest: Lesion nematodes (Pratylenchus spp.) **page-5-6-15**
Pest: Golden nematodes (Globodera rostochiensis and G. pallida) **page-5-6-15**
Pest: Foliar nematodes (Aphelenchoides fragariae) **page-5-6-15**
Pest: Cyst nematodes (Heterodera humuli) **page-5-6-15**

T554—Pest: Bulb nematodes—Ditylenchus dipsaci and D. destructor **page-5-6-16**
T555—Pest: Bulb nematodes—Ditylenchus dipsaci **page-5-6-16**
T556—Pest: Root-knot nematodes (Meloidogyne spp.) **page-5-6-16**
T557—Pest: Meloidogyne spp. and Pratylenchus spp. **page-5-6-16**
T558—Pest: Pratylenchus spp. (surface diseases) **page-5-6-17**
T559—Pest: Foliar nematode (Aphelenchoides fragariae) **page-5-6-17**
T560—Pest: Meloidogyne spp. **page-5-6-17**.
T561—Treatment for Infestations of Cercospora mamaonis and Phomopis carica-papayae on Papayas **page-5-6-17**
T562—(deleted) **page-5-6-18**
T563—(deleted) **page-5-6-18**
T564—Pest: Foliar nematodes (Aphelenchoides fragariae) **page-5-6-20**
T565—**Pest: Ditylenchus destructor page-5-6-18**
Pest: Ditylenchus dipsaci page-5-6-19i
Pest: Aphelenchoides subtenuis, Ditylenchus destructor page-5-6-18
Pest: Globodera rostochiensis, G. pallida page-5-6-19
T566—Pest: Precautionary treatment for corn-related diseases **page-5-6-19**
Pest: Aphelenchoides fragariae **page-5-6-19**
T567—Pest: Bulb nematodes (Ditylenchus dipsaci) **page-5-6-19**
T568—Pest: Foliar nematodes (Aphelenchoides fragariae) **page-5-6-19**
T569—Pest: Foliar nematodes (Aphelenchoides fragariae) **page-5-6-20**
T570—Pest: Pratylenchus spp. **page-5-6-20**.
Pest: Aphelenchoides fragariae spp. **page-5-6-20**
T571—(Deleted) **page-5-6-20**

The following section lists the recommended treatments or actions to be applied to items or commodities found infected with various diseases, or infested with various plant pests including nematodes. Commodities may include cut flowers and greenery, propagative plant materials, as well as entire plants. Due to recent restrictions and prohibitions on the use of certain chemicals, every effort has been made to substitute the best alternative treatment available to us. The diseases and commodities for which these treatments are recommended are listed in the Index to Schedules and with the following treatment schedules. Ports should endeavor to make post-treatment examinations or arrange to have the consignee or importer submit data concerning the material following the treatment. Ports should forward any information of this nature to:

Center for Plant Health Science & Technology
USDA-APHIS-PPQ-CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606

General Schedules

T501—Treatment for infestation of Chrysomyxa spp., Cercospora spp., and Phoma chrysanthemi on various commodities

T501-1 Azalea

Pest: *Chrysomyxa spp.*

Treatment: T501-1 Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray.

Important

See alternative treatment **T501-1** for *Chrysomyxa* spp.

T501-2 Azaleodendron

Pest: *Chrysomyxa spp.*

Treatment: T501-2 Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray.

Important

See alternative treatment **T501-1** for *Chrysomyxa* spp.

T501-4 Chrysanthemum

Pest: ***Phoma chrysanthemi***

Treatment: T501-4 Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray.

T501-5 Christmas trees

Pest: ***Phoma chrysanthemi***

Treatment: T501-5 Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray.

T501-3 Orchid

Pest: *Cercospora spp.*

Treatment: T501-3 Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray.

T501-6 Rhododendron

Pest: *Chrysomyxa* spp.

Treatment: T501-6 Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray.

Important

See alternative treatment **T501-2** for *Chrysomyxa* spp.

T502—Treatment for infestation of Potato cyst nematode on various commodities

T502-1 Bags and bagging used for commodities grown in soil

Pest: Potato cyst nematode

Treatment: T502-1 Methyl bromide—8 lbs/1,000 ft^3 for 16 hours in 26" vacuum at 40°F or above.

T502-2 Covers used for commodities grown in soil

Pest: Potato cyst nematode

Treatment: T502-2 Methyl bromide—8 lbs/1,000 ft^3 for 16 hours in 26" vacuum at 40°F or above.

T502-3 Soil

Pest: Potato cyst nematode

Treatment: T502-3 Methyl bromide—8 lbs/1,000 ft^3 for 16 hours in 26" vacuum at 40°F or above.

T503—Treatments for Infestations of Downy Mildews and Physoderma diseases of Maize

T503-1 Bags and bagging (used) for small grains

Pest: Diseases listed in 7CFR 319.24: Downy Mildews and Physoderma diseases of Maize

Alternative treatments:

Treatment: T503-1-2 Hot water treatment—soak in water slightly below boiling (212°F) for 1 hour.

Treatment: T503-1-3 Live steam for 10 minutes at 240°F, NAP. For baled material, live steam at 10 pounds pressure for 20 minutes.

Treatment: T503-1-4 Dry heat at 212°F for 1 hour. Treat small bales only.

T503-2 Covers used for small grains

Pest: Diseases listed in 7CFR 319.24: Downy Mildews and Physoderma diseases of Maize

Alternative treatments:

Treatment: T503-2-2 Hot water treatment—soak in water slightly below boiling (212°F) for 1 hour.

Treatment: T503-2-3 Live steam for 10 minutes at 240°F, NAP. For baled material, live steam at 10 pounds pressure for 20 minutes.

Treatment: T503-2-4 Dry heat at 212°F for 1 hour. Treat small bales only.

T504—Treatment for Infestation of Flag Smut on various commodities

T504-1 Bags and bagging (used) for small grains

Pest: Flag smut

Alternative treatments:

Treatment: T504-1-1 Dry heat at 212°F for 1 hour. Treat small bales only.

Treatment: T504-1-2 Steam at 10 pounds pressure at 242°F (114°C) for 20 minutes.

T504-2 Covers used for wheat

Pest: Flag smut
Alternative treatments:

Treatment: T504-2-1 Dry heat at 212°F for 1 hour. Treat small bales only.

Treatment: T504-2-2 Steam at 10 pounds pressure at 242°F (114°C) for 20 minutes.

T505—Treatment for Infestation of Chrysomyxa spp. on various commodities

T505-1 Azaleodendron

Pest: Chrysomyxa spp.
Alternative treatments:

Treatment: T505-1-1 Treat with mancozeb or other approved fungicide ofequal effectiveness. (Use label instructions for treatment.)

Treatment: T505-1-2 See alternative treatment T501

T505-2 Rhododendron

Pest: Chrysomyxa spp.
Alternative treatments:

Treatment: T505-2-1 Treat with mancozeb or other approved fungicide ofequal effectiveness. (Use label instructions for treatment.)

Treatment: T505-2-2 See alternative treatment T501-1.

T506—Treatment for Infestation of Potato Cyst Nematode on various commodities

T506-1 Containers

Pest: Potato cyst nematode
Alternative treatments:

Treatment: T506-1-1 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
40°F or above	8 lbs	16 hrs
OR	10.5 lbs	12 hrs
OR	16 lbs	8 hrs

Treatment: T506-1-3 High pressure steam. See nonplant articles T506C.

T506-2 Nonplant articles

Pest: Potato cyst nematode
Alternative treatments:

Treatment: T506-2-1 MB ("Q" label only) in 26" vacuum

Temperature	Dosage Rate (lb / 1,000 ft^3)	Exposure Period
40°F or above	8 lbs	16 hrs
OR	10.5 lbs	12 hrs
OR	16 lbs	8 hrs

Treatment: T506-2-3 High pressure steam.

Live steam is introduced into a closed chamber containing the material to be treated until the required temperature and pressure are indicated. The temperature/pressure relationship is maintained at or above this point for the required exposure period. The exposure period will depend on the nature of the material, quantity, and its penetrable condition.

For loose masses of material which permit rapid and complete penetration of steam to all parts of the mass, no initial vacuum is needed but air must be released until steam vapor escapes, and exposure at 20 pounds pressure for 10 minutes, 15 pounds for 15 minutes, or 10 pounds for 20 minutes is sufficient.

For closely packed material, such as soil, special measures are needed to ensure rapid heat penetration to all parts of the material. Soil, if in large containers, will not allow adequate treatment under normal sterilization exposure periods. Quicker penetration of the steam is obtained by first exhausting the air in the chamber to a high vacuum and then introducing live steam until the required positive pressure is reached.

T507—Treatment for Infestation of Phyllosticia Bromeliae Uredo and Septoria gentinae on various commodities

T507-1 Bromeliads

Pest: ***Phyllosticta bromeliae Uredo*** spp. (when destined to Florida, refuse entry)

Treatment: T507-1 Remove infected leaves and treat all plants of same species in shipment with Captan following label directions.

Important

Advise importer or consignee that treatment may cause commodity damage.

T507-2 Gentiana

Pest: ***Septoria gentinae***

Treatment: T507-2 Remove infected leaves and treat all plants of same species in shipment with Captan following label directions.

Important

Advise importer or consignee that treatment may cause commodity damage.

T508—Treatment for Infestation of Rusts on various commodities

T508-1 Orchids (to Florida)

Pest: Rusts

Treatment: T508-1 ***For rust-infected shipments to Florida:*** Refuse entry to all infected plants and all other plants of the same species or variety in the shipment. Treat other orchid species in the shipment (which may have become contaminated) with Captan. Repackage treated orchids in clean shipping containers. For rusts on orchids to States other than Florida, follow the procedures in T509.

T509—Treatment for Infestation of Various Plant Pests of Camellia and Orchids

T509-1 Camellia

Pest: ***Cylindrosporium camalliae***
Alternative treatments:

Treatment: T509-1-1 ***Light infection:*** Remove infected leaves and dip or spray plant with 4-4-50 Bordeaux. Dry quickly and thoroughly before release.

Treatment: T509-1-2 ***Heavy infection:*** Refuse entry.

T509-2 Orchids

Pest: ***Hemileia*** spp.
Leptosphaeria spp.
Mycosphaerella spp.
Opiodothella orchidearum
Phomopsis orchidophilia
Phyllachora spp.
Phyllosticta spp.
Sphenospora spp.
Sphaerodothis spp.
Uredo spp. (except ***U. scabies***)
Alternative treatments:

Treatment: T509-2-1 ***Light infection:*** Remove infected leaves and dip or spray plant with 4-4-50 Bordeaux. Dry quickly and thoroughly before release.

Treatment: T509-2-2 ***Heavy infection:*** Refuse entry.

T510—Treatment for Infestation of various Corn-Related diseases

T510-1 Corn (seed) (Commercial lots (not for propagation))

Pest: Various corn-related diseases

Treatment: T510-1 Live steam from jet or nozzle into loose masses of material until all parts reach 212°F.

T510-2 Corn (seed) (Small lots for propagation but not for food, feed, or oil purposes)

Pest: Various corn-related diseases

Treatment: T510-2 Treat seeds with a dry application of Mancozeb in combination with Captan. Disinfect bags by: 1) Dry heat at 212°F for 1 hour. Treat small bales only; or 2) Steam at 10 pounds pressure at 40°F for 20 minutes.

T511—Precautionary treatment for Infestations of Xanthomonas axonopodis, pv. citri (citrus canker)

T511-1 Citrus and other Rutaceous seeds from citrus canker countries

Pest: ***Xanthomonas axonopodis***, pv. ***citri*** (citrus canker)

Treatment: T511-1 Seeds shall be treated for possible infection with citrus canker bacteria by first washing the seeds if any mucilaginous materials is adhering. Next, immerse the seeds in water at 125 degree F or higher for 10 minutes. Then immerse seed for a period of at least 2 minutes in a 0.525% sodium hypochlorite (Clorox) solution at a pH of 6.0 to 7.5. Drain, dry and repack near original moisture content.

Important

A 0.525% sodium hypochlorite solution is prepared by diluting 1 part Clorox (containing 5.25% sodium hypochlorite) in 9 parts of water. If using "ultra strength" chlorine bleach, use only 3/4 as much bleach.

T512—(Deleted)

T513—Treatment for Infestations of Ascochyta on various commodities

T513-1 Orchids

Pest: ***Ascochyta*** spp.

Treatment: T513-1 Defoliate if leaf-borne only; refuse entry if pseudo-bulbs infected.

T514—Treatment for Infestations of *Xanthomonas albilineans* and *X. vasculorum*

T514-1 Saccharum (sugarcane) (Seed pieces)

Pest: ***Xanthomonas albilineans and X. vasculorum***

Treatment: T514-1 Presoak in water at room temperature for 24 hours then immerse in water at 122°F for 3 hours.

This treatment may damage sprouted cane.

T514-2 Saccharum (sugarcane) (True seed (fuzz))

Pest: ***Xanthomonas albilineans and X. vasculorum***

Treatment: T514-2 Immerse in 0.525 percent sodium hypochlorite solution for 30 minutes followed by at least 8 hours air drying before packaging. (Dilute 1 part Clorox or similar solution containing 5.25 percent sodium hypochlorite; if using “ultra strength” chlorine bleach, use only 3/4 as much bleach).

T514-3 Saccharum (sugarcane) (Bagasse)

Pest: ***Xanthomonas albilineans and X. vasculorum***

Treatment: T514-3 Dry heat treatment for 2 hours at 158°F.

T514-4 Saccharum (sugarcane) (Field and processing equipment)

Pest: ***Xanthomonas albilineans and X. vasculorum***

Treatment: T514-4 Remove all debris and soil from equipment with water at high pressure (300 pounds per square inch minimum) or with steam.

T515—Treatment for Infestations of various Sugarcane-Related diseases

T515-1 Sugarcane (Baled)

Pest: Various sugarcane-related diseases
Alternative treatments:

Treatment: T515-1 Introduce live steam into 25" vacuum until pressure reaches 15 to 20 pounds. Hold until center of bale is 220°F–230°F and maintain for 30 minutes.

T515-2-1 Sugarcane (Loose Sugarcane)

Treatment: T515-2-1 Introduce steam into 25" vacuum (or if with initial vacuum, “bleed” air until steam vapor fills chamber).

T515-2-3 Sugarcane (Loose Sugarcane)

Treatment: T515-2-3 Dry heat—212°F for 1 hour.

T515-2-4 Sugarcane (Loose Sugarcane)

Treatment: T515-2-4 Pulped in water at 190°F–205°F, followed by drying at 212°F for 1 hour.

T515-2-5 Sugarcane (Loose Sugarcane)

Treatment: T515-2-5 Flash heated to 1,000°F (Arnold dryer).

T516 (Deleted)

T517 (Deleted)

T518—Treatment for Infestations of Various Rice-Related diseases

T518-1 Brooms made of rice straw

Pest: Various rice-related diseases

Treatment: T518-1 Dry heat at 170°F for 4.5 hours—may take 2 hours to reach this temperature.

T518-2-1 Novelties made of rice straw

Two alternative treatments

Pest: Various rice-related diseases

Treatment: T518-2-1 Dry heat at 180°F–200°F for 2 hours

T518-2-2 Novelties made with rice straw

Pest: Various rice-related diseases

Treatment: T518-2-2 Steam sterilization

Temperature	Pressure	Exposure Period
260°F	20 lbs	15 minutes
250°F	15 lbs	20 minutes

T519—Treatment for Infestations of Various Rice-Related diseases

T519-1 Closely packed rice straw and hulls

Pest: Various rice-related diseases

Treatment: T519-1 Introduce steam into 28" vacuum until pressure reaches 10 pounds and hold for 20 minutes.

T519-2 Loose rice straw and hulls

Pest: Various rice-related diseases

Treatment: T519-2 Introduce steam into 28" vacuum (or if without initial vacuum, “bleed” air until steam vapor escapes) until pressure reaches 20 pounds AND temperature 259°F and hold for 10 minutes (OR 10 pounds and 240°F for 20 minutes).

Important

See also **T518-1**.

T520—Treatment for Infestation of Verticillium albo-atrum on various commodities

T520-1 Seeds of alfalfa (*Medicago falcata, M. gaetula, M. glutinosa, M. media, and M. sativa*) from Europe

Pest: ***Verticillium albo-atrum***
Alternative treatments:

Treatment: T520-1-1 Dust with 75 percent Thiram at the rate of 166 grams per 50 kilograms of seed (3.3g/kg).

Treatment: T520-1-2 Treat with a slurry of Thiram 75 WP at a rate of 166 grams per 360 milliliters of water per 50 kilograms of seed (3.3g pesticide/7.2ml water/kg seed).

Hot Water Treatments

T551—Treatment for Infestation of Globodera rostochiensis and G. pallida (Nematodes) on Convallaria (pips)

T551-1 Convallaria (pips)

Pest: ***Globodera rostochiensis, G. pallida***

Treatment: T551-1 Keep pips frozen until time for treatment, then thaw enough to separate bundles one from another just before treatment begins. Without preliminary warm-up, immerse in hot water at 118°F for 30 minutes, following with a 5 minute drain, finishing with 5 minutes cooling dip or hosing with tap water.

T552—Treatment for Infestation of *Ditylenchus dipsaci and D. destructor*

T552-1 *Allium, Amaryllis,* and Bulbs (NSPF)

Pest: Bulb nematodes: *Ditylenchus dipsaci, D. destructor*

Treatment: T552-1 Presoak bulbs in water at 75°F for 2 hours, then at 110°F–111°F for 4 hours.

T553—Treatment for Infestations of Nematodes on various plant commodities

T553-1 **Achimenes, Actinidia, *Agapanthus, Aloe, Amorphophallus* (bulbs), *Ampelopsis, Anchuse, Anemone, Astilbe, Begonia* (tubers), *Bletilla hyacinthina* (bulbs) (NSPF), Cactus, Calliopsis, *Campanula, Cestrum*, *Cimicifuga, Cissus, Clematis, Convolvulus japonicus*, Corytholoma, *Curcuma* (turmuric), *Cyclamen, Cytisus*, Dahlia (tubers), *Dracaena*, *Epimedium pinnatum* (only; other spp. not tolerant), *Euonymus alata* (only), *Eupatorium, Euphorbia, Fragaria* (strawberry), Gardenia, *Gentiana*, *Gerbera*, Gesneria, *Geum, Gladiolus*, *Heliopsis, Helleborus, Hibiscus, Hosta, Hoya, Iris, Jasminum*, Kaempferia, Kohleria, Naegelia, Orchid, *Ornithogalum, Paeonia*, *Passiflora*, Polyanthes (tuberose), *Primula*, Reichsteineria, *Sansevieria, Scabiosa*, *Sedum,* Senecio (Lingularis), Thompsonia nepalensis, Tydaea, *Verbena, Vitis* (grape), *Weigela, Zantedeschia*, Zingiberaceae**

Pest: Root-knot nematodes (*Meloidogyne* spp.)

Treatment: T553-1 Hot water at 118°F for 30 minutes.

T553-2 ***Anchusa, Astilbe, Clematis, Dicentra, Gardenia, Helleborus, Hibiscus, Kniphofia, Primula***

Pest: Lesion nematodes (*Pratylenchus* spp.)

Treatment: T553-2 Hot water at 118°F for 30 minutes.

T553-3 **Armoracea (horseradish roots), bulbs (NSPF)**

Pest: Golden nematodes (*Globodera rostochiensis* and *G. pallida*)

Treatment: T553-3 Hot water at 118°F for 30 minutes.

T553-4 ***Bletilla hyacinthina* (alternate treatment: T564)**

Pest: Foliar nematodes (*Aphelenchoides fragariae*)

Treatment: T553-4 Hot water at 118°F for 30 minutes.

T553-5 **Humulus**

Pest: Cyst nematodes (*Heterodera humuli*)

Treatment: T553-5 Hot water at 118°F for 30 minutes.

T554—Treatment for Infestations of Ditylenchus dipsaci and D. destructor on Hyacinthus

T554-1 *Hyacinthus* (bulbs), *Iris* (bulbs and rhizomes), *Tigridia*

Pest: Bulb nematodes—*Ditylenchus dipsaci* and *D. destructor*
Alternative treatments

Treatment: T554-1-1 Presoak in water at 70°F–80°F for 2.5 hours, followed by hot water immersion at 110°F–111°F for 1 hour.

Treatment: T554-1-2 Hot water immersion at 110°F–111°F for 3 hours with no presoaking.

T555—Treatment for Infestations of Ditylenchus dipsaci on *Narcissus*

T555-1 *Narcissus* (bulbs)

Pest: Bulb nematodes—*Ditylenchus dipsaci*

Treatment: T555-1 Presoak in water at 70°F–80°F for 2 hours, then at 110°F–111°F until all bulbs reach that temperature and hold for 4 hours.

T556—Treatment for Infestations of Root-knot nematodes (*Meloidogyne* spp.) on *Calla*

T556-1 *Calla* (rhizomes)

Pest: Root-knot nematodes (*Meloidogyne* spp.)

Treatment: T556-1 Dip in hot water at 122°F for 30 minutes.

T557—Treatment for Infestations of *Meloidogyne* spp. and *Pratylenchus* spp. on *Chrysanthemum* (not including *Pyrethrum*)

T557-1 *Chrysanthemum* (not including *Pyrethrum*)

Pest: *Meloidogyne* spp. and *Pratylenchus* spp.

Treatment: T557-1 Dip in hot water at 118°F for 25 minutes.

T558—Treatment for Infestations of *Pratylenchus* surface diseases on *Fragaria* (strawberry)

T558-1 *Fragaria* (strawberry)

Pest: *Pratylenchus* spp. (surface diseases)

Treatment: T558-1 Dip in hot water at 127°F for 2 minutes.

T559—Treatment for Infestations of Foliar Nematodes on *Begonia* and Oryza (paddy rice)

T559-1 Begonia

Pest: Foliar nematode (*Aphelenchoides fragariae*)

Treatment: T559-1 Dip in hot water at 118°F for 5 minutes.

T559-2 Oryza (paddy rice)

Pest: Foliar nematode (*Aphelenchoides fragariae*)

Treatment: T559-2 Dip in hot water at 132.8°F (56°F) for 15 minutes.

T560—Treatment for Infestations of *Meloidogyne* spp. on Rosa

T560-1 *Rosa* spp. (except multiflora, which is not tolerant)

Pest: *Meloidogyne* spp.

Treatment: T560-1 Dip in hot water at 123°F for 10 minutes.

T561—Treatment for Infestations of *Cercospora mamaonis* and *Phomopis carica-papayae* on Papayas

T561 Papayas

Pest: *Cercospora mamaonis* and *Phomopis carica-papayae*

Treatment: T561-1 Dip in hot water at 120.2°F (49°C) for 20 minutes.

T562—(deleted)

T563—(deleted)

T564—Treatment for Infestations of Foliar Nematodes on various commodities

T564-1 *Astilbe*, *Bletilla hyacinthina, Cimicifuga, Epimendium pinnatum* (only; other spp. not tolerant), *Hosta, Paeonia*

Pest: Foliar nematode (*Aphelenchoides besseyi*)

Treatment: T564-1 Presoak in water at 68°F for 1 hour followed by hot water soak at 110°F for 1 hour. Then dip in cold water and let dry.

Important

See Alternative treatment for **Bletilla hyacinthina**: **T553-1**

T565—Treatment for Infestations of Nematodes on various commodities

T565-1 Amaryllis

Pest: ***Ditylenchus destructor***

Treatment: T565-1 Hot water at 110°F for 4 hours. (Should be done immediately after digging.)

T565-2 Crocus

Pest: ***Aphelenchoides subtenuis, Ditylenchus destructor***

Treatment: T565-2 Hot water at 110°F for 4 hours. (Should be done immediately after digging.)

T565-3 Gladiolus

Pest: ***Ditylenchus destructor***

Treatment: T565-3 Hot water at 110°F for 4 hours. (Should be done immediately after digging.)

T565-4 Scilla

Pest: ***Ditylenchus dipsaci***

Treatment: T565-4 Hot water at 110°F for 4 hours. (Should be done immediately after digging.)

T565-5 *Solanum* (potato tubers)

(see Restricted Entry Orders, Part 321)

Pest: ***Globodera rostochiensis, G. pallida***

Treatment: T565-5 Hot water at 110°F for 4 hours. (Should be done immediately after digging.)

T566—Treatment for Infestations of various diseases on Broomcorn, Broomcorn Articles, and Libium (bulbs)

T566-1 Broomcorn

Pest: Precautionary treatment for corn-related diseases

Treatment: T566-1 Hot water at 102°F.

T566-2 Broomcorn Articles

Pest: Precautionary treatment for corn-related diseases

Treatment: T566-2 Hot water at 102°F.

T566-3 Libium (bulbs)

Pest: *Aphelenchoides fragariae*

Treatment: T566-3 Hot water at 102°F.

T567—Treatment for Infestations of Bulb nematodes on various commodities

T567-1 *Muscari, Ornithogalum, Polyanthes* (tuberose)

Pest: Bulb nematodes (*Ditylenchus dipsaci*)

Treatment: T567-1 Dip in hot water at 113°F for 4 hours.

T568—Treatment for Infestations of Foliar nematodes on Senecio

T568-1 Senecio (Lingularis)

Pest: Foliar nematodes (*Aphelenchoides fragariae*)

Treatment: T568-1 Treat with hot water at 110°F for 1 hour.

T569—Treatment for Infestations of Foliar nematodes on *Fragaria* (strawberry)

T569-1 *Fragaria* (strawberry)

Pest: Foliar nematodes (*Aphelenchoides fragariae*)

Treatment: T569-1 Hot water at 121°F for 7 minutes. (National Plant Board Conference, Tennessee, 1968)

T570—Treatment for Infestations of various diseases Acalypha and Aconitum

T570-1 Acalypha

Pest: *Pratylenchus* spp.

Treatment: T570-1 Hot water dip at 110°F for 50 minutes. (Tolerance not established.)

T570-2 Aconitum

Pest: ***Aphelenchoides fragariae*** spp.

Treatment: T570-2 Hot water dip at 110°F for 50 minutes. (Tolerance not established.)

T571—(Deleted)

6

Treatment Manual

Certifying Facilities

Overview

Contents

Certification of Vacuum Fumigation Chambers **page-6-2-1**
Certification of Atmospheric Fumigation Chambers **page-6-3-1**
Certification of Cold Treatment **page-6-4-1**
Certification of Hot Water Immersion Facilities **page-6-5-1**
Certification of Forced Hot Air and Vapor Heat Treatment Facilities **page-6-6-1**
Certification of Niger Seed Treatment Facilities **page-6-7-1**
Certification of Irradiation Treatment Facilities **page-6-8-1**

The Certification of Facilities section of this manual is organized by the following categories:

- Vacuum Fumigation Chambers
- Atmospheric Fumigation Chambers
- Cold Treatment Facilities
- Hot Water Immersion Facilities
- Forced Hot Air and Vapor Heat Treatment Facilities
- Niger Seed Treatment Facilities
- Irradiation Treatment Facilities

Domestic and foreign treatment facilities must be certified by APHIS before they can perform treatments to meet United States quarantine requirements. Specific requirements for each type of facility are included in this section.

After the Center for Plant Health Science and Technology (CPHST) has approved blueprints or drawings of a treatment facility, the treatment facility can request certification from Plant Protection and Quarantine at local ports or State Plant Health Directors.

Important

Blueprints or drawings of **domestic** treatment facilities should be sent to:

Peter Witherell
USDA-APHIS-PPQ-CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606
tel: 919-513-2496, ext. 236

Request for certification can be sent to State Plant Directors listed at the following URL:

http://www.aphis.usda.gov/travel/aqi.html

Important

Blueprints or drawings and request for certification of **foreign** treatment facilities should be sent to:

David Reeves
Director, Preclearance Programs
USDA, APHIS, PPQ
4700 River Road, Unit 60
Riverdale, MD 20737
tel: 301-734-8295
fax: 301-734-8318

For foreign treatment facilities, the company requesting certification is responsible for paying money into a trust fund account to pay the salary, travel costs, and per diem of a PPQ Officer to be sent on temporary duty.

Sea-going vessels that participate in the APHIS cold treatment program for fresh fruit may be certified at a port in the USA or at a foreign port. Also, if the certification is to be carried out overseas, a trust fund account will be needed to cover the costs. (For details call Stephanie Hyatt, PPQ Quarantine Policy, Analysis and Support (QPAS), tel: 301-734-6404.

6

Treatment Manual

Certifying Facilities

Certification of Vacuum Fumigation Chambers

Contents

Construction and Performance Standards **page-6-2-1**
- Chamber **page-6-2-1**
- Vacuum Pump **page-6-2-2**
- Fumigant Introduction Systems **page-6-2-2**
- Circulation and Exhaust System **page-6-2-2**
- Accessories **page-6-2-3**
- Performance Standards **page-6-2-3**

Construction and Performance Standards

Fumigation by vacuum consists of placing the commodity in a gas-tight steel chamber, removing most of the air, and replacing a small portion of it with a gas which is lethal to insects and other pests. Vacuum fumigation provides a more rapid penetration of commodities undergoing treatment than is obtained in atmospheric fumigations. The length of exposure in vacuum fumigation may range from 2 to 4 hours as compared with 12 to 24 hours under atmospheric conditions.

Chamber

Vacuum chambers are usually of welded steel construction. A rectangular chamber may be preferred for more effective use of space. Reinforcement of the chamber body by means of steel ribs, or other supports, is usually required to enable the chamber to withstand the difference in pressures when the vacuum is drawn. Doors may be provided at one or both ends of the chamber. In cylindrical chambers, the doors may be either concave or convex, but in rectangular chambers flat doors are commonly used with suitable reinforcements. The doors may be hinged at the side, or at the top and counterbalanced. Many doors are fitted with special mechanisms for rapid closing. Door gaskets should be durable and at the same time provide gas-tight seal. The efficiency of a chamber depends to a large extent upon the tightness with which the door or doors will seal. All other chamber openings must be equally tight to sustain the prescribed vacuum over a specified period of time.

To permit circulation beneath the load, the chamber must be designed to enable the loading of commodities stacked on pallets, skids, or small trucks. Small chambers which are usually hand loaded should be provided with removable floors.

Vacuum Pump

Each installation required a high quality, high capacity vacuum pump. The vacuum pump should have the capacity to reduce the chamber pressure to 1–2 inches (25–51 mm) of mercury (28–29 inch or 711–737 mm vacuum) in 15 minutes or less.

Fumigant Introduction Systems

The introduction system needed will vary with the type of fumigant in use and the size of the chamber. For small chambers and for introducing fumigants in small quantities, the fumigant may be measured by volume using a graduated dispenser. For larger chambers the gas supply cylinder is placed on a platform scale and the amount of fumigant required is measured by weight.

For most fumigants, a volatilizing unit is required to insure fumigant introduction in a gaseous state. The volatilizer is located outside of the chamber between the gas cylinder or dispenser and the introduction port of the chamber. The volatilizer consists essentially of a metal coil submerged in water which is kept hot enough to vaporize the fumigant. If more than one fumigant will be used in the chamber, a separate volatilizer and gas introduction line should be used for each in order to reduce the possibility of corrosion or formation of precipitates.

Within the chamber the gas introduction system should consist of tubing with multiple graduated openings which will provide uniform distribution of the fumigant throughout the length of the chamber. The tubing shall be installed along the ceiling.

Circulation and Exhaust System

Adequate distribution of the gas is often hindered by the cargo placed in the chamber. To overcome this, vacuum chambers should be equipped with a circulatory system. If fans are employed, the number of fans required would depend upon the chamber design, volume, and loading arrangements. A minimum of two would normally be required for chambers of over 1,000 cu ft capacity (28.31 m^3). The fans are to be placed at opposite ends of the chamber facing each other—one high, one low. Additional fans may be required for larger chambers. Their combined capacity should be such that they are capable of moving each minute a volume of air which is equal to approximately one-third the volume of the chamber. Non-sparking, explosion-proof type circulation systems are required with some fumigants.

In most installations, the vacuum pump is used to remove the fumigant following the exposure period. The air-gas mixture is pumped out of the chamber through exhaust ducts or stacks installed

for that purpose. The actual height of these stacks will vary with the location of the chamber, and may be regulated by local safety ordinances.

Accessories

Chambers must be equipped with a vacuum gauge and an instrument for measuring and recording the vacuum drawn and maintained during the exposure period. A temperature instrument must be installed in chambers used for quarantine treatments with long exposure periods. Combination temperature and vacuum recorders are available.

Performance Standards

To qualify for program approval, vacuum chambers must be able to meet or exceed specified vacuum leakage tests. The tests are listed below and determine the classification under which the chamber qualified.

Classification	Initial vacuum equivalent to inches of mercury	Allowable vacuum loss			
		4 hr	6 hr	16 hr	24 hr
Superior	28 1/2	—	1/2”	—	1"
A	28 1/2	1/2”	—	1"	2"
B	28 1/2	1"	—	2 1/2”	3"
C	26	1"	—	2 1/2”	3"

In addition, ***ALL*** chambers must be capable of meeting the following requirement: A vacuum equivalent to 26 inches (660 mm) of mercury is drawn. The vacuum is then reduced to 5 inches (127 mm) and held for a period of 4 hours. A vacuum of 2 inches (55 mm) or more after 4 hours is considered adequate for this test.

Chambers classified “Superior” or “A” are approved for all vacuum treatments. These chambers are to be tested annually.

Chambers classified “B” are approved for all vacuum schedules up to and including 28-inch (711 mm) sustained vacuum. These chambers are to be tested semiannually.

Approval of a chamber for vacuum fumigation does not include approval for atmospheric (NAP) fumigations. If the vacuum chamber will also be used as a normal atmospheric pressure chamber, then it must also pass a pressure leakage test (see **page-2-5-6**).

Actual detailed instructions for constructing a vacuum chamber are not included in this discussion. The information presented is designed to list the component parts that are needed in the chamber and the function of each. Instructions and additional information can be

obtained from the following list of vacuum chamber manufacturers. In furnishing the names of these dealers, no discrimination is intended against any firm whose name may have been omitted. Neither does this program endorse the firms mentioned nor guarantee the reliability of their products. The list is furnished solely for information and convenience.

Partial List of Manufacturers of Vacuum Chambers

Cos-Med Group
(a.k.a. ETO Sterilization, Inc.)
250 Brunswick Avenue
Linden, NJ 07036

Slack Associates, Inc.
540 South Longwood Street
Baltimore, MD 21223

Vacudyne Altair
375 East Joe Orr Road
Chicago Heights, IL. 60411

6

Treatment Manual

Certifying Facilities

Certification of Atmospheric Fumigation Chambers

Contents

Construction and Performance Standards **page-6-3-1**
- Discussion (Overview) **page-6-3-1**
- Basic Elements for Design and Construction of Chambers **page-6-3-2**
- Gas-Tight Construction **page-6-3-3**
- Circulation and Exhaust Systems **page-6-3-3**
- Fumigant Dispensing System **page-6-3-4**
- Pressure-leakage Test for NAP Fumigation Chambers **page-6-3-4**
- Other Auxiliary Equipment **page-6-3-5**

Construction and Performance Standards

Discussion (Overview)

The primary purpose of a program fumigation is to obtain quarantine control of the pests in all stages of development in or on the product being fumigated. A properly constructed fumigation chamber will provide an enclosure into which the product can be loaded and where the fumigant will be maintained at the prescribed concentration for the required exposure period.

The primary consideration in the construction of an atmospheric fumigation chamber is to make it as gas tight as possible. In addition, circulation equipment must be installed to distribute the fumigant properly throughout the chamber. The chamber must retain these qualities of tightness and fumigant circulation during every fumigation.

Although chamber sizes are not restricted to specific dimensions, chambers should be sized according to the volume of material to be fumigated. Experience has shown that two moderately sized chambers would be preferable to one large facility.

The construction material may be selected according to the type of product to be fumigated and the method of operation involved. Wood construction of wood frame with light metal sheathing could be utilized if the products to be fumigated are lightweight and are to be hand loaded. Heavy products often loaded by machinery or handtrucks would require that the construction be of heavy gauge sheet metal, masonry, or metal plates. It is advisable to construct the chamber in the most durable manner consistent with its intended use.

Auxiliary equipment will be required to measure, vaporize, circulate, and exhaust the fumigant. Such equipment should be sized according to the volume of the chamber. When a relatively small amount of fumigant is used, it is often measured by volume in graduated dispensers (MB only). When larger amounts are used, the fumigant is most often measured by weight.

For the fumigant methyl bromide (MB) a volatilizing unit through which the fumigant passes is located outside the chamber.

For the fumigant sulfuryl fluoride (SF), no volatilizer or graduated dispenser should be used. For phosphine (PH), a chamber is generally not used because phosphine will corrode copper and brass (including tubing, fans, and electrical wiring).

Fans or blowers developing the prescribed minimum air movement are essential to the proper distribution of the fumigant.

Chambers may be equipped with heating or refrigeration units depending on the climatic environment and the products to be fumigated. Product injury or an ineffective fumigation may occur within certain temperature ranges. Although provisions for temperature control are not generally mandatory, in certain fumigation operations temperature control is necessary and therefore must be considered in the design and construction.

While complete construction details for an atmospheric fumigation chamber are not contained in the following narrative and illustrations, sufficient information is available to develop specifications for a proposed structure. Firms considering chambers for approval by the U.S. Department of Agriculture should submit drawings to the Center for Plant Health Science & Technology (CPHST) in Religh, North Carolina.

Basic Elements for Design and Construction of Chambers

- Must be gas tight and must remain so during every use.
- Must be provided with an efficient system for circulating and exhausting the fumigant.
- Must be provided with an efficient system of dispensing the fumigant.
- Must be provided with suitable fittings to facilitate a pressure-leakage test and gas concentration sampling.
- Should be provided with a recording thermometer when product temperatures are critical or treatments are of such duration that temperature variations could affect the efficiency of the fumigation.

- Should be provided with heating or refrigeration units when they are required for fumigation efficiency or to prevent product injury.
- Should be equipped with removable, slatted floors unless all material placed in the chamber is on pallets or carts.

The criteria listed above deal primarily with the efficiency of the fumigation chamber itself. In determining the ultimate design and construction, it is essential to give consideration to the safe and practical operation of the facility.

Gas-Tight Construction

Interior surfaces must be impervious to the fumigant. Joints must be sealed with proper compound, solders, or welds. All doors and vents must be provided with proper gaskets. All openings such as for wiring, thermometer, tubing, ports for pressure-leakage tests, etc., must be made gas-tight.

Interior surfaces whether metal, cement, concrete block, tile, or plywood must be painted with epoxy resin, vinyl plastic, or asphalt base paints. Such paint coverings make the surfaces less sorptive, an important factor in maintaining gas concentrations.

Important

Aluminum base paints are **not** acceptable because of the corrosive effect caused by a reaction between such paints and the fumigant. A list of sources for approved paints is available from the Riverdale office.

When wood or wood and sheet metal are used in construction, it is critical that all joints and seams be sealed with nonhardening mastic. This makes a gas-tight seal and allows for expansion and contraction without leakage. In masonry construction, the mortar between all courses of cement blocks should be jointed to produce a smooth compact surface. Poured concrete structures should also have smooth compact surfaces.

The construction and fastening of chamber doors is most critical. Doors may be hinged from the top or side, or on a davit. A chamber door hinged at the top is less apt to sag. Refrigerator hinges should be used if the door is hinged at the side. A high quality gasket, such as neoprene must be provided along the entire perimeter of the chamber facing. To obtain maximum tightness, the doors must be fastened uniformly against the gaskets.

Circulation and Exhaust Systems

Various methods can be used to circulate the fumigant within the chamber. Equipment should be capable of circulating air at the rate of at least one-third the volume of the chamber per minute. The rate of

airflow of the blower should give approximately one complete change of air per minute, based on the volume of the empty chamber. For smaller chambers, a suitable circulating fan will usually provide the necessary air movement. For larger chambers, effective gas distributions can be obtained by using a circulating or squirrel cage fan which picks up the air/gas mixture from a duct reaching near the floor and blowing it across the top of the load. A blower located outside the chamber may also be used, but this method considerably increases the possibilities of leakage. Non-sparking explosion-proof units are required with some fumigants.

Exhaust blowers should also be sized according to the volume of the chamber. Volume of enclosure (in cubic feet) divided by the sum of cubic feet per minute (cfm) of the exhaust fan(s) or exhaust blower equals the number of minutes required per complete gas volume exchange. (2) Sixty minutes divided by the number of minutes per gas volume exchange equals the number of complete gas exchanges per hour. The result should be in the range of 4 to15. The faster the rate of aeration the better, particularly for perishable commodities. If the exhaust flow is connected to a methyl bromide recovery system, this device must not impede the flow rate to less than 4 volumes per hour. Frequently, circulation and exhaust systems are designed to utilize the same blower. Venting to the outside is essential, and the exhaust stack should extend well above all nearby structures. Compliance with local safety ordinances is essential.

Fumigant Dispensing System

The dispensing system needed will vary with the types of fumigants in use. The fumigant MB is usually introduced into the chamber through a tube extending from the supply cylinder. Within the chamber this tube should be provided with properly spaced openings through which the fumigant is dispersed. Fumigants in small quantities are generally measured by volume using a graduated dispenser. The dispenser is located in the introduction line between the supply cylinder and the volatilizer. For larger quantities the supply cylinder is placed on a platform scale and the fumigant used is measured by weight. The measured amount of fumigant must pass through a volatilizer where it is converted from a liquid to a vapor. The volatilizer is most often constructed of copper tubing immersed in a hot water bath which should be kept near the boiling point. The introduction tube for MB should be located in the uppermost part of the chamber.

Pressure-leakage Test for NAP Fumigation Chambers

Before a chamber is used for fumigation, the manometer can be used during a pressure-leakage test as a measure of tightness. An opening (usually 1 inch diameter) should be provided in the chamber for the use of a blower or other means for the introduction of air to create a

positive pressure in the chamber. An additional opening, such as a gas sampling line opening, must be provided for the manometer. The procedure for testing is as follows:

1. Close chamber as for fumigation.
2. Attach one end of the manometer to the chamber opening.
3. Use vacuum cleaner blower or similar apparatus to create pressure of 25 mm as measured on an open-arm, kerosene or water filled manometer.
4. Discontinue blower and close its entry.
5. Observe time for pressure to recede from 25 to 2.5 mm in the open arm.

The time lapse for the chamber pressure to recede from 25 to 2.5 mm in the open arm must be 22 or more seconds for minimum approval. Chambers shall be reinspected every 6 months when 22 to 29 seconds are recorded. Chambers which retain the pressure for 30 seconds or longer should be tested annually. (Chambers used for fumigating cherries for export to Japan are required to meet a higher standard—the time lapse for the chamber pressure to recede from 25 to 2.5 mm must be 60 or more seconds for minimum approval.) Inability to develop or maintain adequate pressure indicates considerable leakage. In such cases, the chamber operator may use a smoke bomb or other device in an effort to determine the areas of leakage.

Electronic manometers are also available and may be used in lieu of the Open-arm (U-tube) type.

Directions for using this equipment are explained in the Equipment section.

Other Auxiliary Equipment

According to the needs of the operation, other auxiliary equipment should be provided. When heat is required, steam pipes or low temperature electric strip heaters are generally recommended. Open flame or exposed electric coils should not be used as they tend to break down the gas and form undesirable compounds. Refrigeration units should be sized to the volume of the chamber and the type and amount of commodity involved. Recording thermometers when required are usually attached to the outside of the chamber with a remote sensing unit attached to the inside wall or inserted into the product.

Figure 6-1-1 through ***Figure 6-1-4*** illustrate various construction features and auxiliary equipment.

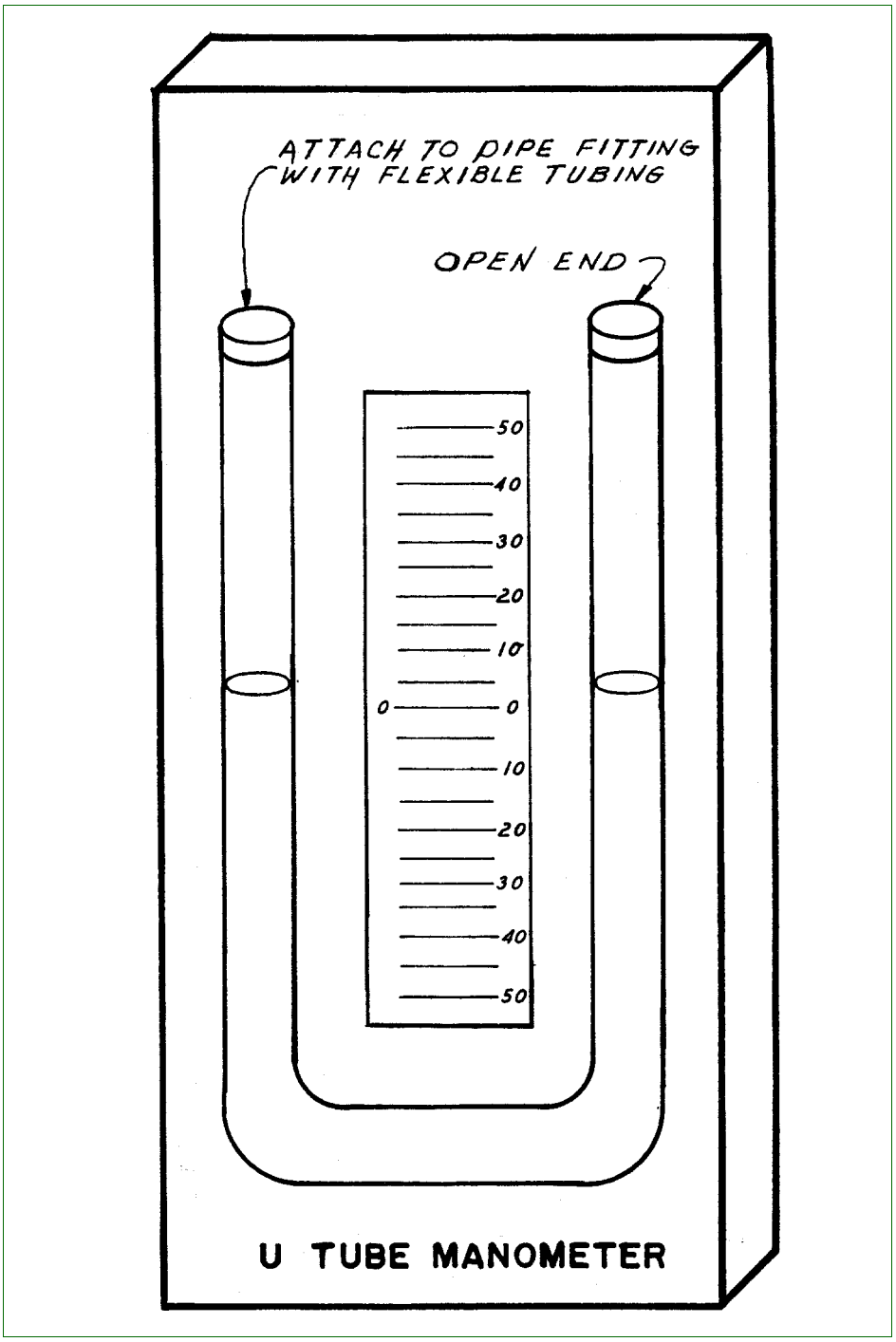


FIGURE 6-1-1: U Tube Manometer

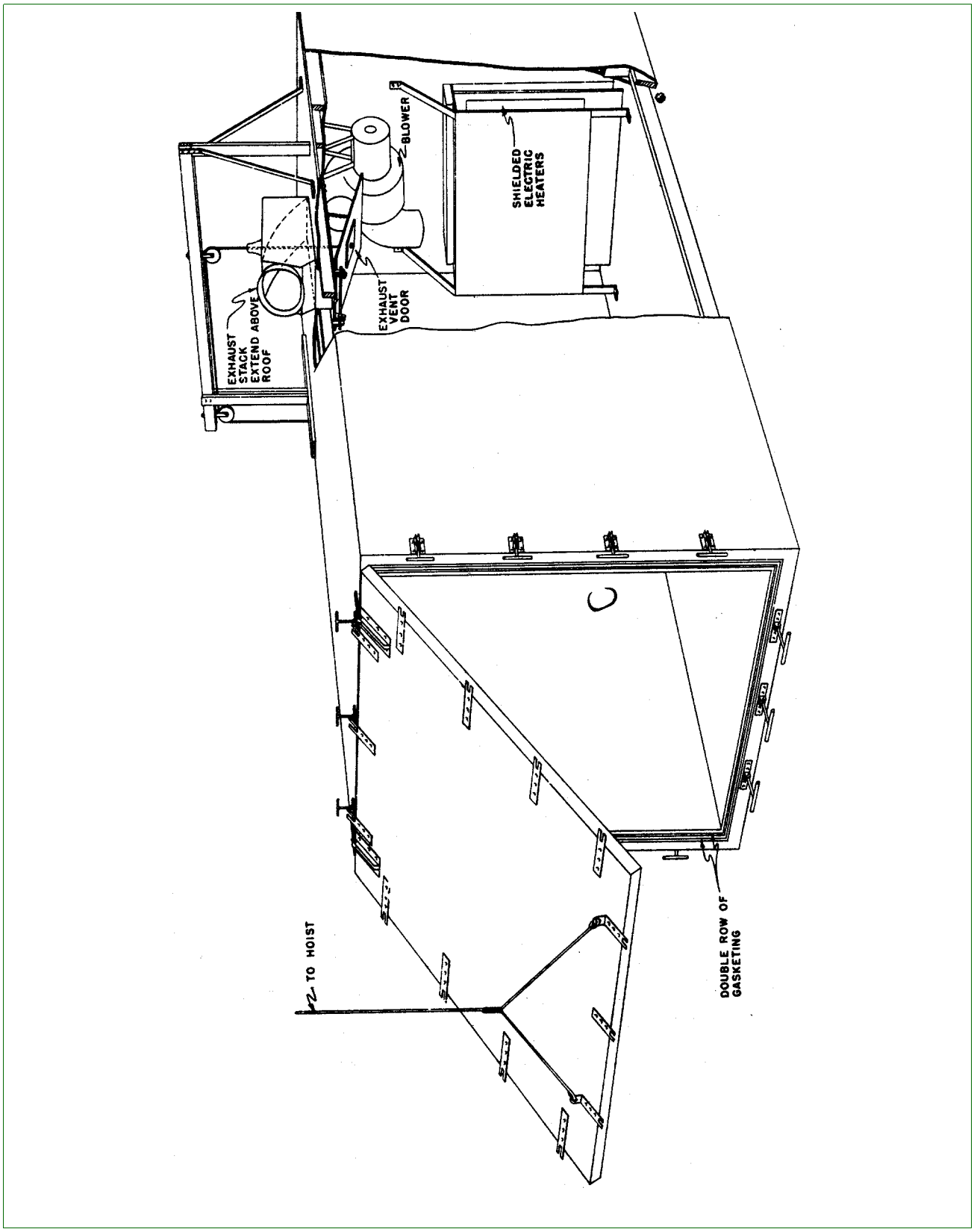


FIGURE 6-1-2: Generalized Plan of Atmospheric Fumigation Chamber Showing Heat and CIrculation Systems

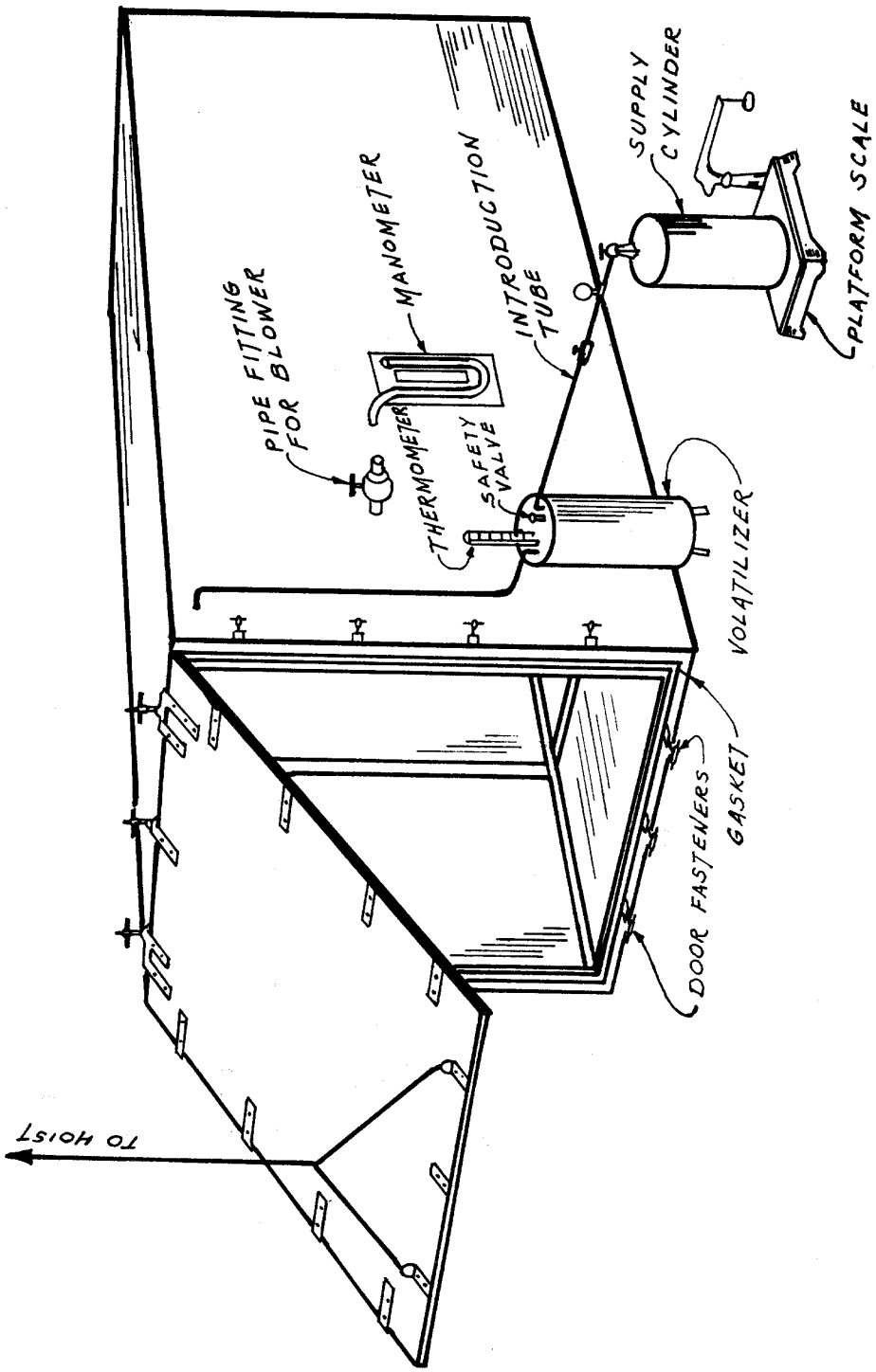


FIGURE 6-1-3: Generalized Plan of an Atmospheric Fumigation Chamber

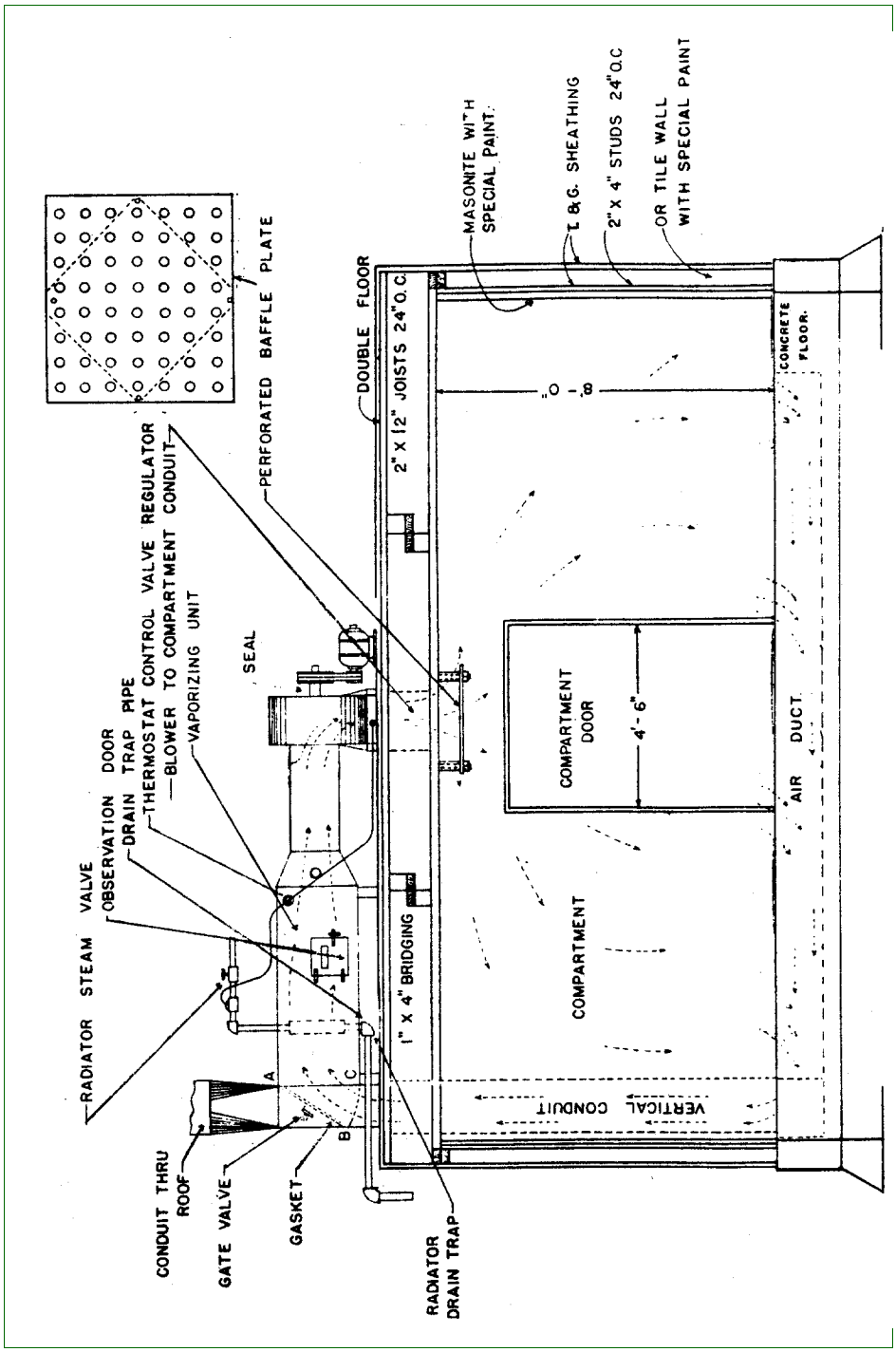


FIGURE 6-1-4: Forced-air Circulation Plan for Fumigation Chamber

6

Treatment Manual

Certifying Facilities

Certification of Cold Treatment

Contents

Introduction **page-6-4-1**
Vessels Used for Intransit Cold Treatment **page-6-4-2**
General Requirements for Approval of Refrigerated Compartments **page-6-4-2**
Special Requirements for Approval of Refrigerated Compartments **page-6-4-3**
Standards for Temperature Recording Systems **page-6-4-4**
Recording Instruments. **page-6-4-4**
Temperature Sensors. **page-6-4-5**
Integral Containers Used for Cold Treatment **page-6-4-7**
General Requirements for Approval **page-6-4-7**
Standards for Temperature Recording Instruments **page-6-4-7**
Warehouses Used for Cold Treatment **page-6-4-8**
Requirements for Approval of Structures and Equipment **page-6-4-8**

Introduction

Since the early 1900s, sustained cold temperature has been employed as an effective postharvest method for the control of the Mediterranean and certain other tropical fruit flies. Exposing infested fruit to temperatures of 2.2°C (36°F) or below for specific periods results in the mortality of the various life stages of this group of notoriously injurious insects. Procedures were developed so that cold treatment can be effectively applied to fruit while in transport in refrigerated holds of ships, in refrigerated containers, and in warehouses located in the country of origin or in the United States.

The U.S. Department of Agriculture (USDA) incorporates this method of eradication in its regulations to facilitate the importation of certain types of fruit from areas of the world where tropical fruit flies, and other insects which can be similarly controlled, are among the significant fruit pests of concern. Under prescribed conditions, agreements are made between USDA and the appropriate governmental agency of a country of export, for establishing procedures of operation. The procedures provide for temperature equipment control by requiring calibration tests prior to each loading and for air circulation control by a prescribed method of storage under monitoring. Other aspects of the operation and certification are designed to ensure an overall control of the treatment procedures at the point of origin and during the treatment.

For intransit treatment, the entire treatment procedure is reviewed for accuracy and completeness by USDA inspectors when the carrier arrives at a U.S. port of entry. In the case of warehouse treatments, the temperatures are checked periodically during the treatment, and the entire temperature record is reviewed at the end of the treatment period.

Facilities for intransit and warehouse cold treatment are subject to approval by USDA. Approval is needed only when treating fruit under USDA regulations, and does not constitute an endorsement for the carrying or storage of refrigerated cargo.

Vessels Used for Intransit Cold Treatment

General Requirements for Approval of Refrigerated Compartments

A vessel must have adequate refrigeration, insulation, and thermostatic control to precool and hold fruit at 2.2°C (36°F) or below for the entire voyage. Proper design of compartments is necessary to assure good distribution of circulating air so that all parts of the cargo spaces are maintained at approximately the same temperature level. USDA does not furnish specifications for refrigerating equipment or designs for compartment construction. However, reefer vessels presented for approval must be classified under the rules of the American Bureau of Shipping or a comparative internationally recognized ship classification society.

Application for approval of refrigerated compartments must be made in writing to the Center for Plant Health Science & Technology, USDA-APHIS-PPQ-CPHST, Treatment Support & Certification, 1017 Main Campus Drive, Suite 2500, NC 27606. In applying for approval of compartments aboard a specific vessel or series of vessels, the owner or builder should provide plans and drawings of the refrigerated compartments showing dimensions, air circulation, and other specifications of the refrigerating equipment. From this information, the number of temperature sensors required in each compartment and their location, will be specified by means of a drawing. For each new building requiring approval, it will be necessary to submit the number of sets of drawings to be approved and stamped, with one additional set to be filed at the Center for Plant Health Science & Technology (CPHST).

The owner or builder should also submit specifications showing the complete recording system to be installed, including the recorder and sensors. These specifications must be reviewed and the system approved before installation. After installing the system, the vessel should be made available at a U.S. port for final inspection. For

inspection to be made at a foreign location, prior arrangements and a cooperative agreement must be established with USDA. Generally, a 60-day notification is needed before the inspection can be scheduled. For specific information on the required procedure, contact Quarantine Policy, Analysis and Support (QPAS), Preclearance Programs, USDA-APHIS-PPQ, 4700 River Road, Unit 67, Riverdale, MD 20737. Calibration and identification tests will be made during such an inspection. Clean containers filled with crushed ice and fresh water have to be made available for the immersion of the temperature sensors. If containers are not insulated, the refrigerated compartments must be near 0° to 1.1°C (32° to 34°F). A communication system must also be made available to facilitate communication between personnel in the compartments and the recording room.

A representative from the temperature recorder instrument company, who is familiar with the installation, should be on hand to advise on the performance of the instrument and to correct any deficiencies. Before requesting final inspection, the vessel's owner must complete all arrangements.

Upon meeting all requirements, the vessel will be designated as approved to conduct intransit cold treatments under the provisions of the PPQ's Fruit and Vegetable Quarantine 56. A Certificate of Approval listing the approved refrigerated compartments will be issued to the vessel. This certificate will expire three (3) years from the date of inspection. Request for renewal has to be given sixty (60) days before expiration to the Center for Plant Health Science & Technology (CPHST). Arrangements for the certification survey are to be made with the local PPQ office at the port of arrival. This approval is for equipment only, and each shipment of fruit must satisfy all requirements as described in Section 319.56-2d of Quarantine 56, as a condition of entry for importation into the United States.

Special Requirements for Approval of Refrigerated Compartments

In the event that owners wish to qualify their vessel to carry fruit in other than the standard stowage arrangement, the following additional data must be submitted:

- An analysis of load and equipment balance.
- A schematic diagram of the air distribution pattern with specific reference to those areas most difficult to cool under load conditions.
- Test results of the air delivery system in terms of distribution balance.

Actual performance tests under treatment conditions will be required before approval.

Standards for Temperature Recording Systems

The standards are intended to meet the USDA requirements for a temperature recording installation for use on vessels engaging in the intransit cold treatment of fruit. The recording system must have an overall accuracy of plus or minus 0.3°C in the range of –3° to +3°C or plus or minus 0.5°F in the range of +27° to +37°F, with a resolution of 0.1°C or 0.1°F. The design, construction, and materials used, shall be such, that the performance of the installation is unaffected by marine conditions. Plans and specifications of the temperature recording instrument and equipment are to be submitted for review and approval. These are to include details of all components of the recording installation.

Recording Instruments.

- Accuracy Standards—The readings of the instrument have to be accurate to within plus or minus 0.15°C of the true temperature in the range of –3°C to +3°C or plus or minus 0.25°F of the true temperature in the range of +27°F to 37°F, in the usual conditions of inclination, vibration, and environment associated with marine service. The instrument must be capable of repeatability in the range of –3°C to +3°C (+27°F to +37°F).
- Display Standards for Strip Chart Recorders—The scale deflection of the chart cannot be less than 0.10 inches for each degree Fahrenheit, and not less than 5 mm for each degree Celsius. A print interval of approximately 2 minutes and a chart speed near 5 cm per hour is usually satisfactory.

The chart scale shall be graduated with major scale marks at every degree, and minor scale marks at every 0.2 of a degree.

Temperature values for each sensor must print at least once every hour.

Each symbol on the print wheel must correspond to and identify the sensor it represents.

Charts have to be of sufficient length to display a complete treatment record during the voyage.

- Display Standards for Data Logger—For each sensor, the temperature value, location and/or identification, and test point print at least once an hour on continuous log sheets with identified temperature points accurate to one decimal place.

Each hourly entry must contain a clear, fully informative record including the date and time. Text may be preprinted, or printed at the time of each temperature printout.

- See **Appendix H** for a list of temperature recorders approved by APHIS for self-refrigerated containers.

Commercial suppliers for these recording instruments are listed under Temperature Recorders for self-refrigerated containers under USDA cold treatment regulations in Appendix H, Reference Guide to Commercial Suppliers of Treatment and Related Safety Equipment.

Temperature Sensors.

- Construction Standards: Sensors designated for fruit temperatures should have an outer sheath of 0.25 inch (6.4 mm) diameter, or less. The sensing unit must be located within the first inch of the sensor.
- Accuracy Standards: The sensors have to be accurate to plus or minus 0.15°C in the range of –3°C to +3°C or within plus or minus 0.25°F in the range of +27°F to +37°F.

The sensors must show a steady indication of temperatures within three (3) minutes when immersed in a mixture of crushed ice and water.

- Identification: All sensors in the refrigerated compartments must be identified so as to distinguish the sensors in one compartment from those in others (e.g., A1, A2,. . ., B1, B2, . . ., etc.). A common letter designation is also required for twin deck compartments.

The sensors for each compartment have to be identified so that the air sensors are numbered first (e.g., A1, A2 — air; A3, A4, . . ., etc., — fruit pulp).

All sensors will be identified according to the assigned number from the recording system. This number must be placed on the box where the sensor is stowed or on the bulkhead near the sensor and on a permanent tag attached to the cable near the sensor.

A diagram illustrating the location and identification of every sensor by compartment should be posted adjacent to the recording instrument.

1. Location:
   - **A.** Air sensors—Sensors have to be located on the center line of the vessel approximately 30 centimeters from the ceiling.

Sensors must be attached in such a way that they do not touch the bulkhead and are protected from damage from the cargo.

Should be readily detachable and connected to cables at least 5 meters in length for ease of calibration.

One sensor has to be located on the fore and one on the aft bulkheads of each compartment. In the case of twin deck compartments, two sensors are required in the upper compartment plus one sensor in the lower compartment. This sensor is to be located on the bulkhead furthest from the cooling unit.

Shall be stowed in compartments to protect from damage when not in use.

B. Fruit sensors—Must be distributed throughout the compartment so that all areas of the compartment can be reached (5 to 15 meter cable lengths are usually sufficient).

2. Installation Standards: The equipment is to be installed in accordance with the highest standard of the classification society of concern.

The number, location, and identification of sensors will be specified in accordance with the submitted drawings of the refrigerated spaces.

The number of temperature sensors is based upon the cubic capacity of the compartment.

The following table can be used to determine the number of sensors required per compartment based on the cubic capacity:

Important

It is highly recommended that more temperature sensors be installed than the minimum number required for each refrigerated compartment. If a sensor malfunctions during a treatment, the Port Director has the option of disregarding it, providing that an additional working sensor is present, and the functional sensors were uniformly distributed. Otherwise, the entire treatment must be repeated for the fruit in that compartment.

Two of the sensors shall be designated as air sensors, and the others as fruit sensors. (See previous page for required locations.) Any sensors above the required minimum may be either fruit or air sensors.

For compartments exceeding 100,000 cubic feet, contact the Center for Plant Health Science & Technology (CPHST) for the minimum number of required sensors"

Cubic Capacities		
Cubic Feet	**Cubic Meters**	**Number of Sensors (Minimum)**
0 to 10,000	0 to 283	4
10,001 to 15,000	284 to 425	5
15,001 to 25,000	426 to 708	6
25,001 to 45,000	709 to 1,274	7
45,001 to 70,000	1,275 to 1,980	8
70,001 to 100,000	1,981 to 2,830	10

Integral Containers Used for Cold Treatment

General Requirements for Approval

Requests for approval of refrigerated containers must be made in writing to: USDA-APHIS-PPQ-CHPST, Center for Plant Health Science & Technology, 1017 Main Campus Drive, Suite 2500, NC 27606. The following specifications should be submitted for each container series for which approval is required (See container specification form in **Appendix A**):

- Container size
- Make and model of refrigeration unit
- Air flow type
- Air flow rate at 2 or more water pressures
- Controller type
- Adjustment capability and accuracy

Containers must have adequate refrigeration, insulation, and thermostatic control to precool and uniformly hold fruit temperatures at 2.2°C (36°F) or below for the entire treatment period.

Standards for Temperature Recording Instruments

Recording instruments to be used for cold treatments conducted in self-refrigerated containers must be approved by the Center for Plant Health Science & Technology (CPHST). When applying for approval, the specifications of the recorder and sensors must be submitted.

The readings of the instrument have to be accurate to within plus or minus 0.3°C of the true temperature in the range of –3°C to +3°C, or plus or minus 0.5°F of the true temperature range of +27°F to +37°F, with a resolution of 0.1°F or C°

Sensors also will have an outer sheath of .25 inch (6.4 mm) diameter or less. The sensing element must be located within the first inch (2.5 cm) of the sensor.

Sensors must be capable of collecting temperature data at least once every hour, and recording or storing data for up to 30 days.

System should have a visual display so that temperatures can be reviewed manually during the treatment, and for ease of calibration.

Printout must identify each sensor and indicate time and temperature. An identification number has to be printed so that the recorder and printout can be matched.

If the recorder is to be carried inside the container, the data should be accessible without opening the container.

At least three sensors are necessary for each container.

Warehouses Used for Cold Treatment

Requirements for Approval of Structures and Equipment

Fruit which have not received CT in transit may be treated in accordance with Quarantine 56 (7CFR 319.56-2d) in approved refrigerated warehouses. As with the intransit treatments, a temperature recorder is required to verify that the proper temperature be maintained for the specified period. In addition to the general requirements, warehouse approval is subject to specific geographical pest-risk considerations.

Firms interested in obtaining approval are required to submit specifications on the refrigeration units and recording equipment to the Center for Plant Health Science & Technology (CPHST). The performance survey, approval (see M390.480 and M390.610) and clearance of treated fruit, will be made by local PPQ inspectors. Cold treatment facilities are approved for 1 year from the date of inspection. Warehouse must be designed with adequate refrigeration, insulation and thermostatic control to precool and hold fruit temperatures at 2.2°C (36°F) or below for the entire treatment period. Proper design is necessary to assure good distribution of cooled air so that all parts of the warehouse are maintained at approximately the same temperature level.

The following information should be submitted when applying for approval.

1. Name and address of the firm owning the warehouse chamber and the address of the warehouse location.
2. A drawing of each warehouse, including dimensions, cubic capacity, and door locations.

Important

May be hand-drawn, but must clearly show location of refrigeration units, circulation fans, temperature recorder, and sensors.

3. The type, model, and year of the refrigeration system.
4. The type, model, and year of circulation system with specifics as to the number of air changes and direction of air flow.
5. The type of temperature recorders and sensors to be installed (must be USDA approved), see the section **Standards for Temperature Recording Systems**, under **Vessels Used for Intransit Cold Treatment**.
6. The number of sensors and length of the cable of each sensor. Cables have to be long enough so that all areas of the load can be reached.
7. The number of temperature sensing elements required per shipment will vary with the quantity of fruit. The minimum requirement is three (3) sensors—one (1) for measuring air temperature, and two (2) for measuring pulp temperatures. For each 10,000 ft^3 (283 m^3) of fruit or part thereof, another pulp sensor must be provided.

EXAMPLE: Fruit shipment totals 28,000 ft^3 (792 m^3) or 14,000 cases of 2 ft^3 (.6 m^3) per case.

First 10,000 ft^3 (283 m^3) 3 sensors (minimum)
Next 10,000 ft^3 (283 m^3) add 1 sensor
Next 8,000 ft^3 (226 m^3) add 1 sensor
Total 28,000 ft^3 (792 m^3) requires 5 sensors (minimum)

Important

If a refrigerated room is equipped according to the cubic capacity of the storage area (rather than of the load itself), the same criteria apply.

It is highly recommended that additional sensors be installed beyond the required minimum.

Methods of segregating fruit under treatment and securing it from unauthorized movement must be addressed.

6

Treatment Manual

Certifying Facilities

Certification of Hot Water Immersion Facilities

Contents

Introduction **page-6-5-1**
Preliminary Performance Testing **page-6-5-1**
Procedures for Conducting the Annual APHIS Performance Test **page-6-5-2**
List of Possible Ideas to Try If a Hot Water Immersion Tank Fails Its Performance Test **page-6-5-4**
Address for Technical Contact **page-6-5-5**
Protocols for Foreign Treatment Facilities **page-6-5-5**

Introduction

Quarantine treatment by immersion in hot water is used primarily for fruits that are hosts of tropical fruit flies. Exposing the fruit to a temperature of at least 115°F (46.1°C) for specific periods of time (depending upon the specific pest, type of fruit, and size of fruit) constitutes a quarantine treatment. The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) incorporates this principle of insect control into its regulations to facilitate the importation or interstate movement of certain fruits from areas where tropical fruit flies are the significant pests of concern.

Commercial facilities using hot water immersion treatment are subject to USDA-APHIS, certification on an annual basis. More frequent tests may be required at the option of APHIS. APHIS certification is given solely in conjunction with quarantine treatment requirements.

Important

The certifying official shall check with the manager of the facility to be sure that he is aware of the requirement for using potable water. Whenever water comes into contact with fresh produce, the water's quality dictates the potential for pathogen contamination. To reduce the risk of food- borne illnesses, the water used for washing, treatments, and cooling must be fortified with sodium hypochlorite (household bleach), and constantly maintained at a chlorine level between 50 and 200 ppm.

Preliminary Performance Testing

If the facility has not been previously certified by APHIS, the operators should conduct preliminary, informal performance tests on their own (together with an engineer, if needed), to assure themselves that their equipment is in good working order.

By trial and error, the manager of the facility should decide on a tentative temperature set point for their tanks. This should be done by immersing one or more full baskets of fruit into each tank, to be certain that the water temperature (nearest the fruit) reaches at least 115.0°F (46.1°C) within 5 minutes. A thermostatic set point for each tank is typically in the range of 115.8°F to 116.9°F (46.6°C to 47.2°C).

As an option, some hot water immersion systems use an initial higher set point for the first several minutes, then automatically drop to a lower set point for the remainder of the treatment. (If this programming option is used, the change to the second set point must be done automatically, not manually.)

Data from the preliminary tests need not be recorded on official forms. These data, however, must be presented to APHIS, as evidence that the facility is ready for the official performance test.

Once the facility has been officially certified, APHIS does not require the facility to present preliminary performance test data in subsequent years, except when there have been major engineering changes to the equipment.

Procedures for Conducting the Annual APHIS Performance Test

To approve the facility, the APHIS officer (or designated representative) shall take the following steps:

1. Compare the plans and drawings with the actual installation, if the facility has not been previously certified, or if modifications have been made since the last performance test. Plans and specifications must clearly show dimensions, water circulation, temperature sensing and recording systems, and safeguarding precautions.
2. Inspect the heating, water circulation, and alarm systems, and check to see that all necessary safeguards (including screens, fans, locks, and air curtains) are secure and operational.
3. Calibrate the portable sensors, recording the results on APHIS form 205 (or a plain sheet of paper). Using a factory-calibrated, glass mercury thermometer as the standard, compare the reading of each portable sensor to the standard, and record any deviation. To facilitate this process, a specially designed, portable temperature calibrator may be used, which uses either hot air or a swirling hot water bath, set at about the temperature at which treatments will take place. A treatment tank may also be used for this purpose, provided that the water is kept in motion.

4. Check the calibration of the tank's permanent RTD sensors, and record the results on APHIS form 206.
5. Conduct a performance test (at least annually), during an actual treatment (as described below), to determine (or verify) a temperature "set point" for the system, and to determine the minimum duration of time required between the immersion of successive baskets of fruit within the same tank.
6. To prepare for the performance test, the APHIS officer shall tape the cord of 3 or 4 portable "water temperature sensors" to the skin of selected fruits in each basket. (Do not cover the end of the sensor with tape.)
7. Insert a portable "pulp temperature sensor" approximately 1 cm into the flash of one or more fruits in the tank. Hold them in place with tape. *It is not necessary to have a pulp temperature sensor in each basket.*
8. The fruit should be at ambient temperature (70°F or above) immediately prior to the performance test. However, if the operator chooses to pre-warm the fruit by artificial means, then this routine must be noted as a condition of approval, and must also be followed for each commercial treatment following certification.
9. On the location diagram (APHIS form 207), show the relative position of each portable sensor used in the test, and indicate whether it is a "water" or a "pulp" sensor. Each should be numbered.
10. While the fruit are immersed in water, the APHIS officer shall use an electronic thermometer to monitor the temperatures of each portable sensor at various times throughout the test. (Record this information on APHIS form 208 for each tank.) As a second option, a portable, automatic recording instrument may be used. It must, however, operate independently from the temperature recording system installed at the facility.
11. During the performance test, the operator lowers the baskets of fruit into the hot water immersion tank. The "water temperature sensors" are closely monitored during the first 5 minutes of treatment. APHIS requires that the temperatures of all "water temperature sensors" must reach at least 115°F (46.1°C) within 5 minutes. If not, then the test must be repeated, using other fruit, using a slightly higher water temperature set point, and/or a slightly longer time interval between subsequent basket immersions, in order to achieve the 5-minute temperature recovery requirement, The test should be run for the full duration (up to 90 minutes, depending upon fruit size). During that time, all "water temperature sensors" must read at least

115°F (46.1°C) at the 5 minute point and beyond. In addition, the "pulp temperature sensor" (or sensors) must read at least 113°F (45°C) *by the end of the test.*

Important

It should be noted that APHIS standards for passing the official performance test are higher than the standards accepted for commercial treatments. This is intentional. *During commercial treatments* of mangoes, the water in the tank is allowed up to 5 minutes to reach the minimum treatment temperature of 115°F after the fruit have been submerged.

Important

The mango hot water schedules also have a built-in tolerance for subnormal temperatures in the range of 113.7°F to 114.9°F for up to 10 minutes (in the case of 65 or 75-minute treatments), or 15 minutes (in the case of 90-minute treatments). This tolerance was designed to "save" an ongoing treatment during an emergency situation such as an electrical power outage. However, *for purposes of the official performance test*, all water temperature sensors are required to read at least 115.0°F within the first 5 minutes, and to maintain temperatures at or above that threshold during the remainder of the treatment.

12. Submit all supporting documents to the APHIS-Regional Office (or to another APHIS office delegated by the Region), for issuance of a Certificate of Approval (PPQ form 482). APHIS will certify the facility only when all requirements are met, including *two* successful hot water immersion treatments in each tank, using standard fruit loads. For annual recertification, however, only *one* successful performance test is required per tank, unless the Work Plan requires additional tests.

List of Possible Ideas to Try If a Hot Water Immersion Tank Fails Its Performance Test

Ideas usually not requiring an engineer to implement:

Cages (baskets) holding the fruit:

- In tanks that use more than one basket (cage), try submerging the cages of fruit in a different order, such as leaving vacant water space between subsequent cages.
- Require a longer period of time between submerging each basket (for example, 15 minutes instead of 8).
- Require operating the tank at less than full capacity, including:
  - Immersing fewer baskets at a time.
  - Immersing fewer crates per baskets.
  - Filling crates less full.

Temperature measurement:

- Require a higher thermostatic set-point.
- Recalibrates or replace any faulty sensors (permanent sensors in the tank, as well as portable sensors used in the performance test).

Ideas that usually require an engineer to implement:

- Replace the existing boiler with one that has a higher capacity. (1,000,000 B.T.U. is typical for large multi-basket tanks.)
- Redesign the baskets or crates to allow a greater water flow around the fruit.
- Propellers used in water circulation—increase the blade size; increase their number; change their position within the tank; increase the speed (rpm).
- Water delivery pipes—increase their diameter; change their location.

Address for Technical Contact

Center for Plant Health Science & Technology
USDA, APHIS, PPQ, CHPST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606

Tel: 919-513-2496
Fax: 919-513-1995

Protocols for Foreign Treatment Facilities

This section includes the protocol for requesting approval of new hot water immersion treatment facilities in countries wishing to export fruit to the United States.

1. Fruit exporter applicants contact the national plant protection service of the exporting country, indicating his interest in constructing a hot water immersion treatment to treat fruit for export to the U.S.
2. The national plant protection service government of the exporting country studies all proposals, makes its selection(s), and issues an official invitation to the appropriate Area or Regional Office of the United States Department of Agriculture, Animal & Plant Health Inspection Service, International Services (USDA-APHIS-IS) to participate in a preclearance program. (It

must he emphasized here that it is the government of the exporting country, not APHIS, that makes the final selection among the various applicants wanting to construct hot water immersion treatment facilities.)

3. APHIS responds to the host country's invitation by:

   A. First, completing a new pest risk analysis for the requesting country (if not previously done). If surveys for mango seed weevils or other internal feeding insects will be required, this fact will be made known to the national plant protection service making the request, as well as guidelines and techniques for conducting an acceptable survey.

   B. Then, writing a Work Plan. This plan must include provision for a trust fund agreement to pay the salary and expenses of APHIS personnel assigned to certification and/or pre-clearance duties. This agreement must be in place before any APHIS representatives may be sent to the exporting country.

4. The national plant protection service of the host country notifies the candidate fruit exporters of their selection or non-selection, for participating in the program.

5. Companies, upon being notified of their selection to participate, then individually contract with engineering firms of their choice, and draw up detailed plans and drawings.

6. Exporters then submit detailed plans and drawings to the Area or Regional APHIS Office through the national plant protection service of the Ministry of Agriculture of the country of origin. At least three copies of the plans and drawings must be submitted. The ministry retains one copy and forwards two copies to APHIS.

Important

APHIS will return (without action) any unsolicited plans that are received directly from exporters or engineering firms. Correct protocol requires that all proposals, plans and drawings must be submitted through, and be recommended to APHIS by the Ministry of Agriculture. The two copies that APHIS receives should either be written in English, or have an English translation attached.

7. The APHIS Area or Regional Office considers the accessibility of the location proposed for facility construction. Depending upon availability and workload of trained APHIS inspectors required to monitor treatments, APHIS sets a limit on the number of facilities it will be able to monitor in each country.

Important

The ideal location for a hot water immersion treatment facility should be near an international airport or seaport, and not far removed from production areas. Availability of adequate temporary lodging for an APHIS inspector (PPQ Officer) should also be considered.

The APHIS Area or Regional Office corresponds with the fruit exporter applicant and engineering firm, as needed, keeps a file copy of each proposal, and submits (for technical comment) a second copy to:

Center for Plant Health Science & Technology
USDA-APHIS-PPQ-CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Religh, NC 27606

8. A specialist at CPHST analyzes the plans and drawings for technical compliance with APHIS requirements, and corresponds, as needed, with the engineering firm and exporter applicant.

CPHST notifies the APHIS Area or Regional Office that plans are technically approved or need modification.

9. APHIS Area or Regional Office notifies the potential fruit exporter applicant and the host country government that the proposed plans are technically approved or disapproved, and what modifications are needed, if any.

Important

Once APHIS has granted approval to begin construction, we may later revoke our approval if the applicant has not completed construction within two years. In that case, the fruit exporter applicant may initiate another application, but must begin again at Step 1.

10. The engineering firm and potential fruit exporter applicant make any required modifications on the equipment, and notify CPHST and the APHIS Area or Regional Office when this has been accomplished. They then request an official visit for the purpose of inspection, testing, and certification. Included in the request should be a proposed time frame. At its option, the facility may call APHIS for an inspection when construction is 75% complete. This is not a requirement. An APHIS officer is not required until the facility is ready for its performance test.

Important

In selected cases, a specialist from CPHST will be dispatched to do the inspection and initial performance testing. This requires an advanced notice of at least 2 to 3 weeks, to arrange for preparation of the travel authorization, passport, visa, country clearance, and airline tickets. *All costs, including salary, per diem, and travel shall be charged to the trust fund, which shall be paid in advance by the fruit exporter applicant.* In cases in which the equipment being installed is judged not to be unique, then another experienced officer from APHIS shall be assigned this duty (in which case, skip to Step 13).

11. The APHIS Area or Regional Office confirms that all agreements are properly signed and the trust fund is in place, then notifies CPHST of the proposed date for official inspection and performance testing of the new facility.

12. CPHST acknowledges the proposed date, or proposes a different date that would be mutually convenient, and takes steps to secure the needed travel documents. CPHST then requests the exporter or engineering firm to do at least one preliminary performance test on their own. Instructions shall be provided, as needed. (Note: The notification to CPHST must come from the appropriate APHIS office, and not from the engineering company or facility manager.)

13. The engineering firm or exporter sends the results of their preliminary performance test to the APHIS Area or Regional Office, who may, if necessary, fax copy to CPHST. An APHIS officer need not be present to oversee a preliminary performance test.

14. Upon receiving the data from the preliminary performance test, APHIS and CPHST analyze the data to determine acceptability. If acceptable, APHIS then sends an officer to serve on temporary duty at the new facility.

15. Two or more official performance tests are conducted at the hot water immersion treatment facility, under the on-site direction of an APHIS inspector or a specialist from CPHST. These tests will require the following:

A. The presence (on site) of a representative of the engineering firm that constructed the facility.

B. Several packinghouse employees (including at least one who speaks English), including a forklift operator, a hoist operator, someone to monitor the temperature recorder, and a crew to load and unload baskets, weigh fruit, monitor the stopwatch, and assist in the placement and removal of portable temperature sensors.

C. Enough fruit to run two or more tests (per tank) at full-load capacity. The fruit should be of uniform size and shape.

D. Two dozen portable temperature sensors with leads at least 10 ft. in length, and a hand-held digital thermometer (or computerized recording system), an accurate scale for weighing individual fruit, and an immersible certified calibrated glass thermometer for reading water temperatures.

E. Pending the outcome of the inspection and performance tests, the new facility may be certified. An official Certificate of Approval (PPQ form 482) ll be issued by the APHIS Regional or Area Office, or by the APHIS officer on site.

Important

Fruit used during the performance tests must be adequately safeguarded if they are to be exported to the U.S., but shipment must await the arrival of the assigned APHIS inspector, who will issue the preclearance document (PPQ form 203) to accompany each shipment. If this is impractical, then these fruit may be sent to other markets.

16. The APHIS officer running the official performance tests notifies (by telephone) the APHIS Area or Regional Office of the results (pass or fail). In case of failure, the operator of the facility should make the required adjustments or improvements, then call APHIS to conduct another official performance test at a later date.

17. Assuming that the performance tests were successful, the following chain of events will quickly occur.

A. The APHIS Area or Regional Office notifies the Preclearance Coordinator (USDA, APHIS, PPQ, Quarantine Policy, Analysis and Support (QPAS), Riverdale, Maryland) of treatment facility approval.

B. The Preclearance Coordinator notifies the Permit Unit, (PPQ, APHIS, Riverdale, Maryland) of treatment facility approval.

C. The Permit Unit notifies (by electronic mail) all PPQ field offices at U.S. ports of entry. Ports expected to receive immediate shipments may be notified by telephone. The Permit Unit also issues any pending permits to the respective fruit importer(s) in the U.S.

D. APHIS will dispatch an inspector to monitor hot water immersion treatments of fruit for export to the U.S. PPQ inspectors are generally assigned to this duty on a 30 to 60-day rotating basis.

E. Their salary, transportation, and living expenses are borne by the fruit exporters, through a formal trust fund agreement arranged in advance. All commercial treatments and shipments to the U.S. must be done under the monitoring of the inspector assigned to a particular treatment facility (or to 2 or more facilities located within 5 km of one another).

Important

In countries that have special agreements with the U.S., including Mexico and Haiti, APHIS may hire and train a local national to monitor treatments. In the special case of Puerto Rico, where APHIS has a large presence, local PPQ Officers will be assigned to monitor. In other countries, an inspector from the U.S. will be sent on temporary duty.

Important

APHIS may temporarily withdraw its inspector from a facility for many valid reasons including the facility' s failure to comply with instructions, or attempting bribery. Our inspector may also be withdrawn for reasons of personal safety, including threats, civil unrest, a disease epidemic such as cholera, or a natural disaster.

F. The inspector who monitors the performance tests will depart after this task has been accomplished. Upon request, however, he/she may remain on site for another day, if needed, to provide a smooth transition for another inspector newly assigned to the facility.

Important

APHIS is a regulatory agency of the U.S. Department of Agriculture. We are not a funding agency and cannot become involved in financing proposed commercial ventures. Financial arrangements are the sole responsibility of the exporter in cooperation with his investors.

Important

APHIS reserves the right to limit the number of hot water immersion treatment facilities which we approve in each country. We do this because we currently have only a small number of inspectors technically trained in all aspects of monitoring hot water immersion treatments. During the fruit export season, our inspectors are much in demand.

6

Treatment Manual

Certifying Facilities

Certification of Forced Hot Air and Vapor Heat Treatment Facilities

Contents

Introduction **page-6-6-1**
Procedures for Conducting the Official Performance Test for Certification **page-6-6-2**
Calibrating the portable sensors **page-6-6-2**
Calibrating the permanent sensors installed in the chamber **page-6-6-2**
Conducting an actual test treatment **page-6-6-3**
Conducting an actual test treatment **page-6-6-3**
Frequency of performance testing **page-6-6-3**

Introduction

Commercial facilities using FHA[1] or VH treatment are subject to certification by an APHIS Inspector on a yearly basis, usually at the beginning of the shipping season. Certification is given solely in conjunction with quarantine treatment requirements. However, certification may be refused because of safety deficiencies at the plant (for example--open motors with exposed gears; unprotected fan belts within 6 ft of the floor level; or for sanitary or phytosanitary reasons). Certification may also be refused if any required repairs or modifications to the quarantine zone have not been done.

Preliminary Performance Testing

If the facility has not previously been officially certified, the operator must conduct preliminary, unofficial performance tests on his own and APHIS, that his equipment is in good working order. By trial and error, the operator shall establish a tentative temperature set point for the FHA or VH chamber, such that the fruit center temperature will reach the treatment temperature within a reasonable period of time. The operator shall do at least one trial treatment, with sensors placed in various parts of the load, to determine where the coolest spots occur. (For purposes of this test, the load in the FHA or VH chamber must contain fruits, though not necessarily of export quality.) At the option of APHIS, the operator of the facility may be required to conduct a preliminary performance test at the beginning of each shipping

1 Forced hot air (FHA) is also referred to as high-temperature forced air (HTFA).

season. The resulting data are submitted to APHIS with written comments, as evidence that the FHA or VH chamber is ready for its official performance test.

Procedures for Conducting the Official Performance Test for Certification

The official performance test has three basic steps: (1) calibrating the portable sensors; (2) calibrating the permanent sensors installed in the FHA or VH chamber; and (3) conducting an actual test treatment. These three steps are discussed below, in detail.

Calibrating the portable sensors

Using a factory-calibrated, certified glass-mercury thermometer (readable in tenths of a degree) as the standard, compare the reading from each portable sensor to the standard, and record any deviation. To facilitate this process, a specially designed portable sensor calibration device) preferably a swirling hot water bath) should be used. Calibration should be done at or near the required treatment temperature (not in an ice-water bath.)

Identify which sensor with a unique number or letter, and record the correction factor for each one. Any sensor that deviates by more than plus or minus 0.5° F (0.3° C) from the standard shall not be used.

NOTICE

If cordless sensors are used, these are already factory-calibrated, and require no further calibration by the user.

The number of portable sensors required during the test shall be at least one half (1/2) of the number of permanent sensors required to be installed in the chamber.

NOTICE

It is also permissible to substitute additional permanent sensors for portable sensors, provided that the temperature recorder is capable of monitoring them.

Calibrating the permanent sensors installed in the chamber

Calibrate the permanent sensors in the same manner as for the calibrating the portable sensors. A portable sensor (with a “zero” correction factor) may be used instead of the certified glass thermometer as the standard against which the permanent sensors are compared. Permanent and portable sensors must both pass the same high standard of accuracy.

Conducting an actual test treatment

To prepare for the test treatment, the APHIS Inspector shall insert the numbered portable and permanent sensors into fruits. Portable sensors may be placed anywhere in the load, with attention given to sites where the coolest spots are most likely to occur.

NOTICE

Portable and permanent sensors shall not be placed in the same fruits, but may be in the same trays.

- Draw a three-dimensional diagram showing where each numbered sensor has been placed. Have the operator place the fruit into the FHA or VH chamber, close the door, turn on the heat generator, and start the automatic temperature recorder.
- Take readings on the portable sensors at least once every 5 minutes.
- Note how many minutes it took for the warm-up period to be completed.
- Run the “dwell time” portion of the treatment, and hold it for the minimum amount of time required by the particular treatment schedule.
- Review all temperature records from the portable as well as permanent sensors. If the treatment was successful, the attending APHIS Inspector shall initial the chart. Remove all sensors. Allow the operator to move the fruit to the quarantine zone, where it can be cooled (optional), sorted, and boxed.

One successful test is required, for certification or recertification. When all requirements have been met, APHIS will issue a Certificate of Approval (PPQ form 482 or equivalent).

Frequency of performance testing

A new performance test shall be required (1) at least once a year (usually at the beginning of the shipping season), and (2) whenever the FHA or VH chamber has been out of service for 10 days or more.

NOTICE

Additional performance tests are not required for each type or size of fruit, nor when the operator wishes to vary the delivery air temperature, blower speed, or column height. This is because a successful treatment is based solely upon pulp temperature.

In addition the FHA or VH chamber’s permanent sensors shall be recalibrated daily (on days when the chamber is in use) and whenever sensors are replaced.

6

Treatment Manual

Certifying Facilities

Certification of Niger Seed Treatment Facilities

Contents

PPQ Regulation Policies Governing the Entry of Niger seeds into the United States **page-6-7-1**
The Certification Process **page-6-7-1**
Approval of engineering construction plan **page-6-7-1**
Requesting certification for a treatment plant. **page-6-7-2**
Performance test for a Niger seed treatment facility. **page-6-7-2**
Minimum standards and specifications **page-6-7-3**
Actions Required During Plant Certification **page-6-7-4**
Certification (approval) of a Treatment Facility. **page-6-7-4**
Quality Assurance **page-6-7-5**

PPQ Regulation Policies Governing the Entry of Niger seeds into the United States

Seeds of Guizotia abyssinica (Niger seed) from any foreign place, at or before the time of arrival at the port of first arrival, shall be heat treated for possible infestation with noxious weeds or prohibited pathogens in accordance with the applicable provisions of PPQ's Treatment Manual.

The Certification Process

Certification of a niger seed treatment facilities includes the following steps:

1. The facility submits an engineering construction plan
2. APHIS approves the engineering construction plan
3. The facility formally requests certification
4. APHIS conducts a performance test for certification
5. APHIS makes final approval for certification and issues a Certification of Approval (PPQ From 482)

Approval of engineering construction plan

Plans and specifications showing dimensions, capacity, heating units and temperature time recording system must be sent for approval through the appropriate State officials and through Center for Plant Health Science & Technology, Raleigh, NC (Foreign treatment facilities must be constructed to meet foreign standards). The equipment must

be designed in a manner to hold the temperature at or above temperatures prescribed in the treatment schedule for heat treatment of niger seed (T412-a). When the engineering plans are approved, the treatment plant will be constructed accordingly. Any modification of the original plans, will require advanced approval in writing from PPQ.

Requesting certification for a treatment plant.

To obtain certification from APHIS, a Niger seed treatment plant should submit a written request to the APHIS. The request should include the following:

- Listing of names, addresses and phone numbers of the facility, facility manager or supervisor and plant construction engineer,
- Assurance that the facility manager accepts responsibility for facility operations
- Assurance that required equipment is on site
- Data from at least two preliminary performance tests indicating that the plant meets performance requirements for certification, including copies of completed treatment sheets and related temperature printout sheets for test treatments.

Important

The appropriate permits and approval to import niger seeds for tests must be approved by PPQ Permit Unit prior to shipment of the commodity to the United States.

Performance test for a Niger seed treatment facility.

Initial certification/performance testing will be conducted by CPHST (Center for Plant Health Science and Technology) in conjunction with PPQ. CPHST may delegate this responsibility to others for the purpose recertification.

Equipment/materials needed by APHIS or its designee to conduct facility performance tests for certification.

The facility must supply the following equipment and materials to conduct a performance test for certification:

- Copy of plans and specifications showing dimensions and other details of heating and temperature recording systems.
- Certified calibrated thermometer (temperature range to at least 270° F (132.2° C))
- Stop watch and tape measure
- Temperature recording system to record temperature and processing time.

Minimum standards and specifications

To qualify for certification/recertification, the facility must meet the following minimum standards and specifications:

- Temperature probes (a minimum of 2) situated in the heat treating equipment in such a way as to determine when the niger seeds reaches the target temperature. Probes or sensors shall be placed in the commodity in order accurately record commodity temperature.
- Temperature recording chart shall be in increments of not less than 0.10 inch for each degree F. (or 5mm for each degree C)
- Temperature readings shall be recorded on a chart in time intervals not to exceed four minutes between each reading.
- Accuracy of the total temperature recording system shall be within plus or minus 0.5 degree F. (0.3 degree C.) of actual temperatures as measured with a certified calibrated thermometer.
- Speed indicator shall be present for continuous flow systems.
- All the valves and controls that affect heat flow to the treatment system shall be secured to avoid manipulation during the treatment process by unauthorized personnel.
- Heating controls shall be automatic and run continuously throughout the treatment process, manual adjustments are allowed.
- Gear systems used to control the niger seed conveyor (if applicable) shall be capable of being adjusted as needed to meet treatment requirements.
- An audible alarm or highly visible light shall be installed on burners or other equipment to indicate system failure and/or when not operating properly.
- A system shall be in place to divert any untreated niger seeds for treatment.
- An action plan shall be available to address any pests which may be associated with the storage, treatment and shipment of niger seeds.
- Proper sanitation measures shall be implemented to ensure that there are no potential breeding grounds for pests on the premises and therefore, little risk of re-infestation or cross-contamination.
- Treated seeds shall be stored in a location separate from the non-treated seeds. The treated and non-treated seeds shall be handled in a manner to prevent cross-contamination.

- Seed processing equipment shall have the capability to divert for re-treatment any non-treated, or treated seeds which do not meet treatment standards.

Actions Required During Plant Certification

Also, the facility must conform to the following operating procedures:

- Sufficient niger seeds for two (2) test runs at the maximum load for one (1) hour must be on hand for APHIS personnel overseeing the tests.
- All temperature sensing probes must be verified during the test runs or evidence provided that the probes have been calibrated by an official calibration company within a 12 month period.
- The temperature and conveyer speed must be verified to coincide with the readings taken during manual testing and calculation.
- Check the continuity of the system to verify the lack of any cross-contamination.
- Ensure that after treatment and cooling, the niger seeds are immediately bagged in new bags. The old bags must be treated or disposed of in a manner that will preclude regulated pests.

Certification (approval) of a Treatment Facility.

If treatment standards are not met during performance testing, APHIS will record the test as not acceptable for certification. A copy of the data sheet with explanation as to why the test was not acceptable, should be provided to the facility operator for corrective action.

Final approval of niger heat treating equipment will be given after two (2) consecutive successful runs of maximum capacity at the longest treating period consecutive successful runs of maximum capacity at the longest treating period (at least 15 minutes at 248 degrees F. minimum or 120 degrees C). Upon approval, APHIS will issue a Certification of Approval (PPQ form 482).

Important

Any compliance agreement/workplans or standards developed be APHIS for the facility must be adhered to. (See Dry heat Treatment Facilities for Niger seeds.)

Quality Assurance

PPQ will monitor by sampling the treated seeds periodically to find actionable contaminants. Every 25th lot after treatment is to be sampled according PPQ sampled protocol.

6

Treatment Manual

Certifying Facilities

Certification of Irradiation Treatment Facilities

Contents

Introduction **page-6-8-1**
Certification Requirements **page-6-8-1**
- Current Licence **page-6-8-2**
- Minimum Dosage **page-6-8-2**
- Biological Safeguards **page-6-8-2**
- Documented Training **page-6-8-2**
- Documented Procedures **page-6-8-3**

Request for Approval **page-6-8-3**
Site Approval Visit **page-6-8-3**
Certificate of Approval **page-6-8-4**

Introduction

To be authorized to apply approved phytosanitary irradiation treatments, an irradiation facility shall obtain a Certificate of Approval from USDA, and either into a binding Compliance Agreement with USDA and/or the official national plant protection organization (NPPO) in the country where located.

In general, approved facilities must be able to demonstrate that their equipment and personnel are able to deliver the minimum dose, safely, accurately, and consistently, to all components of the commodity, over the range of conditions expected for commodities treated. In addition, USDA may consider characteristics of each facility in assessing the degree to which unique physical and process specifications are necessary to ensure adequate safeguarding. The requirements for irradiation facility approval for overseas facilities shall be equivalent to those applied to facilities located in the United States. All approved facilities must agree, as part of the certification process, to immediately notify USDA of any problems, concerns, or irregularities in commodity treatments. USDA or its NPPO counterpart may conduct periodic quality assurance and operational scrutiny.

Certification Requirements

To receive a Certificate of Approval to treat commodities to mitigate regulated pests in commodities, the facility shall satisfactorily comply with the following five key elements described in this section:

1. Current Licence
2. Minimum Dosage
3. Biological Safeguards
4. Documented Training
5. Documented Procedures

Current Licence

The facility must be currently licensed by all relevant State, or appropriate National regulatory authorities.

Minimum Dosage

The facility must be capable of administering at least the minimum required absorbed ionizing radiation dose, as prescribed by USDA for the particular pest complex/commodity to be treated.

Biological Safeguards

The facility must be constructed so as to provide physical separation of untreated and treated commodities, ensuring biological security. If mobile pests (such as adult fruit flies) are the target, the commodity shall be in pest-proof containers or separated by a wall or by a screen with a mesh size fine enough to exclude flying insects. Retrofitting an established facility with a screen barrier or wall may not be a practical option. USDA may waive this requirement if one or more of the following three conditions apply:

- The irradiation facility is located in an area that would not support an infestation of the target pests
- The pests of concern are immobile
- The commodity to be irradiated arrives at the facility in pest-containment cartons.

Important

In all such cases, a physical separation of treated and untreated product is still necessary, and may consist (at the minimum) of a barrier sufficient to prohibit inadvertent movement of commdities, wherein commingling of treated and untreated products might occur.

Documented Training

Document the training of key employees on the operation of an irradiation processing facility, applicable to irradiation treatment of agricultural products. All personnel with treatment-related responsibilities shall have proper credentials, training, and authority for application of irradiation treatments. Appropriate records shall be made available for inspection by USDA officials, and/or by officials of the corresponding national plant protection organization, on request.

Documented Procedures

The irradiation facility shall be required to have well documented standard operating procedures (SOPs) defining the processing, handling, and safeguarding of regulated agricultural commodities. The SOPs shall be reviewed by the regulatory official during inspections, to ensure conformance to the Compliance Agreement, applicable treatment schedule(s), and other applicable regulations.

Important

For the purpose of expediency, the manager of the facility is advised to submit a letter to the certifying official, specifically addressing how the facility proposes to comply with the safeguards that will become part of the Compliance Agreement. (see Safeguarding Irradiation Treatment Facilities, **page-3-3-12**.)

Request for Approval

The request package shall address the five key elements listed in the certification requirements section. Applicants requesting approval of an irradiation processing facility for mitigating regulated agricultural pests shall submit the request, in writing, to:

Important

Center for Plant Health Science & Technology
USDA, APHIS, PPQ, CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606

The request should include a cover letter identifying the facility, operator, owner, and the individual who will be responsible for the Compliance Agreement. The latter person shall be physically located at the treatment facility and have full authority to ensure compliance with the conditions of the agreement. Attachments to the request should include a plan of the facility and an outline of the processes and procedures to be used by the facility to meet the requirements described above. This information shall be held in strict confidence.

Site Approval Visit

The certifying official(s) from USDA shall review all documents for completeness, and correspond with the applicant, as needed. When all documents have been approved, an official site approval visit will be scheduled. During this visit, the certifying official shall compare the floor plan schematic and product flow pattern with the actual installation, review the safeguards that are in place, and conduct an audit of treatment records (if any). The site approval visit may include

a representative from the host country's national plant protection organization (NPPO), if applicable, and may also include officials from other interested regulatory agencies.

Important

Following certification, the facility manager shall agree that USDA and/or NPPO officials may make spot checks from time to time at the facility. These visits may be either announced or unannounced.

Certificate of Approval

Upon approval of the facility, USDA shall issue a Certificate of Approval (PPQ form 482), outlining the terms, conditions, and restrictions of the approval. This certificate shall remain valid for one year unless revoked or withdrawn. Recertification shall be required annually, or whenever reinstatement is requested. Recertification shall not be required except in such cases where reinstatement is requested. The USDA approval status of all irradiation treatment facilities, both domestic and foreign, that apply treatments to mitigate regulated agricultural pests shall be tracked by:

Important

Center for Plant Health Science & Technology
USDA, APHIS, PPQ, CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606

7

Treatment Manual

Emergency Aid and Safety

Fumigation Exposure

Contents

Emergency Action—DO NOT HESITATE **page-7-1-1**
- You **page-7-1-1**
- Coworker **page-7-1-1**

First Aid With Rescue Breathing **page-7-1-2**

Signs, Symptoms, Emergency Aid, and Medical Treatment for Poisoning by Some Fumigants Used by APHIS **page-7-1-3**
- Chloropicrin **page-7-1-3**
- Methyl Bromide **page-7-1-3**
- Phosphine (From Aluminum Phosphide) **page-7-1-3**
- Sulfuryl Fluoride **page-7-1-3**

Fumigant Safety **page-7-1-4**

Guidelines for Using Fumigants Safely **page-7-1-6**

Emergency Action—DO NOT HESITATE

You

If exposed to fumigant, immediately move well away from the contaminated area. Notify your coworkers of the danger and that you have been exposed. Onset of symptoms may be delayed in some fumigants. Promptly notify your supervisor of all details.

If liquid fumigants have spilled on skin or clothing—immediately remove contaminated clothing and gently wash the skin with large quantities of water and soap. Do not use abrasive cloths or brushes. Be sure to include areas under finger and toenails. Contaminated skin may also be rinsed with rubbing alcohol.

Contaminated clothing must not be used again until thoroughly aired, washed, and dried. Dangerous vapors will be produced by the liquid fumigant as it evaporates from skin or clothing.

Coworker

If chemical intoxication due to exposure is at any time suspected:

1. Immediately move the victim out of the area to fresh air.

CAUTION

Do not enter contaminated areas without a proper respirator, even to effect rescue.

2. If there is evidence of respiratory weakness, give artificial respiration. Oxygen can be beneficial. **Artificial respiration takes precedence over all other first aid.** (See next page.)
3. Call a physician when symptoms suggest immediate care is needed.
4. Keep patient warm, comfortable, and as quiet as possible.
5. If convulsions occur, use gentle restraint and prevent injury.

First Aid With Rescue Breathing

If you think a person has stopped breathing, don't delay. Give first aid immediately. Ask someone else to get medical help.

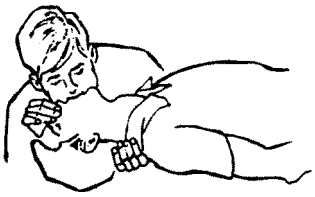
1. Is the person breathing?

To find out if the person is breathing, place him flat on his back and put your ear close to his mouth. If he is breathing, you will feel his breath and see his chest rise and fall.

2. Open the airway.

If the person has stopped breathing, lift up his neck with one hand and push down on his forehead with the other. This opens the airway and the person may start to breathe. If he doesn't, begin RESCUE BREATHING at once.

3. Rescue Breathing. Keep one hand under the person's neck so that his head is tilted backward with his chin up. Pinch his nostrils shut with the fingers of your other hand.



Take a deep breath and cover his mouth completely with yours. Blow air into his mouth. When his chest moves up, take your mouth away and let his chest go down by itself.

Repeat this procedure every 5 seconds. Do not stop until the person starts breathing or medical help comes.

Signs, Symptoms, Emergency Aid, and Medical Treatment for Poisoning by Some Fumigants Used by APHIS

Chloropicrin

Signs and Symptoms

Powerful irritant; affects all body surfaces, lacrimation, vomiting, bronchitis, pulmonary edema. Inhalation causes anemia, weak and irregular heart beat, recurrent asthmatic attacks.

Emergency Aid

Artificial respiration. Oxygen if available.

Medical Treatment

Symptomatic—oxygen. Sample analysis might be helpful in diagnosis and prognosis.

Methyl Bromide

Signs and Symptoms

Central nervous system depression, nausea, fever, dizziness, confusion, delirium, staggering, visual disturbances, abdominal pain, mania, tremors, pulmonary edema, convulsions, coma. ***Onset may be delayed 4-12 hours.*** On skin, severe irritations, skin blisters, dermatitis.

Emergency Aid

Artificial respiration. Oxygen if available. No mechanical resuscitation. If on skin, wash 15 minutes with large amounts of water. If on clothing, vapors may be released in toxic quantities.

Medical Treatment

Symptomatic—Artificial respiration, oxygen without mechanical resuscitator. Analysis of breath and blood may help in diagnosis and prognosis. Nausea, accompanied by vomiting. Give intravenous, glucose-bearing vehicles.

Phosphine (From Aluminum Phosphide)

Signs and Symptoms

2,000 ppm in air, rapidly fatal. Chest pain, headache, dyspnea, restlessness, vomiting, diarrhea, convulsions, coma, paralysis, low blood pressure, slow heart, death may be delayed several days.

Emergency Aid

Artificial respiration. Oxygen if available.

Medical Treatment

Symptomatic—oxygen; control convulsions with sedatives, restore fluid balance with glucose and saline.

Sulfuryl Fluoride

Signs and Symptoms

Central nervous system depression, excitation may follow.

Emergency Aid

Place patient in fresh air, face downward, with head slightly below level of lungs. Keep warm. If breathing stops, give artificial respiration.

Medical Treatment

First symptoms expected are those of respiratory irritation and central nervous system depression. Treat symptomatically.

Fumigant Safety

Specific precautions to be followed when using each of the fumigants are listed on the label and labelling. However, the following general safety procedures can be applied to most applications.

1. Hazards vary with:
   - **A.** Relative toxicity of each fumigant
   - **B.** Dosage rate (concentration)
   - **C.** Size of enclosure
   - **D.** Tightness of enclosure
   - **E.** Physical condition of employee (allergies, heart condition, respiratory ailments, etc.)
2. It is important to:
   - **A.** Know the characteristics of the fumigants you are working with
   - **B.** Have the proper equipment to carry out the fumigation
   - **C.** Be familiar with the emergency aid required should an accident occur
3. Wear protective equipment if there is a chance of exposure to highly toxic liquid fumigants.
   - **A.** Gloves should be impermeable to liquid fumigant being used
   - **B.** Rubber aprons should be long enough to prevent legs from being exposed
   - **C.** A face shield or respirator should be worn when liquids are being transferred and there is a possibility of splattering
4. Dispensers for measuring the amount of fumigant should have shatter-proof shields.
5. The area surrounding the fumigation enclosure should be well-aerated. Operators should be located upwind from treatment.
6. If it is necessary to stay in the area of a treatment, the air should be monitored to determine if harmful levels of the fumigant are present.

7. Under no circumstances should an inspector be exposed to concentrations above minimum safe standards. A self-contained breathing apparatus (SCBA) should always be readily available should an emergency develop.
8. A SCBA is required at all fumigation sites. Use of such respirators is mandatory for PPQ Officers when within 30 feet of tarpaulin fumigation or whenever TLV is exceeded (5 ppm for methyl bromide).. You must have a medical evaluation and clearance to use SCBA equipment. The evaluation must be performed by a physician or licensed health care professional. Also, you must follow OSHA standards for respirator use. (See APHIS Safety and Health Manual, Chapter 11, Section 3)
9. Wash hands and face after leaving area where toxic amounts of fumigants are being used.
10. Do not eat, drink, smoke, or carry tobacco in areas where fumigants are being used.
11. A first-aid kit equipped with the proper materials should be readily available at the treatment site.
12. Persons working regularly with toxic fumigants should have blood tests and physical examinations if warranted by supervisor's consultation with local medical authorities.
13. Have telephone numbers of local hospitals, doctors, and poison control centers prominently displayed.
14. Learn to recognize the signs and symptoms of fumigant poisoning. Training should be given to each inspector.
15. Supervisors should be aware of signs of fatigue. Risk of accidents increases in tired employees.

Guidelines for Using Fumigants Safely

Emergency-Rescue and respirator[1] for each of the fumigants is a SCBA.

TABLE 7-1-1: Fumigant Monitoring Devices and Sources of Exposure

Fumigant / Routes of Entry	Detector Unit or Monitoring Device	Sources of Exposure
Chloropicrin: Inhalation	None	Application of liquid, leakage from enclosure, aeration
Methyl bromide: Inhalation, skin	Gas detector tubes, Halide detector, T/C Unit	Cylinder connection, leaks in tarpaulin, applicators, aeration
Phosphine (from aluminum phosphide): Inhalation	Gas detector tubes	Application of pellets, leakage from enclosure, aeration
Sulfuryl fluoride (Vikane®): Inhalation	T/C Unit	Applicator and cylinder connections, leakage from enclosure, aeration

1 For use outside of enclosure only.

7

Treatment Manual

Emergency Aid and Safety

Pesticide Exposure

Contents

Emergency Action—DO NOT HESITATE **page-7-2-1**
- You **page-7-2-1**
- Coworker **page-7-2-1**

First Aid With Rescue Breathing **page-7-2-2**
General Symptoms **page-7-2-3**
- Mild Poisoning **page-7-2-3**
- Moderate Poisoning **page-7-2-3**
- Severe Poisoning **page-7-2-3**

Pesticide Safety **page-7-2-3**

Emergency Action—DO NOT HESITATE

You

If your clothing is soaked with pesticide, remove the contaminated articles quickly. Then gently wash the skin with large quantities of soap and water. Do not scrub the skin or use an abrasive cloth or brush. Include areas under your fingernails and toenails. Contaminated skin can also be rinsed with rubbing alcohol. Call or notify your supervisor or coworker immediately, giving full details of the incident.

Coworker

Move the victim well away from the contaminated area.

1. If there is respiratory weakness or **if breathing ceases, give artificial respiration immediately**. (See next page.)
2. Call a physician as quickly as possible. If you are alone, do not abandon the first-aid treatment.
3. Keep the patient as quiet as possible, warm, and comfortable.
4. When symptoms are moderate or severe and caused by organophosphate or carbamate poisoning, and if the patient is conscious, immediately give two atropine tablets (1/100 grain each). (See number 13 under Pesticide Safety, **page-7-2-3**). Then immediately contact the nearest medical help and request assistance, even if symptoms disappear.
5. If pesticide is splashed in the eyes, immediately wash with large volumes of clean water. Continue for at least 15 minutes.

6. If medical help cannot be obtained or is delayed, transport the patient to the nearest hospital, physician's office, or urgent medical clinic. If possible, use a radio or other means of communication to alert authorities and the hospital. Drive safely if you must transport a patient. Take the pesticide label or any available records of pesticides used and any other information which may aid in diagnosis and treatment.

First Aid With Rescue Breathing

If you think a person has stopped breathing, don't delay. Give first aid immediately. Ask someone else to get medical help.

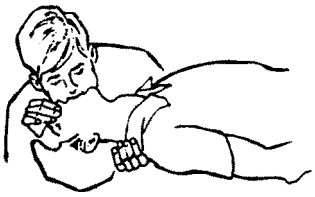
1. Is the person breathing?

To find out if the person is breathing, place him flat on his back and put your ear close to his mouth. If he is breathing, you will feel his breath and see his chest rise and fall.

2. Open the airway.

If the person has stopped breathing, lift up his neck with one hand and push down on his forehead with the other. This opens the airway and the person may start to breathe. If he doesn't, begin RESCUE BREATHING at once.

3. Rescue Breathing. Keep one hand under the person's neck so that his head is tilted backward with his chin up. Pinch his nostrils shut with the fingers of your other hand.



Take a deep breath and cover his mouth completely with yours. Blow air into his mouth. When his chest moves up, take your mouth away and let his chest go down by itself.

Repeat this procedure every 5 seconds. Do not stop until the person starts breathing or medical help comes.

General Symptoms

Mild Poisoning

Any discomfort can be an indication of mild poisoning or some other sickness. Individuals who are exposed to poison and who experience the following symptoms should be aware that more serious indications may follow.

Headache, fatigue, skin irritation, loss of appetite, dizziness, weakness, nervousness, nausea, perspiration, diarrhea, eye irritation, insomnia, thirst, restlessness, irritation of nose and throat, loss of weight, soreness of joints, changes of mood.

Moderate Poisoning

May be the beginning of severe symptoms. Nausea, trembling, muscular incoordination, excessive saliva, blurring of vision, feeling of constriction in the throat and chest, difficulty in breathing, flushed or yellow skin, abdominal cramps, vomiting, diarrhea, mental confusion, twitching of muscles, weeping, excessive perspiration, profound weakness, rapid pulse, cough.

Severe Poisoning

Vomiting, loss of reflexes, inability to breathe, uncontrollable muscular twitching, constriction of pupils (to pinpoint pupils), convulsions, unconsciousness, severe secretion from respiratory tract, fever, intense thirst, increased rate of breathing.

Pesticide Safety

1. Read the label before using any pesticide and follow precautions. If material is transferred to another container for application, a copy of the label should be kept near the dispersing point.
2. Use only proper tools for opening containers. Carefully open bags and use the proper tools to prevent pesticide from spilling onto your face or hands.
3. Pesticides should be opened in an area where any spills can be cleaned up properly. Mixing and pouring should be done in a well-ventilated place removed from other personnel. If there is a breeze, personnel should be upwind of any transfer of pesticides.
4. Pour pesticides properly. If an air vent is provided, use it.
5. A good supply of lime, coarse clay, sand, sawdust, or other absorbent material should be readily available.
6. Do not allow any person to work alone, especially when handling highly toxic materials.

7. Wear clean, dry, long-sleeved shirts and trousers made of cotton or any protective clothing as directed by the label.
8. Wear rubber gloves, well-fitted goggles, a rubber apron, and rubber boots when handling concentrates. Be certain the equipment is adequate for the task. Thin rubber gloves (disposable) should only be used once. An apron or gloves made of permeable material may be hazardous.
9. Be careful not to spill toxic chemicals on skin or clothing. If this happens, remove contaminated clothing at once and wash skin and clothing thoroughly. All operators should have available one change of clean clothes in case of accidental spillage.
10. Wash hands and face immediately after applying pesticide, before using toilet, and before eating, drinking, or smoking. Do not eat, drink, or carry tobacco in areas where pesticides are present.
11. Do not use mouth to siphon or to blow out nozzles or clogged lines, etc. on equipment. Do not put fingers in mouth or rub eyes while working with pesticides.
12. Never use arms to stir or to reach into a container of pesticides to retrieve tools or other accidentally dropped items.
13. When applying the more toxic organophosphates and carbamate insecticides, be prepared to contact a physician. In case of poisoning, the physician can prescribe atropine tablets. Also, read the label to learn what additional actions to take in case of poisoning—like giving liquids or inducing vomiting.
    - **A.** If symptoms from poisoning include blurred vision, abdominal cramps, or tightness in the chest, and if a physician is not readily available, then immediately have the patient transported to the nearest doctor, hospital, posion control center, or urgent care clinic, even is symptoms subside.
    - **B.** Further symptoms may include nausea, vomiting, diarrhea, pinpoint pupils, bronchial edema, muscle twitches, giddiness, drowsiness, confusion, difficulty in speech, and finally, coma.
    - **C.** The acute emergency lasts 24 to 48 hours. The patient should be under the observation of a physician during this period. Illness caused by carbamate poisoning does not last as long as organophosphate poisoning symptoms.
14. A supply of detergent soap, clean water, rubbing alcohol, skin lotion, and a nail file (if possible) should be readily available.

15. Persons working regularly with or frequently exposed to the more toxic organophosphate pesticides should have periodic cholinesterase level checks and physical examinations if warranted by supervisor in consultation with local authorities, and Chapter 7, APHIS Safety and Health Manual.

16. Respirators or filter masks with proper canisters approved or the particular type exposure noted in the label directions should be used when such pesticides are handled. Rubber boots may be needed in an area drenched with pesticides.

17. Know the limitation of the protective clothing and equipment, especially respirators.

18. Learn to recognize the symptoms of pesticide poisoning and know the first-aid measure to be taken in case of accident. Training in emergency measures should be given to all employees who work with pesticides.

19. Have the telephone numbers of local hospitals, doctors, or poison control centers prominently displayed.

20. Fatigue lowers the standards of pesticide safety. Key personnel should be aware that risk increases after long hours of work.

21. If an employee feels any sign of illness suspected as being due to poisoning, he should contact a doctor immediately. However, certain circumstances such as consuming large amounts of liquids following excessive heat exposure may cause nausea, vomiting, dizziness, and cramps. Such signs mimic pesticide poisoning.

7

Treatment Manual

Emergency Aid and Safety

Guidelines for Managing Pesticide Spills

Contents

Guidelines for Managing Pesticide Spills **page-7-3-1**
Introduction **page-7-3-1**
Emergency Spill Procedures **page-7-3-2**
- Identify Contacts and Telephone Numbers **page-7-3-3**
- Evaluate the Situation (Take care of people first!!!) **page-7-3-3**
- Safety and First Aid **page-7-3-3**
- Crash Notification **page-7-3-5**
- Contamination Control **page-7-3-5**
- Notification **page-7-3-6**
- Site Security **page-7-3-7**
- Cleanup Techniques **page-7-3-7**
- Decontamination **page-7-3-8**

Post-Spill Procedures **page-7-3-10**
- Disposal of Contaminated Material **page-7-3-10**
- Environmental Monitoring **page-7-3-10**
- Reporting **page-7-3-10**

Planning for Pesticide Spills **page-7-3-11**
State Hazardous Waste Management Agencies **page-7-3-12**
Accident or Spill Emergency Kit **page-7-3-17**
- Safety **page-7-3-17**
- Cleanup **page-7-3-17**

Introduction

This document provides instructions for dealing with pesticide spills during program operations. “Pesticide spill” refers to any unplanned spill or leakage into the environment that occurs during storage, use, transport, or disposal of pesticide. Examples include aircraft and surface vehicular crashes, jettisoning pesticide cargoes from the air, and leaks or other equipment failures. After a pesticide spill, the responsible program person should evaluate the situation and begin appropriate corrective measures. (Use **Figure 7-3-2** to identify your responsible program contact.)

The Officer-in-Charge (OIC), Contracting Officer’s Representative (COR), or other responsible program official should prepare a site-specific plan based on the generic plan, **Emergency Spill Procedures**. (See **Figure 7.4.1** for an abbreviated plan. Make a copy of this figure, and keep it for your pocket reference.) Prepare the plan

before program operations begin by filling in the names, telephone numbers, and other required information. Specific objectives of each plan include:

- Protecting people working in the spill area.
- Preventing or minimizing the risk of further pesticide exposure to people, animals, and the environment.
- Cleanup of the area and disposal or detoxification of residual material.
- Notifying Federal, State, and local government officials of the magnitude and details of the pesticide spill.
- Evaluation of the potential impact to the environment based on chemical residues found in environmental components.

Responsible Program Contact (Name)

(Work telephone number)

(Home telephone number)

IF A PESTICIDE SPILLS TAKE THE FOLLOWING STEPS:

1. **Evaluate**. (Take care of people first!!!)

2. **Safety and First Aid**. The most immediate concern is for the health and well-being of persons in and around the area.

3. **Call 911** for fire/rescue squad to obtain medical assistance for injured or contaminated persons.

4. **Contamination Control**. Consult pesticide label & MSDS for appropriate protective clothing and hazards (or **CHEMTREC Emergency Hotline (800) 424-9300**).

FIGURE 7-3-1: Abbreviated Spill Plan, Personal Reference Card (Wallet-size)

Emergency Spill Procedures

Use this section as your guide to prepare a site-specific plan for pesticide spills. (Please, complete the blanks for your specific program.) The following is a summary of factors you must consider when a pesticide spill occurs (details follow this summary):

- Identify Contacts and Telephone Numbers
- Evaluate the Situation
- Safety and First Aid
- Crash Notification

- Contamination Control
- Notification
- Site Security
- Cleanup Techniques
- Decontamination

Identify Contacts and Telephone Numbers

You must know who to contact and where to call if a pesticide spill occurs. **Figure 7.4.2** identifies preliminary information that you will need in case of an emergency. Fill in the blanks for your site-specific plan.

_____
(Program name)

_____
Responsible Program Contact (Name)

_____
(Work telephone number)

_____
(Home telephone number)

_____
Alternative Program Contact (Name)

_____
(Work telephone number)

_____
(Home telephone number)

FIGURE 7-3-2: Emergency Contacts for Pesticide Spills

Evaluate the Situation (Take care of people first!!!)

1. Injury/pesticide exposure. Go to **Safety and First Aid** (below).
2. Vehicle or aircraft crash. Go to **Crash Notification** (below).
3. Spill containment. Go to **Contamination Control** (below).

Safety and First Aid

The most immediate concern is for the health and well-being of persons in and around the area.

1. Call **911** for fire/rescue squad to obtain medical assistance for injured or contaminated persons.

2. Evacuate the immediate area, if necessary get upwind.
3. Remove injured people from the area. (Do not move a seriously injured person unless absolutely essential because of the risk of further injury.)
4. Consult the pesticide label and/or MSDS for appropriate protective equipment and hazards.
5. Administer first aid as necessary. See the pesticide's MSDS or contact the nearest poison control center. **Figure 7-3-3** identifies information that you will need in case of an emergency. Fill in the blanks for your site-specific plan.

_____
(Center Name)

_____
(Telephone)

FIGURE 7-3-3: Poison Control Center

6. Remove contaminated clothing and wash affected area with soap and water. If eyes are contaminated, flush with clean water.
7. If individuals experience pesticide poisoning symptoms (blurred vision, trembling, nausea, etc.) then transport them to the nearest medical emergency facility. **Figure 7-3-4** identifies information that you will need in case of an emergency. Fill in the blanks for your site-specific plan.

_____

_____
(Address)

_____
(How to get there)

FIGURE 7-3-4: Medical Emergency Facility

8. Eliminate sources of ignition (e.g., pilot lights, electric motors, gasoline engines, or smoking) to prevent the threat of fire or explosion from flammable vapors.

Crash Notification

1. If the spill involved a vehicle or aircraft crash, contact the local police (911) as soon as practical.
2. If the spill involved an aircraft crash, notify the nearest Federal Aviation Administration (FAA) office. **Figure 7.4.5** identifies information that you will need in case of an emergency. Fill in the blank for your site-specific plan.

_____
(Telephone number)

FIGURE 7-3-5: Federal Aviation Administration (FFA) Office

Contamination Control

1. Consult the pesticide label and/or MSDS for appropriate protective clothing and hazards (**or call the CHEMTREC Emergency Hotline at (800) 424-9300**).
2. Try to contain the spilled pesticide at the original site, and prevent it from entering streams, rivers, ponds, storm drains, wells, and water systems as follows:
   - **A.** If possible, reposition the pesticide container to stop further leakage.
   - **B.** Prevent the spill from spreading by trenching or encircling the area with a dike of sand, sand snakes, absorbent material, soil or rags.
   - **C.** If a liquid formulation spills, cover it with absorbent material; however, use absorbent sparingly, since it also becomes hazardous waste. Use no more than necessary.
   - **D.** If a dry formulation spills, securely cover it with polyethylene or plastic tarpaulin to prevent tracking or airborne spreading of dust.

Notification

1. Notify by telephone state officials and the PPQ regional office. Headquarters management will be notified through normal channels.
2. Contact the local Community-Right-To-Know or Emergency Planning Coordinator (often the Fire Marshall). **Figure 7.4.6** identifies information that you will need in case of an emergency. Fill in the blanks for your site-specific plan.

_____
(Name)

_____
(Telephone number)

FIGURE 7-3-6: Community-Right-To-Know or Emergency Planning Coordinator (Fire Marshall)

3. Call the CHEMTREC Emergency Hotline at **(800) 424-9300**.
4. Notify by telephone the National Monitoring and Residue Analysis Laboratory (NMRAL) in Gulfport, Mississippi, Area Code (601) 863-8124 or (601) 863-1813. NMRAL will provide any supplies needed for sampling environmental components.
5. If the spill involves a large area (4 hectares (10 acres) or more) or you judge that it could affect a large area through runoff or other movement, notify the State Fish and Game Department or equivalent through appropriate channels. **Figure 7.4.7** identifies information that you will need in case of an emergency. Fill in the blank for your site-specific plan.

_____
(Telephone number)

FIGURE 7-3-7: Fish and Game Department

6. If animal poisoning may occur, notify the Regional Veterinary Services (RVS) Office. **Figure 7.4.8** identifies information that you will need in case of an emergency. Fill in the blank for your site-specific plan.

_____
(Telephone number)

FIGURE 7-3-8: Regional Veterinary Services (VS) Office

7. If the spilled product is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) classified hazardous substance or a Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III classified extremely hazardous substance, spills of active ingredient exceeding the reportable quantities may be reportable (see Appendix 8 for information on determining whether to report).
8. If you are unsure as to reporting under CERCLA or SARA look at the product's MSDS or call the National Response Center **(800) 424-8802** for CERCLA, and for SARA call the at **(800) 535-0202**.
9. Notify your Regional Safety and Health Coordinator. **Figure 7.4.9** identifies information that you will need in case of an emergency. Fill in the blank for your site-specific plan.

_____
(Telephone number)

FIGURE 7-3-9: Regional Safety and Health Coordinator

Site Security

Secure the spill site from unauthorized entry by roping off the area and posting warning signs. If necessary, request assistance from local police. **Figure 7.4.10** identifies information that you will need in case of an emergency. Fill in the blank for your site-specific plan.

_____
(Telephone number)

FIGURE 7-3-10: Local Police

Cleanup Techniques

The following are general techniques. You should consult local hazardous waste officials, the pesticide's label, or its MSDS to determine specific cleanup and disposal techniques. (See State Hazardous Waste Management Agencies for a list of local hazardous waste officials.) **Figure 7.4.11** identifies information that you will need in case of an emergency. Fill in the blanks for your site-specific plan.

_____

FIGURE 7-3-11: Local Hazardous Waste Official

(Name)

(Telephone)

FIGURE 7-3-11: Local Hazardous Waste Official

Adequate cleanup of spilled pesticides is essential to minimize health or environmental hazards. When cleaning pesticide spills, **NEVER WORK ALONE**. Be sure to ventilate the area and use appropriate protective equipment. Clean up dry spills (dusts, wettable powders, granular formulations) as follows:

- Immediately cover powders, dusts, or granular materials with polyethylene or plastic tarpaulin to prevent them from becoming airborne. If outside, weight the tarp ends, especially the end facing into the wind. Begin cleanup operations by rolling up the tarp while simultaneously sweeping up the spilled pesticide using a broom and shovel or dust pan. Avoid brisk movements to keep the dry pesticide from becoming airborne. When practical, lightly sprinkle the material with water to minimize dust. Always use an approved dust mask or respirator when working with dry pesticide materials.
- Collect the pesticide and place it in heavy-duty plastic bags. Secure and label the bags, properly identifying the pesticide and possible hazards. Set the bags aside in a secured area for disposal.
- Clean up liquid spills by placing an appropriate absorbent material (floor-sweeping compound, sawdust, sand, etc.) over the spilled pesticide. Work the absorbent into the spill using a broom or other tool to force the absorbent material into contact with the pesticide. Collect all spent absorbent material and place into a properly labeled metal drum for disposal.

Depending upon the pesticide, the size of the spill, and local conditions, you may need to remove the top ∫-inch layer of contaminated soil with a shovel and dispose of it.

Decontamination

As soon as practical, decontaminate crashed aircraft, wrecked vehicles, and pavements. See the pesticide's MSDS or label for specific instructions. For aircraft, coordinate with investigating officials and FAA authorities. For automobile wrecks, coordinate with appropriate law enforcement agencies or investigative bodies.

Chlorine bleach, caustic soda (lye, sodium hydroxide) detergents, or burnt or hydrated lime effectively decontaminate most spill areas (see attached MSDS sheets for precautions when using these substances).

CAUTION

Use bleach or lye, but never both together since this combination may liberate poisonous chlorine gas. Lye or lime readily decomposes many pesticides, especially the organophosphates, and carbamates. Clean up and remove as much of the spilled pesticide as possible prior to applying any decontaminate. Allow 1 to 6 hours reaction with the decontaminate before using an absorbent material.

Spread decontaminates thinly and evenly over the spill area. Then, lightly sprinkle the area with water to activate the decontaminate. Repeat the cleanup procedures until all the spilled pesticide is removed.

Clean all equipment used for spill cleanup with detergent and appropriate decontaminates. Collect all used decontaminates and rinse water and place them in labeled metal drums. Place clothing and gloves that cannot be decontaminated in the drums for proper disposal.

It may also be necessary to completely remove and dispose of contaminated porous materials.

If pesticides have leaked or spilled on the soil, removal of the visibly contaminated soil (top 1-inch) may be required using a shovel. In such cases, place the contaminated soil in metal drums for disposal. Chemical analysis of monitoring samples may govern removal of additional soil.

Post-Spill Procedures

Disposal of Contaminated Material

You may contact the pesticide's manufacturers for specific instructions regarding their product. Also contact the State or Federal EPA office with jurisdiction over the pesticide spill location about disposal, and consult with the U.S. Department of Transportation (DOT) prior to shipping/transporting across state lines. Shipping by licensed transporters may be required.

In general, place contaminated materials in sealed leak-proof metal disposal drums. Label all drums properly and dispose of in an approved hazardous waste disposal facility (incinerator, landfill site, etc.) under current EPA or State permit. The pesticide's labeling and MSDS contain specific information concerning disposal.

Environmental Monitoring

After cleanup and disposal, if the pesticide spilled into the environment, collect environmental monitoring samples. See M390.1403, ***Collecting Environmental Monitoring Samples*** for specific instructions. Contact the Region and request an Environmental Monitoring Coordinator if you need help with sample collection.

Reporting

Report information regarding pesticide spills in accordance with the program's specific monitoring plan, and as required by state and federal law. In general, reports should include:

1. Detailed map with the site of the pesticide spill clearly marked.
2. Information on location, time, spill area, terrain, pesticide spilled, how spill occurred, and how managed.
3. Any other information the writer deems pertinent to the pesticide spill.

Upon completion of the chemical analyses NMRAL will report its findings to Technical and Scientific Services (TSS). TSS will include the spill residue data in its programmatic environmental monitoring report and distribute as appropriate.

Planning for Pesticide Spills

Pesticides vary in toxicity as described in the pesticide's labeling and MSDS. Actions taken following an accidental spill will depend upon the pesticide toxicity involved. Always consult the labeling and MSDS for your program's pesticides when planning for spills. Check the telephone book for the telephone number of the local poison control center and enter it on your plan.

The Environmental Protection Agency (EPA) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); Resource Conservation and Recovery Act (RCRA); and CERCLA or Superfund assigned the primary responsibility for enforcing safe pesticide use and disposal to most States. States may therefore acquire primary responsibility for determining pesticide spill, cleanup, and disposal procedures.

Not all States will perform or react to pesticide spills in the same way. Therefore the Port Director or COR should assist with cleanup, sample collection, sample analysis, securing affected area, etc. The Port Director or COR must monitor such activities to assure PPQ that the responsible parties take proper actions during and after a spill. Keep in mind that legal actions as a result of a pesticide spill may place liability on the cooperating Federal Agency.

Program Managers should inform the PPQ Assistant Regional Director's office of procedures to follow when pesticide spills occur within their jurisdictions so they may support field operations when needed. The Port Director, COR, or Senior Staff Officer for any given PPQ operation, is responsible for implementing pesticide spill procedures. These officers must be familiar with these guidelines and should make contingency plans for such pesticide spills in advance of field operations.

Useful information for completing your spill plan is found in the appendices to these guidelines. Copies of the MSDS (obtainable from the manufacturer) for your program's pesticides should be included in your spill plan.

State Hazardous Waste Management Agencies

When a pesticide spill occurs, you should consult local hazardous waste officials, the pesticide's label, and its MSDS to determine specific cleanup and disposal techniques. The following is a list of State Hazardous Waste Management Agencies:

ALABAMA
Land Division
Alabama Department of Environmental Management
1751 Congressman W. L. Dickinson Drive
Montgomery, Alabama 36130
(205) 271-7730

ALASKA
Division of Environmental Quality
Alaska Department of Environmental Conservation
P.O. Box 0
Juneau, Alaska 99811-1800
Program Manager: (907) 465-2666
Northern Regional Office (Fairbanks): (907) 452-1714
South-Central Regional Office (Anchorage): (907) 563-6529
Southeast Regional Office (Juneau): (907) 789-3151

AMERICAN SAMOA
Solid Waste Division
Environmental Quality Commission
Government of American Samoa
Pago Pago, American Samoa 96799
Overseas Operator (Commercial call (684) 663-2304)

ARIZONA
Office of Waste and Water Quality Management
Arizona Department of Environmental Quality
2005 North Central Avenue, Room 304
Phoenix, Arizona 85004
Hazardous Waste Management: (602) 257-6829

ARKANSAS
Hazardous Waste Division
Arkansas Department of Pollution Control and Ecology
8001 National Drive, P.O. Box 8913
Little Rock, Arkansas 72219
(501) 570-2858

CALIFORNIA
Toxic Substances Control Division
Department of Health Services
400 P Street, P.O. Box 806
Sacramento, California 95812-0806
(916) 324-1826

COLORADO
Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220
(303) 331-4830
Emergency Response: (303) 377-6326

CONNECTICUT
Hazardous Material Management Unit
Department of Environmental Protection
State Office Building
165 Capitol Avenue
Hartford, Connecticut 06106
(203) 566-5148

DELAWARE
Division of Air and Waste Management
Department of Natural Resources and Environmental Control
P.O. Box 1401, 89 Kings Highway
Dover, Delaware 19903
(302) 739-3672

DISTRICT OF COLUMBIA
Pesticides and Hazardous Waste Management Branch
Department of Consumer and Regulatory Affairs
Room 505
614 H Street, NW
Washington, D.C. 20001
(202) 404-1167

FLORIDA
Solid and Hazardous Waste Section
Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400
(904) 488-0190

GEORGIA
Land Protection Branch
Industrial and Hazardous Waste Management Program
Georgia Environmental Protection Division
Floyd Towers East, Suite 1154
205 Butler Street, S.E.
Atlanta, Georgia 30334
(404) 656-2833

GUAM
Hazardous Waste Management Program
Guam Environmental Protection Agency
P.O. Box 2999
Agana, Guam 96910
Overseas Operator [Commercial Call (671) 646-8863]

HAWAII
Environmental Management Division
Department of Health
Five Waterfront Plaza
500 Ala Moana Boulevard, Suite 250
Honolulu, Hawaii 96813
(808) 543-8225

IDAHO
Hazardous Materials Bureau
Department of Health and Welfare
1410 North Hilton Street
Boise, Idaho 83706
(208) 334-5879

ILLINOIS
Division of Land Pollution Control
Illinois Environmental Protection Agency
2200 Churchill Road,
P. O. Box 19276
Springfield, Illinois 62794-9276
(217) 782-6760

INDIANA
Office of Solid and Hazardous Waste
Indiana Department of Environmental Management
105 South Meridian, P. O. Box 6015
Indianapolis, Indiana 46204
(317) 232-7959

IOWA
Air Quality and Solid Waste Protection
Department of Water, Air, and Waste Management
Henry A. Wallace Bldg.
900 East Grand Ave.
Des Moines, Iowa 50319-0034
(515) 281-8852
(contact EPA Region VII, below, for Iowa generator ID#)
—or—
U.S. EPA Region VII
Hazardous Materials Branch
726 Minnesota Avenue
Kansas City, Kansas 66101
(913) 236-2888
Spills: (913) 236-3778
Iowa RCRA Questions, Toll Free: (800) 223-0425

KANSAS
Hazardous Waste Section
Department of Health and Environment
Forbes Field, Building 740
Topeka, Kansas 66620
(913) 862-1607

KENTUCKY
Division of Waste Management
Department of Environmental Protection
Frankfort Office Park
18 Reilly Road
Frankfort, Kentucky 40601
(502) 564-6716

LOUISIANA
Hazardous Waste Division
Office of Solid Waste and Hazardous Waste
Louisiana Department of Environmental Quality
P.O. Box 44307
Baton Rouge, Louisiana 70804-4307
(504) 342-1354

MAINE
Bureau of Oil and Hazardous Materials Control
Department of Environmental Protection
State House Station #17
Augusta, Maine 04333
(207) 289-2651
Spills, Toll Free: (800) 482-0777

MARYLAND
Hazardous and Solid Waste Management Administration
Maryland Department of the Environment
2500 Broening Highway
Baltimore, Maryland 21224
(301) 631-3343
Emergency:
(301) 225-5700 [Business Hours]
(301) 243-8700 [After Hours]

MASSACHUSETTS
Division of Hazardous Waste
Department of Environmental Protection
One Winter Street, 5th Floor
Boston, Massachusetts 02108
(617) 292-5589,-5851
Emergency Response:
(617) 292-5649 [Business Hours]
(617) 566-4500 [After Hours]

MICHIGAN
Waste Management Division
Hazardous Waste Program
Michigan Department of Natural Resources
Box 30038
Lansing, Michigan 48909
(517) 373-2730
Emergency Response: (800) 292-4706

MINNESOTA
Ground Water and Solid Waste Division
Minnesota Pollution Control Agency
520 Lafayette Road, North
St. Paul, Minnesota 55155-3898
(612) 296-7282
Emergency Response: (612) 296-8100

MISSISSIPPI
Hazardous Waste Division
Bureau of Pollution Control
Department of Natural Resources
P.O. Box 10385
Jackson, Mississippi 39289
(601) 961-5062
Emergency Response: (800) 222-6362

MISSOURI
Waste Management Program
Missouri Department of Natural Resources
205 Jefferson Street
Jefferson City, Missouri 65102
(314) 751-3176
Missouri Hotline: 1 (800) 334-6946

MONTANA
Solid and Hazardous Waste Bureau
Department of Health and Environmental Sciences
Cogswell Building, Room B-201
Helena, Montana 59620
(406) 444-2821
Emergency Response: (406) 444-6911

NEBRASKA
Hazardous Waste Section
Department of Environmental Control
P.O. Box 98922
Lincoln, Nebraska 68509
(402) 471-2186

NEVADA
Bureau of Waste Management
Division of Environmental Protection
123 West Nye Lane
Room 120
Carson City, Nevada 89710
(702) 687-5872
Emergency Response:
(702) 687-4240 [Business Hours]
(702) 885-5300 [Weekends]

NEW HAMPSHIRE
Waste Management Division
Department of Environmental Services
6 Hazen Drive
Concord, New Hampshire 03301-6509
(603) 271-2942

NEW JERSEY
Hazardous Waste Management Programs
Department of Environmental Protection
CN-028
Trenton, New Jersey 08625
Hazardous Waste Advisement Program:
(609) 292-8341
Emergency Response: (609) 292-7172

NEW MEXICO
Ground Water and Hazardous Waste Bureau
Environmental Improvement Division
New Mexico Health and Environment Dept.
1190 St. Francis Drive
Santa Fe, New Mexico 87503
(505) 827-2714
Emergency: (505) 827-9329

NEW YORK
Division of Hazardous Substance Regulation
Department of Environmental Conservation
50 Wolfe Road, Room 209
Albany, New York 12233-7250

NORTH CAROLINA
Hazardous Waste Section
Division of Solid Waste Management
Department of Environment, Health, and Natural Resources
P.O. Box 27687
Raleigh, North Carolina 27611-7687
(919) 733-2178
Emergency Response: 1 (800) 662-7956

NORTH DAKOTA
Division of Waste Management
Department of Health
1200 Missouri Avenue
P. O. Box 5520
Bismarck, North Dakota 58502-5520
(701) 221-5166
Emergency Response: 1 (800) 472-2121

NORTHERN MARIANA ISLANDS, COMMONWEALTH OF
Division of Environmental Quality
Department of Public Health and Environmental Services
Commonwealth of the Northern Mariana Islands
Office of the Governor
Saipan, Mariana Islands 96950
Overseas Operator 6984

OHIO
Division of Solid and Hazardous Waste Management
Ohio Environmental Protection Agency
1800 Watermark Drive/P.O. Box 1049
Columbus, Ohio 43266
(614) 644-2934
Emergency: 1 (800) 282-9378

OKLAHOMA
Waste Management Service
Oklahoma State Department of Health
P.O. Box 53551
Oklahoma City, Oklahoma 73152
(405) 271-5338
Emergency Response: (405) 271-8056

OREGON
Hazardous and Solid Waste Division
Department of Environmental Quality
811 S.W. 6th Avenue
Portland, Oregon 97204
(503) 229-5356
Emergency Management Response, Toll Free: (800) 452-0311

PENNSYLVANIA
Bureau of Waste Management
Pennsylvania Department of Environmental Resources
P.O. Box 2063
Harrisburg, Pennsylvania 17105-2063
(717) 787-9870

PUERTO RICO
Environmental Quality Board
P.O. Box 11488
Santurce, Puerto Rico 00910-1488
(809) 725-0439
—or—
EPA Region II
Air and Waste Management Division
26 Federal Plaza
New York, New York 10278
(212) 264-5175

RHODE ISLAND
Division of Air and Hazardous Management
Department of Environmental Management
291 Promenade Street
Providence, Rhode Island 02908
(401) 277-2797

SOUTH CAROLINA
Bureau of Solid and Hazardous Waste Management
Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201
(803) 734-5200
Emergency Response: (803) 253-6488

SOUTH DAKOTA
Division of Environmental Regulation
Department of Water and Natural Resources
523 East Capitol
Foss Building
Pierre, South Dakota 57501
(605) 773-3153
Emergency Response: (605) 773-3231

TENNESSEE
Division of Solid Waste Management
Tennessee Department of Health and Environment
701 Broadway
Customs House, 4th Floor
Nashville, Tennessee 37247-3530
(615) 741-3424
Emergency Response: (800) 262-3300

TEXAS
Hazardous and Solid Waste Division
Texas Natural Resources Conservation Commission
P.O. Box 13087, Capitol Station
Austin, Texas 78711
(512) 463-7760
Emergency Response: (512) 463-7727

UTAH
Bureau of Solid and Hazardous Waste
Department of Health
P.O. Box 16690
Salt Lake City, Utah 84116-0690
(801) 538-6170
Emergency: (801) 538-6333 [After Hours]

VERMONT
Hazardous Materials Management Division
Department of Environmental Conservation
103 South Main Street
Waterbury, Vermont 05676
(802) 244-8702
Emergency: (800) 424-8802

VIRGIN ISLANDS
Department of Conservation and Cultural Affairs
P.O. Box 4399, Charlotte Amalie
St. Thomas, Virgin Islands 00801
(809) 774-6420
—or—
EPA Region II
Air and Waste Management Division
26 Federal Plaza
New York, New York 10278
(212) 264-5175

VIRGINIA
Division of Technical Services
Virginia Department of Waste Management
Monroe Building, 11th Floor
101 North 14th Street
Richmond, Virginia 23219
(804) 225-2667
Hazardous Waste Hotline:
1 (800) 552-2075

WASHINGTON
Waste Management Programs
Department of Ecology
Mail Stop PV-11
Olympia, Washington 98504-8711
(206) 459-6316
Hazardous Substance Hotline,
In State: 1 (800) 633-7585
24 Hour Spill Hotline,
In State: 1 (800) 262-5990

WISCONSIN
Bureau of Solid and Hazardous Waste Management
Department of Natural Resources
P.O. Box 7921
Madison, Wisconsin 53707
(608) 266-1327
Hazardous Substances Hotline:
(608) 266-3232

WEST VIRGINIA
Waste Management Section
Division of Natural Resources
Department of Commerce, Labor, and Environmental Resources
1356 Hansford Street
Charleston, West Virginia 25301
(304) 348-5393
24 Hour Spill Hotline: (800) 642-3074

WYOMING
Division of Solid Waste
State of Wyoming Department of Environmental Quality
122 West 25th Street
Cheyenne, Wyoming 82002
(307) 777-7752
Emergency: (307) 777-7781

Accident or Spill Emergency Kit

The Port Director, COR, or their designee should have available a fully supplied pesticide emergency spill cleanup/decontamination kit with instructions for its use. The kit will have the label designation “For Use in Handling and Cleanup of Accident Pesticide Spills Only.”

Responsible officials should use their discretion as to what items will be stored in vehicles for immediate use. The following items should be immediately available for responding to a pesticide spill:

Safety

- First aid kit—bus and truck kit, (GSA #6545-00-664-5312, or equivalent)
- Fire extinguisher, 5-lb. size for class A, B, C fires

Cleanup

- One shovel, square-point, “D” handle (GSA 5120-00-224-9326, or equivalent)
- Twenty-five large, heavy-duty plastic bags with ties (GSA 8105-00-848-9631, or equivalent)
- Two pair, unlined vinyl rubber boots
- Four pair, disposable coveralls
- One 5-gallon water container
- Four pair, unlined vinyl rubber gloves

- Two approved respirators with approved pesticide canisters (Self-contained breathing apparatus must also be available in operations where methyl bromide is utilized.)
- One broom and dust pan
- One pint bottle of liquid detergent
- Two scrub brushes (GSA 7920-00-068-7903 or equivalent)
- One plastic cover or tarpaulin (to cover dry spills) (GSA 8135-00-529-6487, or equivalent)
- Twenty-five pound bag, absorbent material (GSA 7930-00-269-1272), or sweeping compound, sawdust, “kitty litter”, or other absorbent materials
- One large metal or heavy duty plastic garbage can with removable cover for storing contaminated materials for later disposal

Important

Use this can to store the spill kit materials during transport.

- Several sand snakes should be kept in storage areas

Obtain many of these items through the GSA Federal Supply System or from a local hardware store. NMRAL will assist in obtaining items not readily available.

7

Treatment Manual

Emergency Aid and Safety

Hazard Communication and Material Safety Data Sheets

Contents

Overview **page-7-4-1**
OSHA Requirements **page-7-4-1**
Guidelines on Opening Containers Containing Commodities Under Controlled Atmosphere (CA) Storage **page-7-4-9**
Oxygen (O^2) **page-7-4-9**
Carbon dioxide (CO^2) **page-7-4-9**
Acronyms and Abbreviations Used in This Section **page-7-4-10**

Overview

Material safety data sheets (MSDS) provide information about hazardous chemicals that are used in the workplace. This information is necessary to safely handle hazardous chemicals.

OSHA Requirements

The Occupational Safety and Health Administration (OSHA) requires that the hazards of all chemicals produced or imported be evaluated, and information concerning chemical hazards is communicated to employers and employees by means of a comprehensive hazard communication program. A hazard communication program should include, but not be limited to, the following:

- Developing and maintaining a written hazard communication program for the workplace, including lists of hazardous chemicals present at the workplace.
- Labeling of containers of chemicals in the workplace, as well as containers of chemicals being shipped to other workplaces.
- Preparation and distribution of MSDS to employees and downstream employers.
- Development and implementation of employee training programs regarding hazards of chemicals and protective measures.

Employers who do not produce or import chemicals need only focus on those parts of 29CFR 1910.1200 that deal with establishing a workplace program and communicating information to their workers.

Appendix E of 29CFR 1910.1200 is a general guide for such employers to help them determine the compliance obligations under this rule, and includes the following topics:

- Becoming Familiar With the Rule
- Identify Responsible Staff
- Identify Hazardous Chemicals in the Workplace
- Preparing and Implementing a Hazard Communication Program
  - Labels and Other Forms of Warning
  - Material Safety Data Sheets (MSDS's)
  - Employee Information and Training
  - Other Requirements
- Checklist for Compliance
- Further Assistance

A copy of **Appendix E** is included in **Figure 7-4-1**—**Guidelines for Employer Compliance**.

The Hazard Communication Standard (HCS) is based on a simple concept—that employees have both a need and a right to know the hazards and identities of the chemicals they are exposed to when working. They also need to know what protective measures are available to prevent adverse effects from occurring. The HCS is designed to provide employees with the information they need.

Knowledge acquired under the HCS will help employers provide safer workplaces for their employees. When employers have information about the chemicals being used, they can take steps to reduce exposures, substitute less hazardous materials, and establish proper work practices. These efforts will help prevent the occurrence of work-related illnesses and injuries caused by chemicals.

The HCS addresses the issues of evaluating and communicating hazards to workers. Evaluation of chemical hazards involves a number of technical concepts, and is a process that requires the professional judgment of experienced experts. That's why the HCS is designed so that employers who simply use chemicals, rather than produce or import them, are not required to evaluate the hazards of those chemicals. Hazard determination is the responsibility of the producers and importers of the materials. Producers and importers of chemicals are then required to provide the hazard information to employers that purchase their products.

Employers that don't produce or import chemicals need only focus on those parts of the rule that deal with establishing a workplace program and communicating information to their workers. This appendix is a general guide for such employers to help them determine what's required under the rule. It does not supplant or substitute for the regulatory provisions, but rather provides a simplified outline of the steps an average employer would follow to meet those requirements.

1. Becoming Familiar With the Rule

OSHA has provided a simple summary of the HCS in a pamphlet entitled "Chemical Hazard Communication." OSHA Publication Number 3084. Some employers prefer to begin to become familiar with the rule's requirements by reading this pamphlet. A copy may be obtained from your local OSHA Area Office, or by contacting the OSHA Publications Office at (202) 523-9667.

FIGURE 7-4-1: Appendix E—Guidelines for Employer Compliance

The standard is long, and some parts of it are technical, but the basic concepts are simple. In fact, the requirements reflect what many employers have been doing for years. You may find that you are already largely in compliance with many of the provisions, and will simply have to modify your existing programs somewhat. If you are operating in an OSHA-approved State Plan State, you must comply with the State's requirements, which may be different than those of the Federal rule. Many of the State Plan States had hazard communication or "right-to-know" laws prior to promulgation of the Federal rule. Employers in State Plan States should contact their State OSHA offices for more information regarding applicable requirements.

The HCS requires information to be prepared and transmitted regarding all hazardous chemicals. The HCS covers both physical hazards (such as flammability), and health hazards (such as irritation, lung damage, and cancer). Most chemicals used in the workplace have some hazard potential, and thus will be covered by the rule.

One difference between this rule and many others adopted by OSHA is that this one is performance-oriented. That means that you have the flexibility to adapt the rule to the needs of your workplace, rather than having to follow specific, rigid requirements. It also means that you have to exercise more judgment to implement an appropriate and effective program.

The standard's design is simple. Chemical manufacturers and importers must evaluate the hazards of the chemicals they produce or import. Using that information, they must then prepare labels for containers, and more detailed technical bulletins called material safety data sheets (MSDS).

Chemical manufacturers, importers, and distributors of hazardous chemicals are all required to provide the appropriate labels and material safety data sheets to the employers to which they ship the chemicals. The information is to be provided automatically. Every container of hazardous chemicals you receive must be labeled, tagged, or marked with the required information. Your suppliers must also send you a properly completed material safety data sheet (MSDS) at the time of the first shipment of the chemical, and with the next shipment after the MSDS is updated with new and significant information about the hazards.

You can rely on the information received from your suppliers. You have no independent duty to analyze the chemical or evaluate the hazards of it.

Employers that "use" hazardous chemicals must have a program to ensure the information is provided to exposed employees. "Use" means to package, handle, react, or transfer. This is an intentionally broad scope, and includes any situation where a chemical is present in such a way that employees may be exposed under normal conditions of use or in a foreseeable emergency.

The requirements of the rule that deal specifically with the hazard communication program are found in this section in paragraph (e), written hazard communication program; (f), labels and other forms of warning; (g) material safety data sheets; and (h) employee information and training. The requirements of these paragraphs should be the focus of your attention. Concentrate on becoming familiar with them, using paragraphs (b) scope and application, and (c) definitions, as references when needed to help explain the provisions.

There are two types of work operations where the coverage of the rule is limited. These are laboratories and operations where chemicals are only handled in sealed containers (e.g., a warehouse). The limited provisions for these workplaces can be found in paragraph (b) of this section, scope and application. Basically, employers having these types of work operations need only keep labels on containers as they are received; maintain material safety data sheets that are received, and give employees access to them; and provide information and training for employees. Employers do not have to have written hazard communication programs and lists of chemicals for these types of operations.

The limited coverage of laboratories and sealed container operations addresses the obligation of an employer to the workers in the operations involved, and does not affect the employer's duties as a distributor of chemicals. For example, a distributor may have warehouse operations where employees would be protected under the limited sealed container provisions. In this situation, requirements for obtaining and maintaining MSDSs are limited to providing access to those received with containers while the substance is in the workplace, and requesting MSDSs when employees request access for those not received with the containers. However, as a distributor of hazardous chemicals, that employer will still have responsibilities for providing MSDSs to downstream customers at the time of the first shipment and when the MSDS is updated. Therefore, although they may not be required for the employees in the work operation, the distributor may, nevertheless, have to have MSDSs to satisfy other requirements of the rule.

FIGURE 7-4-1: Appendix E—Guidelines for Employer Compliance (continued)

2. Identify Responsible Staff
Hazard communication is going to be a continuing program in your facility. Compliance with the HCS is not a "one shot deal." In order to have a successful program, it will be necessary to assign responsibility for both the initial and ongoing activities that have to be undertaken to comply with the rule. In some cases, these activities may already be part of current job assignments. For example, site supervisors are frequently responsible for on-the-job training sessions. Early identification of the responsible employees, and involvement of them in the development of your plan of action, will result in a more effective program design. Evaluation of the effectiveness of your program will also be enhanced by involvement of affected employees. For any safety and health program, success depends on commitment of every level of the organization. This is particularly true for hazard communication, where success requires a change in behavior. This will only occur if employers understand the program, and are committed to its success, and if employees are motivated by the people presenting the information to them.
3. Identify Hazardous Chemicals in the Workplace
The standard requires a list of hazardous chemicals in the workplace as part of the written hazard communication program. The list will eventually serve as an inventory of everything for which an MSDS must be maintained. At this point, however, preparing the list will help you complete the rest of the program since it will give you some idea of the scope of the program required for compliance in your facility. The best way to prepare a comprehensive list is to survey the workplace. Purchasing records may also help, and certainly employers should establish procedures to ensure that in the future purchasing procedures result in MSDSs being received before a material is used in the workplace. The broadest possible perspective should be taken when doing the survey. Sometimes people think of "chemicals" as being only liquids in containers. The HCS covers chemicals in all physical forms—liquids, solids, gases, vapors, fumes, and mists—whether they are "contained" or not. The hazardous nature of the chemical and the potential for exposure are the factors which determine whether a chemical is covered. If it's not hazardous, it's not covered. If there is no potential for exposure (e.g., the chemical is inextricably bound and cannot be released), the rule does not cover the chemical. Look around. Identify chemicals in containers, including pipes, but also think about chemicals generated in the work operations. For example, welding fumes, dusts, and exhaust fumes are all sources of chemical exposures. Read labels provided by suppliers for hazard information. Make a list of all chemicals in the workplace that are potentially hazardous. For your own information and planning, you may also want to note on the list the location(s) of the products within the workplace, and an indication of the hazards as found on the label. This will help you as you prepare the rest of your program. Paragraph (b) of this section, scope and application, includes exemptions for various chemicals or workplace situations. After compiling the complete list of chemicals, you should review paragraph (b) of this section to determine if any of the items can be eliminated from the list because they are exempted materials. For example, food, drugs, and cosmetics brought into the workplace for employee consumption are exempt. So rubbing alcohol in the first aid kit would not be covered. Once you have compiled as complete a list as possible of the potentially hazardous chemicals in the workplace, the next step is to determine if you have received material safety data sheets for all of them. Check your files against the inventory you have just compiled. If any are missing, contact your supplier and request one. It is a good idea to document these requests, either by copy of a letter or a note regarding telephone conversations. If you have MSDSs for chemicals that are not on your list, figure out why. Maybe you don't use the chemical anymore. Or maybe you missed it in your survey. Some suppliers do provide MSDSs for products that are not hazardous. These do not have to be maintained by you. You should not allow employees to use any chemicals for which you have not received an MSDS. The MSDS provides information you need to ensure proper protective measures are implemented prior to exposure.

FIGURE 7-4-1: Appendix E—Guidelines for Employer Compliance (continued)

4. Preparing and Implementing a Hazard Communication Program

All workplaces where employees are exposed to hazardous chemicals must have a written plan which describes how the standard will be implemented in the facility. Preparation of a plan is not just a paper exercise—all of the elements must be implemented in the workplace in order to be in compliance with the rule. See paragraph (e) of this section for the specific requirements regarding written hazard communication programs. The only work operations which do not have to comply with the written plan requirements are laboratories and work operations where employees only handle chemicals in sealed containers. See paragraph (b) of this section, scope and application, for the specific requirements for these two types of workplaces.

The plan does not have to be lengthy or complicated. It is intended to be a blueprint for implementation of your program—an assurance that all aspects of the requirements have been addressed.

Many trade associations and other professional groups have provided sample programs and other assistance materials to affected employers. These have been very helpful to many employers since they tend to be tailored to the particular industry involved. You may wish to investigate whether your industry trade groups have developed such materials.

Although such general guidance may be helpful, you must remember that the written program has to reflect what you are doing in your workplace. Therefore, if you use a generic program it must be adapted to address the facility it covers. For example, the written plan must list the chemicals present at the site, indicate who is to be responsible for the various aspects of the program in your facility, and indicate where written materials will be made available to employees.

If OSHA inspects your workplace for compliance with the HCS, the OSHA compliance officer will ask to see your written plan at the outset of the inspection. In general, the following items will be considered in evaluating your program.

The written program must describe how the requirements for labels and other forms of warning, material safety data sheets, and employee information and training, are going to be met in your facility. The following discussion provides the type of information compliance officers will be looking for to decide whether these elements of the hazard communication program have been properly addressed.

In-plant containers of hazardous chemicals must be labeled, tagged, or marked with the identity of the material and appropriate hazard warnings. Chemical manufacturers, importers, and distributors are required to assure that every container of hazardous chemicals they ship is appropriately labeled with such information and with the name and address of the producer or other responsible party. Employers purchasing chemicals can rely on the labels provided by their suppliers. If the material is subsequently transferred by the employer from a labeled container to another container, the employer will have to label that container unless it is subject to the portable container exemption. See paragraph (f) of this section for specific labeling requirements.

The primary information to be obtained from an OSHA-required label is an identity for the material, and appropriate hazard warnings. The identity is any term which appears on the label, the MSDS, and the list of chemicals, and thus links these three sources of information. The identity used by the supplier may be a common or trade name (“Black Magic Formula”), or a chemical name (1,1,1,—trichloroethane). The hazard warning is a brief statement of the hazardous effects of the chemical (“flammable,” “causes lung damage”). Labels frequently contain other information, such as precautionary measures (“do not use near open flame”), but this information is provided voluntarily and is not required by the rule. Labels must be legible, and prominently displayed. There are no specific requirements for size or color, or any specified text.

With these requirements in mind, the compliance officer will be looking for the following types of information to ensure that labeling will be properly implemented in your facility.

1. Designation of person(s) responsible for ensuring labeling of in-plant containers;
2. Designation of person(s) responsible for ensuring labeling of any shipped containers;
3. Description of labeling system(s) used;
4. Description of written alternatives to labeling of in-plant containers (is used); and
5. Procedures to review and update label information when necessary.

FIGURE 7-4-1: Appendix E—Guidelines for Employer Compliance (continued)

Employers that are purchasing and using hazardous chemicals—rather than producing or distributing them—will primarily be concerned with ensuring that every purchased container is labeled. If materials are transferred into other containers, the employer must ensure that these are labeled as well, unless they fall under the portable container exemption (paragraph (f)(7) of this section). In terms of labeling systems, you can simply choose to use the labels provided by your suppliers on the containers. These will generally be verbal text labels, and do not usually include numerical rating systems or symbols that require special training. The most important thing to remember is that this is a continuing duty—all in-plant containers of hazardous chemicals must always be labeled. Therefore, it is important to designate someone to be responsible for ensuring that the labels are maintained as required on the containers in your facility, and that newly purchased materials are checked for labels prior to use.

Chemical manufacturers and importers are required to obtain or develop a material safety data sheet for each hazardous chemical they produce or import. Distributors are responsible for ensuring that their customers are provided a copy of these MSDSs. Employers must have an MSDS for each hazardous chemical which they use. Employers may rely on the information received from their suppliers. The specific requirements for material safety data sheets are in paragraph (g) of this section.

There is no specified format for the MSDS under the rule, although there are specific information requirements. OSHA has developed a non-mandatory format, OSHA Form 174, which may be used by chemical manufacturers and importers to comply with the rule. The MSDS must be in English. You are entitled to receive from your supplier a data sheet which includes all of the information required under the rule. If you do not receive one automatically, you should request one. If you receive one that is obviously inadequate, with, for example, blank spaces that are not completed, you should request an appropriately completed one. If your request for a data sheet or for a corrected data sheet does not produce the information needed, you should contact your local OSHA Area Office for assistance in obtaining the MSDS.

The role of MSDSs under the rule is to provide detailed information on each hazardous chemical, including its potential hazardous effects, its physical and chemical characteristics, and recommendations for appropriate protective measures. This information should be useful to you as the employer responsible for designing protective programs, as well as to the workers. If you are not familiar with material safety data sheets and with chemical terminology, you may need to learn to use them yourself. A glossary of MSDS terms may be helpful in this regard. Generally speaking, most employers using hazardous chemicals will primarily be concerned with MSDS information regarding hazardous effects and recommended protective measures. Focus on the sections of the MSDS that are applicable to your situation.

MSDSs must be readily accessible to employees when they are in their work areas during their workshifts. This may be accomplished in many different ways. You must decide what is appropriate for your particular workplace. Some employers keep the MSDSs in a binder in a central location (e.g., in the pick-up truck on a construction site). Others, particularly in workplaces with large numbers of chemicals, computerize the information and provide access through terminals. As long as employees can get the information when they need it, any approach may be used. The employees must have access to the MSDSs themselves—simply having a system where the information can be read to them over the phone is only permitted under the mobile worksite provision, paragraph (g)(9) of this section, when employees must travel between workplaces during the shift. In this situation, they have access to the MSDSs prior to leaving the primary worksite, and when they return, so the telephone system is simply an emergency arrangement.

In order to ensure that you have a current MSDS for each chemical in the plant as required, and that employee access is provided, the compliance officers will be looking for the following types of information in your written program:

1. Designation of person(s) responsible for obtaining and maintaining the MSDSs;
2. How such sheets are to be maintained in the workplace (e.g., in notebooks in the work area(s) or in a computer with terminal access), and how employees can obtain access to them when they are in their work area during the work shift;
3. Procedures to follow when the MSDS is not received at the time of the first shipment;
4. For producers, procedures to update the MSDS when new and significant health information is found; and
5. Description of alternatives to actual data sheets in the workplace, if used.

For employers using hazardous chemicals, the most important aspect of the written program in terms of MSDSs is to ensure that someone is responsible for obtaining and maintaining the MSDSs for every hazardous chemical in the workplace. The list of hazardous chemicals required to be maintained as part of the written program will serve as an inventory. As new chemicals are purchased, the list should be updated. Many companies have found it convenient to include on their purchase orders the name and address of the person designated in their company to receive MSDSs.

FIGURE 7-4-1: Appendix E—Guidelines for Employer Compliance (continued)

Each employee who may be "exposed" to hazardous chemicals when working must be provided information and trained prior to initial assignment to work with a hazardous chemical, and whenever the hazard changes. "Exposure" or "exposed" under the rule means that "an employee is subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.) and includes potential (e.g., accidental or possible) exposure." See paragraph (h) of this section for specific requirements. Information and training may be done either by individual chemical, or by categories of hazards (such as flammability or carcinogenicity). If there are only a few chemicals in the workplace, then you may want to discuss each one individually. Where there are large numbers of chemicals, or the chemicals change frequently, you will probably want to train generally based on the hazard categories (e.g., flammable liquids, corrosive materials, carcinogens). Employees will have access to the substance-specific information on the labels and MSDSs.

Information and training is a critical part of the hazard communication program. Information regarding hazards and protective measures are provided to workers through written labels and material safety data sheets. However, through effective information and training, workers will learn to read and understand such information, determine how it can be obtained and used in their own workplaces, and understand the risks of exposure to the chemicals in their workplaces as well as the ways to protect themselves. A properly conducted training program will ensure comprehension and understanding. It is not sufficient to either just read material to the workers, or simply hand them material to read. You want to create a climate where workers feel free to ask questions. This will help you to ensure that the information is understood. You must always remember that the underlying purpose of the HCS is to reduce the incidence of chemical source illnesses and injuries. This will be accomplished by modifying behavior through the provision of hazard information and information about protective measures. If your program works, you and your workers will better understand the chemical hazards within the workplace. The procedures you establish regarding, for example, purchasing, storage, and handling of these chemicals will improve, and thereby reduce the risks posed to employees exposed to the chemical hazards involved. Furthermore, your workers' comprehension will also be increased, and proper work practices will be followed to your workplace.

If you are going to do the training yourself, you will have to understand the material and be prepared to motivate the workers to learn. This is not always an easy task, but the benefits are worth the effort. More information regarding appropriate training can be found in OSHA Publication No. 2254 which contains voluntary training guidelines prepared by OSHA's Training Institute. A copy of this document is available from OSHA's Publications Office at (202) 219-4667.

In reviewing your written program with regard to information and training, the following items need to be considered:

1. Designation of person(s) responsible for conducting training;
2. Format of the program to be used (audiovisuals, classroom instruction, etc.);
3. Elements of the training program (should be consistent with the elements in paragraph (h) of this section); and
4. Procedure to train new employees at the time of their initial assignment to work with a hazardous chemical, and to train employees when a new hazard is introduced into the workplace.

The written program should provide enough details about the employer's plans in this area to assess whether or not a good faith effort is being made to train employees. OSHA does not expect that every worker will be able to recite all of the information about each chemical in the workplace. In general, the most important aspects of training under the HCS are to ensure that employees are aware that they are exposed to hazardous chemicals, that they know how to read and use labels and material safety data sheets, and that, as a consequence of learning this information, they are following the appropriate protective measures established by the employer. OSHA compliance officers will be talking to employees to determine if they have received training. If they know they are exposed to hazardous chemicals, and if they know where to obtain substance-specific information on labels and MSDSs.

The rule does not require employers to maintain records of employee training, but many employers choose to do so. This may help employers choose to do so. This may help you monitor your own program to ensure that all employees are appropriately trained. If you already have a training program, you may simply have to supplement it with whatever additional information is required under the HCS. For example, construction employers that are already in compliance with the construction training standard (29CFR 1926.21) will have little extra training to do.

FIGURE 7-4-1: Appendix E—Guidelines for Employer Compliance (continued)

An employer can provide employees information and training through whatever means are found appropriate and protective. Although there would always have to be some training on-site (such as informing employees of the location and availability of the written program and MSDSs), employee training may be satisfied in part by general training about the requirements of the HCS and about chemical hazards on the job which is provided by, for example, trade associations, unions, colleges, and professional schools. In addition, previous training, education and experience of a worker may relieve the employer of some of the burdens of informing and training that worker. Regardless of the method relied upon, however, the employer is always ultimately responsible for ensuring that employees are adequately trained. If the compliance officer finds that the training is deficient, the employer will be cited for the deficiency regardless of who actually provided the training on behalf of the employer.

In addition to these specific items, compliance officers will also be asking the following questions in assessing the adequacy of the program:

Does a list of the hazardous chemicals exist in each work area or at a central location?

Are methods the employer will use to inform employees of the hazards of non-routine tasks outlined?

Are employees informed of the hazards associated with chemicals contained in unlabeled pipes in their work areas?

On multi-employer worksites, has the employer provided other employers with information about labeling systems and precautionary measures where the other employers have employees exposed to the initial employer's chemicals?

Is the written program made available to employees and their designated representatives?

If your program adequately addresses the means of communicating information to employees in your workplace, and provides answers to the basic questions outlined above, it will be found to be in compliance with the rule.

5. Checklist for Compliance

The following checklist will help to ensure you are in compliance with the rule:

- Obtained a copy of the rule.
- Read and understood the requirements.
- Assigned responsibility for tasks.
- Prepared an inventory of chemicals.
- Ensured containers are labeled.
- Obtained MSDS for each chemical.
- Prepared written program.
- Made MSDSs available to workers.
- Conducted training of workers.
- Established procedures to maintain current program.
- Established procedures to evaluate effectiveness.

6. Further Assistance

If you have a question regarding compliance with the HCS, you should contact your local OSHA Area Office for assistance. In addition, each OSHA Regional Office has a Hazard Communication Coordinator who can answer your questions. Free consultation services are also available to assist employers, and information regarding these services can be obtained through the Area and Regional offices as well.

The telephone number for the OSHA office closest to you should be listed in your local telephone directory. If you are not able to obtain this information, you may contact OSHA's Office of Information and Consumer Affairs at (202) 219-8151 for further assistance in identifying the appropriate contacts.

[59 FR 6170, Feb. 9, 1994, as amended at 59 FR 17479, Apr. 13, 1994; 59 FR 65948, Dec. 22, 1994; 61 FR 9245, Mar. 7, 1996]

FIGURE 7-4-1: Appendix E—Guidelines for Employer Compliance (continued)

Guidelines on Opening Containers Containing Commodities Under Controlled Atmosphere (CA) Storage

Controlled atmosphere (CA) is being used more and more commonly to preserve the quality of fresh produce during and shipment, especially during long voyages. It also has the advantage of reducing the number of many of the pests that may be present. In most cases, however, insufficient research has been done on enough pest species for APHIS to accept CA as a stand-alone quarantine treatment, although this could change in the future.

Opening and inspecting a container known or suspected to be under CA poses a safety risk to the inspector, and to others in the immediate vicinity. A placard is usually posted on the doors of the container prior to shipment, stating that the fresh produce is being shipped under CA. Also, a monitoring device, indicating the kinds and levels of gases in the mixture, should be present. If the monitor is not functioning properly, it is possible to use gas detector tubes specific for oxygen and carbon dioxide. If the nitrogen or carbon dioxide levels are high, or the oxygen level is low, the inspector must not enter the container immediately, because of the high risk of asphyxiation. This risk is very insidious, because the potential victim usually does not recognize the danger signs.

It should be noted that normal air contains 78% nitrogen, 21% oxygen, and 0.03 to 0.04% carbon dioxide (CO^2). Health risk to the inspector occurs when the oxygen level is too low, or the levels of nitrogen or CO^2 are too high.

Oxygen (O^2)

Gases within a CA space normally contain only 3% oxygen or less. The lowest oxygen level considered safe is 19.5%. A personal oxygen monitor (worn by the inspector) would set off an alarm at that level.

An oxygen level of 6% or less causes loss of consciousness within 45 seconds.Breathing is in gasps, followed by convulsive movements, then breathing stops. The heart may continue beating for a few minutes, then stops. If the person attempting to rescue is not equipped with a SCBA, there is a high probability that this person will also become a victim of asphyxiation.

Carbon dioxide (CO^2)

Gases within a CA space often contain high levels of CO2. Although this is a common compound, it can also be deadly--a fact often overlooked. Breathing pure CO2 will cause immediate death. Even at concentrations over 15%, death can be rapid. Above 10%, CO2 causes unconsciousness (coma). At 8%, CO2 causes headache, nausea, vomiting, and may lead to unconsciousness. Concentrations as low as

4 to 5% cause rapid, labored breathing, slight choking, and headache. The threshold limit value (TLV), the highest level at which a person can work without adverse effect, is 0.05% or 5 ppm.

If dangerous gas levels are determined to be present, then the container must be aerated prior to inspection, preferably by using the container's own recirculation system, set in “exhaust” mode. Aeration may also be done passively, or by the use of fans, or by means of a fan-assisted aeration duct.

WARNING

Do not attempt to aerate while the container is parked at a loading dock, because the gases may asphyxiate workers in the area. Have the container moved to an open area. While opening doors and placing fans or a fan-assisted exhaust duct, wear SCBA for personal protection.

Aerate for at least one hour, then recheck gas levels. Proceed with cargo inspection only when safe levels have been reached. The safe waiting time (to achieve at least 19.5% oxygen in the accessible portion of the container) depends upon several factors:

- The type of produce and how it is packed
- The extent of holes in the boxes
- Packing density of the boxes
- Pallet spacing, and return-flow ribs in the floor of the container
- Amount of head-space above the load
- Whether the recirculation blower is on or off
- Percentage of oxygen in the controlled atmosphere

At ports receiving CA containers, periodic training/awareness sessions are needed, and policies clearly spelled out.

Acronyms and Abbreviations Used in This Section

a.i.	active ingredient
ACGIH	American Conference of Governmental Industrial Hygienists
ADI	Acceptable Daily Intake
APHIS	Animal and Plant Health Inspection Service
BBEP	Biotechnology, Biologics, and Environmental Protection
bw	body weight
CAS	Chemical Abstracts Service
cc	cubic centimeters
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
ChE	cholinesterase
CHEMTREC	24-hour emergency telephone service for spills

CNS	central nervous system
COR	Contracting Officer's Representative
CPK	creatine phosphokinase
cu.m	cubic meter
CWA	Clean Water Act
DHEW	U.S. Department of Health, Education, and Welfare
DNA	deoxyribonucleic acid
DOT	U.S. Department of Transportation
DW	drinking water
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
g	grams
GI	gastrointestinal
HDT	highest dose tested
Hgb	hemoglobin
HHS	U.S. Department of Health and Human Services
i.m.	intramuscular
i.p.	intraperitoneal
i.v.	intravenous
kg	kilogram
L	liter
LC50	Lethal Concentration 50; dose lethal to 50% of the animals
LCLO	Lethal Concentration Low; the lowest concentration causing death
LD50	Lethal Dose 50; dose lethal to 50% of the animals
LDLO	Lethal Dose Low; the lowest dose at which death occurred
LDT	lowest dose tested
LEL	lower exposure limit, or lowest-effect level
LOAEL	lowest-observed-adverse-effect-level
m	meter
MED	minimum effective dose
mg	milligram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mmHg	millimeters of mercury; a measure of pressure
MOE	Margin of Exposure
MOS	Margin of Safety
MSDS	Material Safety Data Sheet
MTD	maximum tolerated dose
MTL	median threshold limit
NFPA	National Fire Prevention Association
ng	nanogram

NIOSH	National Institute for Occupational Safety and Health
NMRAL	National Monitoring and Residue Analysis Laboratory
NOAEL	no-observed-adverse-effect level
NOEL	no-observed-effect level
NTP	National Toxicology Program
OIC	Officer-in-Charge
OSHA	U.S. Occupational Safety and Health Administration
PEL	permissible exposure limit
PHS	U.S. Public Health Service
p.o.	per os (by mouth)
ppb	parts per billion
ppm	parts per million
PPQ	Plant Protection and Quarantine
RBC	red blood cell(s)
RfD	Reference Dose
RfDi	Inhalation Reference Dose
RfDo	Oral Reference Dose
s.c.	subcutaneous
STEL	short-term exposure limit
TLV	threshold limit value
TSS	Technical and Scientific Services
TWA	time-weighted average
UCL	upper confidence limit
UEL	upper exposure limit
UF	uncertainty factor
ug	microgram
ug/cu.	micrograms per cubic meter
ug/L	micrograms per liter
USDA	United States Department of Agriculture

8

Treatment Manual

Equipment

Contents

Thermal Conductivity Gas Analyzers **page-8-1-2**
Fumiscope and Gow-Mac **page-8-1-2**
Description **page-8-1-2**
Standardizing the Instrument **page-8-1-4**
Operational Procedures **page-8-1-5**
Repair and Calibration **page-8-1-7**
Maintenance **page-8-1-7**
Halide Detector **page-8-1-9**
Principles of Operation **page-8-1-9**
Description **page-8-1-9**
Usage **page-8-1-10**
Respiratory Protection **page-8-1-12**
Introduction **page-8-1-12**
Responsibility **page-8-1-12**
Management's Responsibilities **page-8-1-12**
Officer's Responsibilities **page-8-1-12**
General **page-8-1-13**
For Fumigants **page-8-1-13**
For Pesticides Other Than Fumigants **page-8-1-13**
Employee Acceptance **page-8-1-13**
Capabilities and Limitations **page-8-1-14**
Use of Respirator Protection **page-8-1-16**
Special Problem **page-8-1-18**
Maintenance and Care **page-8-1-19**
Detector Kits or Gas Samples **page-8-1-23**
Principles of Operations **page-8-1-23**
Volatilizer **page-8-1-24**
Air Velocity Measuring Instruments **page-8-1-26**
Anemometer **page-8-1-26**
Velometer **page-8-1-27**
Auxiliary Pump **page-8-1-27**
Open Arm Manometer **page-8-1-28**
Vacuum Pump **page-8-1-30**
Mityvac Hand-Held Vacuum Pump **page-8-1-30**
Usage **page-8-1-31**
Phosphine Detector **page-8-1-31**
PortaSens Phosphine Detector **page-8-1-31**
Description **page-8-1-31**
Operation **page-8-1-31**
Response Time **page-8-1-32**
Alarm Function **page-8-1-32**
Battery Power Supply **page-8-1-32**
Flow Verification **page-8-1-32**
Power Down **page-8-1-32**

Thermal Conductivity Gas Analyzers

Fumiscope and Gow-Mac

The thermal conductivity gas analyzer (T/C units) is a scientific instrument specifically designed for determining the concentration of gases within a chamber or other enclosure while the actual fumigation is being conducted. These fumigation gases include methyl bromide, ethylene oxide-carbon dioxide mixtures, and sulfuryl fluoride. The following discussions relating to the T/C unit are under these subheadings:

- Description
- Standardizing the instrument
- Operational procedures
- Repair and calibration
- Maintenance

Description

The Fumiscope® or Gow-Mac® is light in weight, portable, completely contained in a compact metal cabinet. It contains a thermal conductivity cell, scale, gas pump, range switch, and gas flow meter. A gas drying tube is also included. For large enclosures, an auxiliary pump may be needed.

Inlet

This tube connector is the gas inlet for the instrument. The sampling tubes are connected directly to the inlet or through the drying tube.

Flow Rate Meter

Indicates the gas flow rate in “simulated cubic feet per hour (SCFH).” Note: The flow rate should always be read at the middle of the ball.

Flow Rate Adjustment

This dial controls the air or gas flow rate by adjusting the pump. After connecting to the gas sampling tube, the flow rate should be adjusted upward until it reads exactly 1.0. The gas concentration reading should be taken only after the meter that registers “ounces per thousand cubic feet” stabilizes, which may take a minute or more (depending upon the length of the tubing and whether or not an auxiliary pump is being used).

Scale

Indicates the concentration of the MB fumigant in ounces per 1,000 cubic feet (milligrams per liter or grams per cubic meter). For some fumigants, the concentration is calculated as the reading times a specific factor.

Zero Adjustment This dial controls the scale needle which is brought to zero as an air sample is being drawn through the instrument.

Line Switches Control electrical supply to pump and scale.

Range Switch Regulates the scale indicating the concentrations of fumigant measured, for example, 0-100 ounces per 1,000 cubic foot or as 0-400 ounces per 1,000 cubic foot (some models). Digital models can indicate a range from 0-999 ounces per 1,000 cubic feet.)

Exhaust Outlet Always connect a tube to exhaust outlet to carry exhaust gas away from the instrument and operator. When using the T/C unit in confined or poorly ventilated areas, recirculate the exhaust gas back to the fumigation space or exhaust it to the outside.

Drying Tube The drying tube (filter tube) is for use with a prepared chemical for removal of certain contaminant gases or vapors which interfere with correct readings of fumigant concentration. For most fumigations, the tube will contain a desiccant such as Drierite® (granules of anhydrous calcium sulfate), or Ascarite® (soda asbestos). Both are available from scientific supply houses. The tube is inserted in the gas sampling line just before the inlet connection. Drierite®, blue in color when dry, turns pink when moisture is absorbed. When most of the desiccant has turned pink, it should be replaced. In extremely high moisture conditions, two tubes can be connected in tandem. Drying tube openings should be closed when not in use.

When a drying tube is used, a thin layer of glass wool or aquarium filter wool should be placed at the bottom and top of the tube to prevent small particles from sifting into the Fumiscope®. The use of absorbent cotton or similar materials is not recommended. Cotton tends to pick up moisture and to become matted, and once matted, the cotton may restrict normal air flow, thus adversely affecting the T/C unit's operation. (Matting may also cause the flow of air to bypass, rather than flow through the Drierite®.)

Mount the drying tube *vertically* so that the gas mixture moves through the drying material and does not pass over the top. This happens when the tube is mounted horizontally (lengthwise).

Commodities that are actively respiring produce carbon dioxide gas that may interfere with the correct readings of fumigant concentration. During a fumigation, you may use tubes containing Ascarite® to remove carbon dioxide from gas samples. Used filtering material should be discarded. The Ascarite® tube should be connected between the Drierite® tube and the sample inlet. In no instance should Drierite® and Ascarite® be mixed in the same tube. Ascarite® should be replaced when the granules begin to aggregate or become moist.

It is always advisable to use Drierite® when taking concentration readings of SF, MB, or CB. Desiccant should be fresh and frequently changed to ensure correct readings. *Never* use Ascarite® when making readings of SF because a chemical reaction will occur. *Never* use Ascarite® when taking readings of CB because carbon dioxide gas is an integral part of the reading to be obtained.

Standardizing the Instrument

Standardizing the instrument is the first and basic operation. Do the following to standardize the instrument.

1. Connect the instrument to an electrical outlet with proper voltage and set the pump and meter switches to "on." If inoperable, check fuse. (Replacements—Little Fuse or Buss #3AG 1/2 Amp.—should be kept on hand.)
2. Attach the drying tube to the inlet port. The instrument should be given a tightness test. This can be accomplished by placing a finger over the inlet of the drying tube. The flow ball in the flow meter should then fall to zero if the tubing and connections are tight.
3. Warm up the instrument for 15 to 30 minutes.
4. Adjust the gas flow rate to 1 cubic foot per hour (CFH) by adjusting the flow rate knob. If the flow rate knob is turned counter clockwise too far, the pump will emit noises and cease to operate properly. When properly adjusted, the flow ball should float at the center mark or slightly below on the calibrated glass cylinder. Slight fluctuations from a stationary position may occur. Dry, fresh air is now being drawn through the T/C cell by means of the pump, the air entering via the inlet on the face of the instrument, passing through the cell, and leaving through the exhaust outlet.
5. Turn the zero adjustment knob to obtain a zero reading on the meter. Several additional adjustments during the first few minutes may be necessary to obtain a stable zero reading. A check of the meter needle should be made periodically to determine if there is any sticking of the needle. A check is done by slowly turning the adjustment knob clockwise. A clockwise turn will swing the needle from 0 to 100/200 on the meter scale. A counterclockwise twist will return the needle to zero.

Standardization is now complete and readings can be made of fumigant-air mixture drawn through the unit. It may be necessary to replace the desiccant at this point.

The difference in the thermal conductivity of the fumigant-air mixture as compared with fresh air is measured electrically and indicated on the meter as concentration readings in ounces of MB per 1,000 cubic

feet. T/C units used in PPQ must be calibrated for MB by the manufacturer or an outside contractor prior to use. You will not get accurate readings when fumigations are under even a small vacuum.

The Gow-Mac® T/C units used by PPQ are equipped to measure MB concentrations up to 400 ounces per 1,000 cubic feet. Since the T/C unit's galvanometer responds linearly to gas concentrations, the MB calibrated instrument may be used for measuring certain other gases by the use of specific multiplication factors determined for each instrument.

Operational Procedures

The proper use of the Fumiscope® is discussed under two headings:

- Selecting Operational Site for the T/C Unit
- Measuring Gas Concentrations With the Standardized Unit

Because of the variety of fumigation situations, some adjustments may be necessary to meet specific needs. Nevertheless, this outline should be helpful in establishing correct operational procedures.

Selecting Operational Site for the T/C Unit

The T/C unit should be close enough to the fumigation site to avoid the use of unreasonable lengths of sampling tubes, to allow for constant surveillance of the fumigation during testing, and to avoid interference with other activities in the area. It should be at a sufficient distance from the fumigation site (at least 30 feet up-wind) to allow the operator to function without the fear of accidental exposure to gas and to allow for easy exit in an emergency. Excessive wiring length should be avoided. When T/C unit readings in multiple locations are necessary, care should be taken to see that each location is the best available.

The T/C unit should be supported on a sturdy, level surface, outside the traffic pattern and protected from wind, rain, excessive cold, and sun in hot weather. Temporary shelter such as a tarpaulin cover may be adequate in some cases. The gas concentration readings indicated by the T/C unit may be inaccurate unless the unit is placed in an area that is approximately the same temperature as the gas mixture in the enclosure being fumigated. Temperature differential may cause moisture to condense inside the gas sampling line.

Most T/C units operate on 110-120 volts alternating current (AC). T/C units operating on 210-220 volts AC on DC are available for overseas or other assignments as necessary. A converter is required to use direct current. To reduce the possibility of electric shock, T/C units repaired at the Center for Plant Health Science & Technology (CPHST) have been converted from the standard two-prong plug to a polarized

plug. Extension wiring and gas sampling line length should be kept to a practical minimum and should be raised above floor level when feasible.

Measuring Gas Concentrations With the Standardized Unit

As a protection for the cell and the pump of T/C units, a drying tube should be used at all times.

In making gas concentration checks, the unit is first warmed up for 15 to 30 minutes depending on ambient temperatures. The pump is then turned on and the gas flow meter adjusted to a 1 cubic foot per hour flow. Should the scale needle seem unstable and wander for a short period of time, the flow rate may be reduced slightly below the 1 cubic foot per hour level for zeroing and maintained at that level for measuring. The unit is now ready to measure gas samples drawn through position tagged tubes from the area being treated. The needle will indicate gas concentrations in ounces per 1,000 cubic feet (grams per cubic meter).

Sufficient time to draw a true sample must be allowed. With 150 to 200 feet of 1/4 inch OD tubing and a temperature of 70°F, this will be approximately 7 minutes. Stations equipped with small, auxiliary pumps can draw a sample through the same length of tubing in 12 to 15 seconds.

Readings should be constant for at least 30 seconds before the line is disconnected. As each sampling tube is disconnected from the T/C set and the needle begins to recede toward zero, a new sampling tube may be attached. It is not necessary to wait for the needle to return to zero after each reading.

Re-zeroing the instrument is generally not needed during the course of a fumigation, except under the following circumstances:

- The pump has been turned off for an hour or more since the last reading. (Be sure to warm up the unit for 15-30 minutes before taking the next reading.) During fumigations of 6 hours or less, it is recommended that the unit be kept running constantly.
- Fresh Drierite® has been added to the gas drying tube.
- The weather during the fumigation has drastically changed since the last reading.

The gas concentration readings indicated by the T/C unit's meter will generally be more accurate if the temperature of the gas mixture within the fumigated enclosure is approximately equal to that of the ambient air outside the enclosure. If there are great differences between the two temperatures, water vapor may condense inside the gas sampling leads. Such condensation, if desiccant is saturated, can result in a lower than normal T/C meter reading, thus leading to the unnecessary addition of fumigant to compensate for the apparent

shortage. Therefore, if vapor condensation appears inside the gas sampling leads, purge the line and move the T/C unit to a new location where the ambient temperature approximates that of the enclosure.

T/C gas analyzers are sensitive to a number of gases other than MB. For example CO_2 may be troublesome when fumigating fruit where kerosene heaters are placed under the tarpaulin to raise pulp temperatures, or with plant material packed in peat moss or subsoil. Correct MB gas concentration readings may be obtained if a CO_2 absorbent is used in the gas sampling line before the air-gas mixture enters the T/C unit. A CO_2 absorbent which may be used is Ascarite®. Inspectors using Ascarite® should observe the poison warning labels on the containers. Drying tubes containing the granules should be clearly labelled "**Warning—Avoid contact with skin, eyes, and clothing.**" An example where CO_2 is included in our minimum gas concentration readings is the EO-CO_2 (Carboxide) fumigations. Since the concentration readings obtained represent the sum of the individual readings for the EO and CO_2, Ascarite® must not be used in this instance.

After the final reading has been taken, the unit should be thoroughly purged by disconnecting from the sampling tube and allowing the pump to draw fresh air through the instrument for several minutes.

Repair and Calibration

The T/C unit will hold its calibration for a considerable length of time under normal service. To ensure that all units are providing accurate gas concentration readings, T/C units should be recalibrated at least annually; calibrate more often if use is frequent.

The instrument should be sent by Priority Mail or Air Parcel Post directly to the manufacturer or an ouside contractor. Prepare a memorandum to accompany each instrument explaining the need for sending the unit. Make sure all instruments are shipped with the a proper return address, name of a contact person, and telephone number. The T/C unit should be calibrated only for MB, unless the PPQ office requests calibration for CB, SF, or other specified fumigants: All port locations will be responsible for payments to contrators.

Use one of the following contractors for repair and calibration:

Key Chemical and Equipment Co. (BPA# 45-6395-3-2872)
13195 49th St. North
Unit A
Clearwater, FL 33762

tel (727) 572-1159
fax (727) 572-4595
($50.00 plus shipping per unit calibrated)

Cardinal Professional Products (BPA# 45-6395-3-2871)
2641 W. woodland Drive
Anaheim, CA 92801
tel (714) 761-3292
fax (714) 761-2095
($55.00 plus shipping per unit calibrated)

Maintenance

The T/C unit requires the same attention as any other equipment if it is to function properly. While the instrument is designed specifically for field use, the components, particularly the meter, may be damaged easily. Careful handling is essential to maintain an instrument capable of accurate gas concentration readings. If repairs are needed and are extensive, or the parts are not readily available, there will be a delay in returning the instrument. Should the need for a substitute T/C unit occur, the port should be prepared to obtain one from another source.

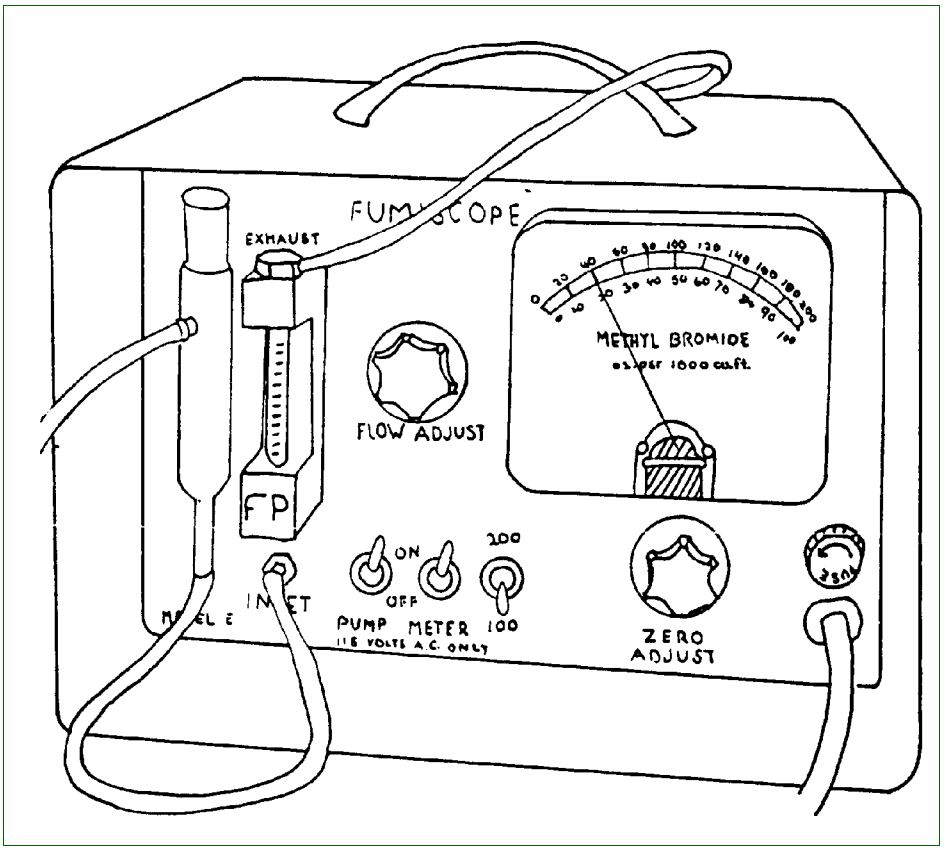


FIGURE 8-1-1: Fumiscope reading of 20 ounces per 1,000ft^3

Halide Detector

The halide gas detector has a long history of commercial usage as a leak detector for halide refrigerant gases. For fumigations, the halide detector has been used both as a leak detector to locate fumigant leakage around chambers, application equipment, temporary enclosures, and as a safety device around fumigation sites. It is also used to indicate freedom from gas concentrations of MB which may be absorbed from treated commodities. As a precautionary safety measure, it should be used regularly in rooms in which MB chambers and MB treated commodities are stored or located.

Principles of Operation

The halide gas detector is used to indicate the presence and approximate concentration of MB or other halogenated compounds in the air. This is accomplished by passing the air-gas mixture over a red hot copper plate or cone through or over which a flame is passing. The color and its intensity imparted to the flame indicates the presence and concentration of the halide gas.

Since the detector will react with other halide gas such as Freon™, a simple demonstration can be shown in the laboratory or office in the following manner:

1. Insert a funnel in the end of the detector search hose.
2. Light the unit (see the following section on Usage).
3. Direct a small amount of Freon™ propelled aerosol across the mouth of the funnel (aerosols used in PPQ aircraft treatments may be used).
4. A blue-green flame will be produced by the Freon™ gas as it contacts the heated reaction plate demonstrating what will occur when MB or other halogen gas is present.

Description

Basically, all halide detectors are quite similarly constructed, differing only in detail by the various manufacturers. Each consists of a fuel tank, a valve assembly to regulate fuel flow, a burner head assembly where the fuel and air mix and unite, the reaction plate or cone assembly where the visible flame reacts in color to the halogen fumigants. The air mixture to be tested is fed to the burner head assembly by an attached search hose.

The halide detector is relatively trouble free. The burner head orifice is extremely small and must be kept free of clogging with dust or other debris. The reaction plate or cone needs to be replaced when it becomes heavily corroded or burned.

Usage

The halide leak detector is made operable by holding a lighted match in the window opening of the burner tube and turning the valve slowly to the left. After the reaction plate or cone has heated to a red hot color, the flame should be adjusted to the minimum size to maintain that color. The detector is now ready for use. This is accomplished by holding the open end of the search hose in, on, or near the area or article to be tested. As the air sample thus drawn into the burner passes over the heated reaction plate or cone, the flame color changes if MB or any other halogen is present.

Since the operating halide leak detector contains an open flame, there must be strict adherence to obvious safety principles. Even when not in operation, it is advisable not to store the detector in a frequently inhabited room, the fuel being a flammable gas under compression.

The following are the approximate MB concentrations associated with the color intensity of the flame:***

TABLE 8-1-1: Approximate MB Concentration Associated with Flame Color

PPM*	Oz/1,000 ft^3**	Flame color
0	0.0	No color change***
25	0.1	Faint fringe of green
50	0.2	Moderate green
125	0.5	Green
250	1.0	Strong green
500	2.0	Strong green-blue fringe
800	3.2	Strong blue-green
1,000	4.0	Blue

*Threshold limit value for MB for exposure for 8 hours is 5 ppm.
**oz/1,000 ft^3 = mg/liter = g/m^3.
***Propane gas burns with a light blue flame when MB (methyl bromide) is not present.

This table of flame colors for various ppm's of MB holds good only when the detector is operated at its most sensitive rate; i.e., when the flame is reduced to the lowest rate sufficient to keep the reactor plate or cone red hot. Also, particularly when using the detector at night, the flame has a bluish cast which must be taken into consideration.

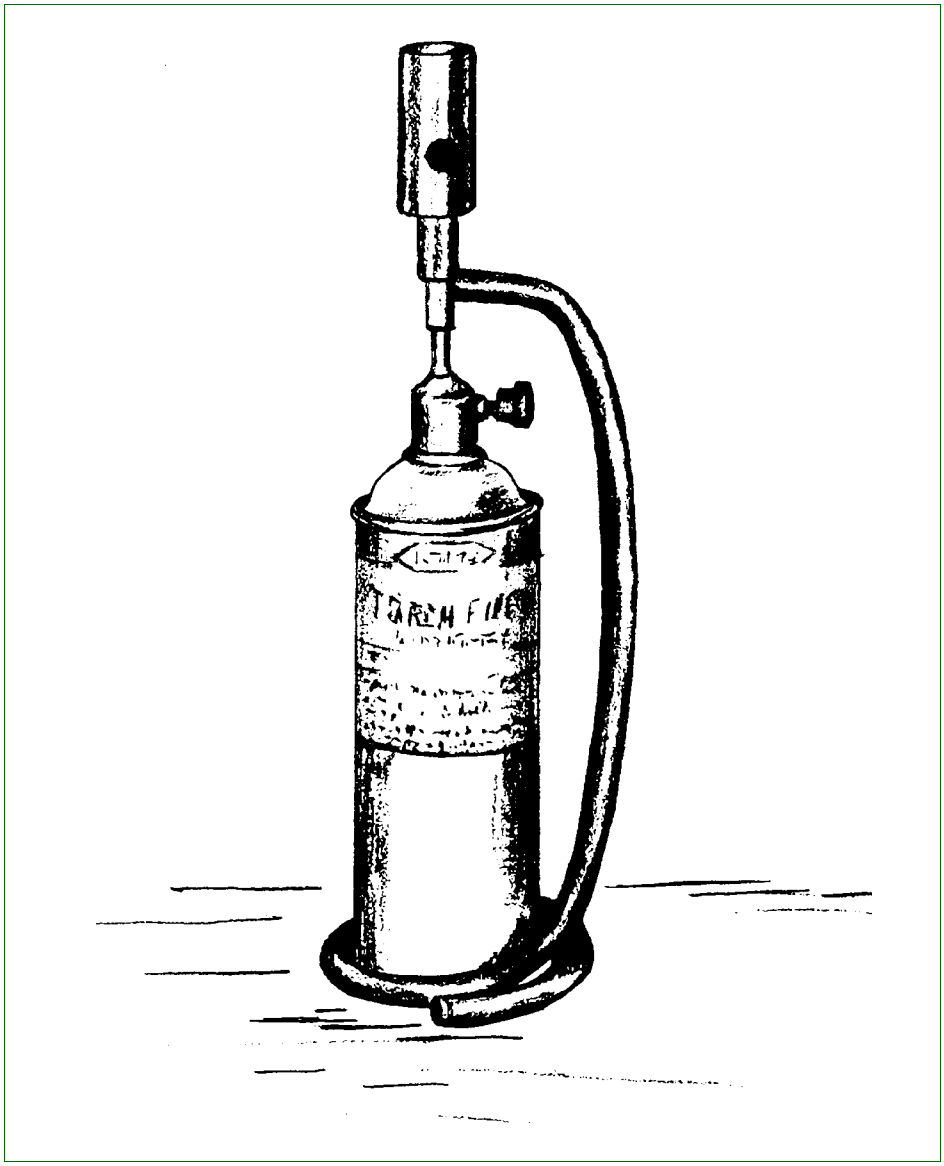


FIGURE 8-1-2: Halide Gas Leak Detector Using Disposable Propane Tank

Respiratory Protection

Introduction

Fumigation or other treatments conducted under the monitored conditions stated in this Manual and other program manuals, are safe operations. The Occupational Safety and Health Administration (OSHA) has ruled that employees with possible exposure to pesticides (including fumigants) shall be provided adequate respiratory protection from such exposure. This section discusses the types, capabilities, limitations, and uses of different respiratory protection available.

Responsibility

Management's Responsibilities

1. Provide respiratory protective equipment when such equipment is necessary to protect the health of the individual.
2. Provide equipment which is applicable and suitable for the purpose intended.
3. Establish a maintenance program for respiratory devices used.
4. Initiate and maintain a regular training program to inform personnel of basic and current information.

Officer's Responsibilities

1. Use and maintain respiratory equipment in accordance with instructions written in this manual and other instructions issued. Adherence or nonadherence to prescribed instructions for the proper use of protective devices and equipment will be a factor in evaluating the quality of an employee's performance. Gross disregard for safety measures may result in disciplinary action. A proper respiratory protection unit is required at the treatment site.
2. Report any damage or malfunction of the device to management.
3. Carry out routine cleaning and care in accordance with instructions in this manual or instructions provided by the manufacturer.

TABLE 8-1-2: Threshold Limit Values of Fumigants

Toxicity	Threshold limit value
Methyl bromide (MB)	5 ppm (skin)* STEL** and ceiling
Sulfuryl fluoride (SF)	10 ppm STEL**; 5 ppm TWA***
Phosphine (PH)	1 ppm STEL**; 0.3 ppm TWA***

*Skin means the potential overall exposure includes absorption through the skin and mucous membranes.
**Short term exposure limit
***Time-weighted average

General

For Fumigants

Every effort will be made by management and workers to prevent exposure of PPQ personnel to atmospheres containing dangerous concentrations of toxic fumigants or other pesticides, or to atmospheres where there is an oxygen deficiency. However, if an emergency situation develops where personnel may be exposed, only respiratory protective equipment with a pressure-demand regulator shall be used. This includes self-contained breathing apparatus (SCBA), air supplied respirators, and units combining these two types. (In this manual the term “SCBA” may be read to include all three of these types.) The pressure-demand respirator affords the best protection currently available because positive air pressure is maintained in the full face mask at all times.

For Pesticides Other Than Fumigants

When there is doubt as to the selection of proper respiratory protection in either of the following categories, the device which offers the best protection must be used. The determination of the type can be made by consulting this manual, the pesticide label, and the supervisor.

Air Purifying Respirators

Air purifying respirators using either a full face mask or half face mask are acceptable in areas where concentrations below maximums designated on the canisters can be expected. They may also be used during application of pesticides with a toxicity or concentration known to pose little or no danger when applied correctly.

Dust Masks

Dust masks may be used when particulate matter such as dust, insect scales, aerosol, spray, or other particles are a nuisance and are of low or moderate toxicity.

Employee Acceptance

The wearer’s acceptance of respiratory protection depends on facepiece comfort, clear and full vision, weight of the device, breathing resistance, individual physical condition, and personal preference. If more than one device with the proper facepiece seal is approved for the conditions, then the most comfortable device may be used by the

individual. PPQ will use only respiratory protective equipment tested and certified by the National Institute for Occupational Safety and Health (NIOSH), and carrying an approval number prefixed by “TC.”

Capabilities and Limitations

Self-Contained Breathing Apparatus (SCBA)

Breathing air is carried in a tank by the user. When properly fitted and used according to instructions, the positive pressure-demand system will prevent harmful contaminants from entering and will provide breathing air in low oxygen areas. A warning device indicates when the air supply is low and allows adequate time for leaving the area. The individual must know that only 5 to 7 minutes air remain at the alarm and that a proper evacuation route must be planned in advance. Each unit should be tested to determine the time remaining at the sound of the alarm.

Limitations

The time which the device will provide respiratory protection is limited by the amount of air in the tank. Rapid breathing due to stress will use the air supply more quickly. There is no protection against skin irritation from toxic gases with the self-contained breathing apparatus. Since some chemicals such as HCN or pesticide groups like the organo-phosphates can be absorbed through the skin, splashes of liquid fumigants or other pesticides must be avoided and protective clothing worn to protect against accidental exposure.

Gas and Vapor Removing Respirators

Canisters and cartridges can be used as protection from most pesticides *other than fumigants*. The type of canister must be selected for a specific gas or vapor or combinations of gases or vapors. These devices have the advantage of being small, light, and simple in operation.

Limitations

Canisters and cartridges are not effective in oxygen-deficient atmospheres. There is no protection from skin irritations or absorption of pesticides through the skin. The capacity of the cartridge or canister determines the maximum contaminant concentration against which a purifying respirator will protect. The maximum concentration for which a canister is designed is printed on the label. Cartridges do not have this information. No protection is provided against particulate contaminants, unless specified on the canister or cartridge label.

The unit will not provide full protection unless the facepiece is carefully fitted to the wearer's face. The time during which protection is provided is dependent on canister or cartridge type concentration of the contaminant, and the wearer's respiratory rate.

A rise in canister or cartridge temperature indicates that a gas or vapor is being removed from the inspired air. However, this characteristic should not be relied on as an indicator of canister performance. An uncomfortably high canister temperature usually indicates a high concentration of gas or vapor and requires an immediate return to fresh air.

Particulate Removing Respirators

Particulate removing respirators may be used only to protect against nonvolatile particles. No protection is afforded against gases and vapors unless a special combination filter and chemical cartridge (canister) system is used. The filter or cartridge shall be replaced when breathing becomes difficult due to plugging by retained particles. Combination respirators using both chemical and mechanical filtering systems are used for dual or multiple exposures to dust and vapors. Normally, filters used for removing dust, mist, or other particulates plug up before the chemical cartridge is exhausted. Both filter and chemical cartridge should be replaced at the same time.

Selection of Respiratory Protection

Work time, including the time necessary to enter or leave a contaminated area, determines the length of time for which respiratory protection is needed. The selection of respirators must be based on all hazards to which the wearer may be exposed.

The only unit with an adequate warning device is the SCBA. The SCBA is equipped with a pressure gauge and audible alarm device. Canisters may have a window indicator which only indicates the presence of moisture. Because canister and cartridge respirators have no indication of remaining service life, used canisters and cartridges should be replaced after each use.

The more active the wearer is, the more rapid his breathing. This shortens the usable working time of all types of respirators. High breathing resistance of air-purifying respirators under conditions of heavy work can result in distressed breathing.

Use of Respirator Protection

Assignment of Respiratory Protection

Every effort will be made to avoid the need for respirators. The supervisor issuing respirators shall be adequately trained to ensure that the correct respirator is issued for each type of possible pesticide exposure. Pesticide labels must be followed regarding respirator use unless more rigid standards are specified by PPQ.

A determination may be made by the supervisor if the officer is physically able to wear the respirator by checking with the employee for any history of pulmonary or cardiovascular problems. If such conditions are disclosed, a physician should evaluate the ability of the employee to wear a respirator. One or more of the following tests should be conducted:

- Pulmonary Function Test
- Chest X-ray
- EKG
- Examination of nasal passages

Any such examination should be requested and reported as outlined in Section 7.2.8 of the Animal and Plant Health Inspection Service (APHIS) Safety and Health Manual. Use APHIS Form 29 for this purpose.

A review must be conducted at least every 3 years or if there is a significant change in the medical or physical condition of the officer. Procedures for conducting this review are outlined in Change No. 5 of the APHIS Safety and Health Manual, dated 2/7/86.

Use in Dangerous Atmospheres

In situations where employees may be overcome by a toxic or oxygen-deficient atmosphere, at least one additional person qualified in the use of respirators (such as the commercial applicator) shall be present. The commercial applicator and the employee should cooperate to limit the likelihood of exposure of both individuals at one time. All precautions shall be followed to prevent exposure to any individual at a treatment site. Should exposure occur and an employee be overcome by a toxic atmosphere, rescue should not be attempted without the SCBA.

Facepiece Fitting

All respirator or SCBA wearers must receive prior fitting instructions from their supervisors, fumigation trainers, or others experienced in these procedures. By demonstrations and practice, the wearer will know how to wear the respirator, how to make adjustments, and how to determine correct fit.

Even the same individual fit can vary over time due to weight loss or gain, hair, and scars. Supervisors will schedule periodic fittings to ensure that officers are diligent in observing these conditions. With ideal wearing conditions, leakage may be as low as 1 percent. The wearer must check facepiece fit according to manufacturer's facepiece fitting instructions each time respiratory protection is put on.

Inward leakage is one of the most important considerations in selecting a facepiece. Since conditions such as growth of beard, sideburns, a skull cap that projects under the facepiece, temple pieces of eyeglasses, or the absence of one or both dentures may prevent obtaining an effective face seal, they must be corrected so an effective seal is obtained. Having a clean shaven area for an effective seal, removal, or repositioning of a skull cap, use of an eyeglass adapter kit (contact lenses may not be worn during fumigations), or inserting dentures are some ways which must be used to correct these conditions. Long sideburns, beards, and other facial hair in the sealing area does prevent an effective seal even for positive pressure masks, and is in violation of the Occupational Safety and Health Administration (OSHA) regulations. Since the presence of facial hair in the sealing area is in direct violation of the OSHA regulations and also creates a significant safety hazard for the employees and their co-workers, the sealing area of the face will be cleanly shaven to permit an effective seal. All supervisors and employees must be advised of this policy.

Important

The proper seal can also be attained with a hooded pressure demand SCBA designed to fit over beards and glasses, such as, Survivair's Puma™, which is NIOSH-certified and OSHA-compliant.

All personnel assigned fumigation and/or pesticide duties wear SCBA's during critical portions of treatment procedures and must not have any condition(s) which prevent obtaining an effective face seal. Individual face masks, available in small, medium, and large sizes may be assigned.

Facepiece Fit Tests

The facepiece fit must be checked by the wearer each time the respiratory protection is used. This will be done by following the manufacturer's facepiece-fitting instructions. Two simple field tests are described below.

Negative Pressure Test

Close off the inlet opening of the facepiece or the canister or cartridges by covering with the palm of the hand(s). Inhale gently so that the facepiece collapses slightly and hold your breath for 10 seconds. If the facepiece remains in a slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is probably satisfactory.

Also, leakage can be detected by crushing an ampoule of isoamyl acetate and passing it 1 to 2 inches around the seal area and exhalation valve. In this case, leakage will be noted by a “banana-like” odor in the facepiece. (See Isoamyl acetate in Appendix H, Reference Guide to Commercial Suppliers of Treatment and Related Safety Equipment.)

Positive Pressure Test

Close the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slightly positive pressure can be built up inside the facepiece without any evidence of outward leakage of air along the seal. For most respirators, this method of leak testing requires that the wearer remove the exhalation valve cover and then be sure to carefully replace it after the test. The exhalation valve cover must be replaced the correct way to prevent affecting the rubber valve.

Special Problem

Corrective Lenses With Full Facepiece

All facepieces will restrict, to some degree, the wearer’s vision. This will increase accident potential. A proper seal cannot be established if the temple bars of eyeglasses extend through the sealing edge of the full facemask. A prescription spectacle kit for respirators is available to correct this problem. All personnel who must wear prescription eyeglasses must use this kit when wearing equipment with a full facepiece.

It is APHIS policy to supply this adapter kit to all personnel requiring one.

WARNING

Wearing of contact lenses in contaminated atmospheres with a respiratory protection device is prohibited.

Eyeglasses With Half Facepiece

If corrective eyeglasses or goggles are required, they shall be worn so they do not affect the fit of the facepiece. Proper selection of equipment will minimize or avoid this problem.

Use in Low Temperatures

The use of full facepieces at low temperatures presents problems such as poor visibility and freezing of exhalation valves. All full facepieces are designed so that the incoming fresh air sweeps over the inside of the lens to reduce fogging. This makes it possible to wear a full facepiece in ordinary room temperatures without severe fogging. Antifog compounds can be used to coat the inside of the lens to prevent fogging at room temperatures and down to temperatures approaching 32°F. However, below 0°F, antifog compounds will not prevent severe fogging.

Although such instances are not usually encountered, the employee should be aware that it is dangerous to work at temperatures near freezing and below when using respirators not designed for such use.

When using air supplied respirators, the high-pressure connections may leak because of metal contraction at low temperatures. It is important to remember that connections should not be over tightened since they may break when temperatures return to normal.

Communications

The conventional respirator exhalation valve will provide a pathway for some speech transmission over short distances in relatively quiet areas. Talking can induce facepiece or component leakage and, therefore, should be limited while wearing a respirator, especially those with half-facepiece.

Maintenance and Care

Equipment must be properly maintained to retain its effectiveness. A program for maintenance and care include the following basic services:

- Inspection for defects (including leak checks)
- Cleaning and disinfecting
- Repairs
- Storage
- Respirable air for SCBA

Inspection

The user shall inspect the respiratory equipment before and after each use. Respiratory equipment that is not routinely used, but is kept ready for emergency use, shall be inspected at least monthly to ensure that it is in satisfactory working condition. SCBA air cylinders shall be fully charged according to the manufacturer's instructions.

Inspection shall include:

1. Check tightness of connections.
2. Check the condition of the facepiece, headbands, valves, connecting tube, and any canisters or cartridges.
3. Check rubber or other elastic parts for pliability and signs of deterioration.
4. Check the regulator and the warning device to determine proper functioning before each use.
5. Check for leaks.

Keep a record of inspection dates and findings in the unit carrying case.

Cleaning and Disinfection

Clean and disinfect routinely used equipment after each use and those not routinely used as necessary to ensure that proper protection is provided for the wearer. The following is recommended for cleaning and disinfecting respiratory protection devices:

1. Remove any filters, cartridges, or canisters.
2. Wash facepiece and breathing tube with a cleaner-disinfectant or detergent solution (see following paragraphs). Use a hand brush to facilitate removal of dirt.
3. Rinse completely in clean, warm water.
4. Air dry in a clean area.
5. Clean other parts as recommended by manufacturer.
6. Inspect valves, headstraps, and other parts. Replace with new parts when defective. Stretching and manipulating rubber elastomer parts with a massaging action will keep them pliable and flexible and prevent them from warping or sticking during storage.
7. Insert new filter, cartridge, or canister in the unit. Make sure seal is tight.

Cleaner-disinfectant solutions containing a bactericidal agent (generally a quaternary ammonium compound) are available.

Commercial products must be used according to the label to obtain the proper solution. However, different concentrations of the quaternary ammonium salt are required for various hardness of water to obtain a satisfactory disinfectant solution. Dermatitis may occur if the quaternary ammonium compounds are not completely rinsed from the facepiece and associated parts.

Strong cleaning and disinfecting can damage parts. Avoid temperatures above 120°F and vigorous mechanical agitation. Solvents which affect elastomer or rubber parts must be used with caution.

Respiratory protective equipment may be contaminated with toxic materials such as organo-phosphates or other pesticides. If the contamination is light, normal cleaning procedures should provide satisfactory decontamination. If contamination is heavy, a separate decontamination step may be required before cleaning. For complete decontamination of phosphate pesticide residues, wash with alkaline soap, rinse with clean warm water and then rinse with 50 percent alcohol (ethyl or isopropyl).

If commercial materials are not available, respiratory equipment may be washed in a liquid detergent solution, then immersed in one of the following:

- Sodium hypochlorite solution (50 parts per million of chlorine) for 2 minutes; **OR**
- An aqueous iodine solution (50 parts per million of iodine) for 2 minutes; **OR**
- A quaternary ammonium solution with 200 parts per million of quaternary ammonium compounds in water of less than 500 parts per million total hardness (See Quaternary Ammonium in Appendix H, Reference Guide to Commercial Suppliers of Treatment and Related Safety Equipment.)

The sodium hypochlorite and iodine solutions are not stable. You must prepare fresh solution for each use. These solutions age rubber parts and are corrosive to metallic parts, therefore, immersion times should not be extended and the disinfectants should be thoroughly rinsed from all parts with clean, warm water.

Repair

Only experienced persons shall handle replacements or repairs using only those parts specifically designed for the equipment. Make no attempt to replace components or to make adjustments or repairs beyond the manufacturer's recommendations. Reducing or inlet valves and regulators shall be returned to the manufacturer or sent to a trained technician for adjustment or repair.

Storage

After inspection, cleaning, and necessary repair, equipment shall be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Respiratory equipment located at stations and work areas for emergency use should be stored in compartments built for that purpose. They should be clearly marked and quickly accessible at all times. Under no circumstances shall a motor vehicle be used for storage of respiratory protective equipment. The excessive and uncontrollable changes in temperature are bad for this equipment.

Routinely used respirators, such as dust respirators, may be placed in resealable plastic bags or heat sealed plastic. Respirators should not be stored in such places as lockers or tool boxes unless they are in carrying cases or cartons and plainly marked. Respirators should be packed or stored so that the facepiece and exhalation valve will rest in a normal position to prevent function impairment by the elastomer taking a permanent set in an abnormal position. It is advisable to rotate the respirator face up, or face down at monthly inspections. Instructions for proper storage of emergency respirators, or self-contained breathing apparatus are found in “use and care” instructions usually mounted inside the carrying case lid. Should the case not have such instructions, obtain them from the manufacturer and place in the case cover.

Respirable Air for Self-Contained Breathing Apparatus

Compressed air shall be of high purity. Breathing air shall meet the requirements for Grade D breathing air as described in Compressed Gas Association Commodity Specification G-7.1-1966. Air tanks can be refilled at most SCUBA diving stores or where local fire departments or rescue squads obtain air for their units. Test data denoting the quality of the compressed air should be available from the air supplier.

There is no need to change the air in the units, even after extended periods of time.

Compressed oxygen shall ***not*** be used. (Compressed air may contain a low concentration of oil. When high-pressure oxygen passes through an oil or grease coated orifice, an explosion or fire may occur.)

Breathing air cylinders shall be tested every 5 years from the date stamped on the tank and maintained in accordance with Department of Transportation (DOT) or Interstate Commerce Commission Specifications for shipping containers.

Breathing air cylinders shall be marked in accordance with American National Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained.

Detector Kits or Gas Samples

Although thermal conductivity (T/C) units such as the Gow-Mac® and the Fumiscope® are used to measure concentrations of methyl bromide, ethylene oxide-carbon dioxide mixtures, sulfuryl fluoride, and certain other fumigants in ounces per 1,000 cubic feet (milligrams per liter). Concentrations of phosphine and some other fumigants cannot be measured with a T/C unit. However, they may be measured with detector tubes. Residual gas concentrations during aeration of commodities or enclosures can also be determined for most fumigants with detector tubes.

Principles of Operations

Special pumps are used to draw a measured sample (usually 100 milliliters) of an air-gas mixture. The sample is drawn through one or two detector tubes where a chemical reaction with the tube reagent takes place, creating a stain. The length of the stain is proportional to the concentration of the gas. Measurement of the length of the stain is made using a calibrated chart or by simply reading the number from a scale printed on the glass tube.

Gas detector tubes are manufactured with a constant reagent weight with corrections for variations in the diameter of each tube. Detailed operational instructions accompany the equipment.

The detector tubes are specific for each fumigant and usually are available from several manufacturers. However, it is advisable to use the pump supplied by the manufacturer of the tube used. In an emergency, detector tubes available under the trade names of Auer, Draeger, Gastec, Kitagawa, and Mine Safety Appliances can be used with pumps manufactured by any of these companies provided they draw 100 ml. Adapters may be necessary because of the different diameters of the tubes sold by each manufacturer. The Kitagawa pump uses a removable, stainless-steel micro-orifice to reduce the rate of air flow through many of their detector tubes. This is to provide greater accuracy in the chemical reaction within the tube. The orifice should be removed when using tubes manufactured by other companies.

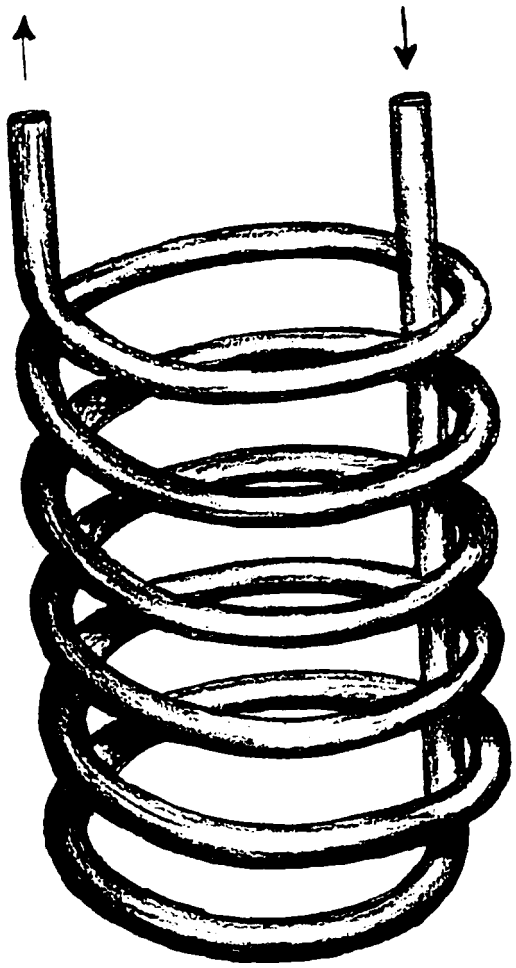
Tubes should be stored under refrigeration to increase shelf life. Before each day's use, pumps should be tested as provided by instructions with each kit and repairs made as necessary. Spare parts and operational instructions should be kept with each kit for use as needed.

When many samples must be drawn to a common point during a large fumigation, an auxiliary pump can be used. If only one sample lead is involved, it may be necessary to pull the fumigant through the line by pumping several times. A used tube can be inserted in the pump to determine when the fumigant has reached the pump.

Volatilizer

It is desirable to pass some fumigants through a vaporizer to assure volatilization at any temperature below 60°F or when large quantities (i.e., a total amount of 5 pounds or more of methyl bromide) are required. The volatilized fumigant should be introduced into or near to the air flow of the blower or fan. A simple volatilizer can be made with a 25-foot coil of 3/8 inch O.D. copper tubing immersed in a container of hot water. For use with amounts greater than 5 pounds of methyl bromide, 50 feet of 1/2 inch O.D. copper tubing can be coiled in a large container of water which has been heated to temperatures of 150°F or above.

The fumigator should be warned that the fumigant should be introduced through the tubing at the rate of 3 to 4 pounds of gas per minute. The gas introduction tube should feel hot to the touch as a good measure of satisfactory vaporization.



The volatilizer should be made of semihard copper tubing. It is important that gas be introduced and discharged as shown by arrows. If applied in reverse order, it may move so rapidly that some liquid will pass into the chamber.

FIGURE 8-1-3: Methyl Bromide Volatilizer Coil

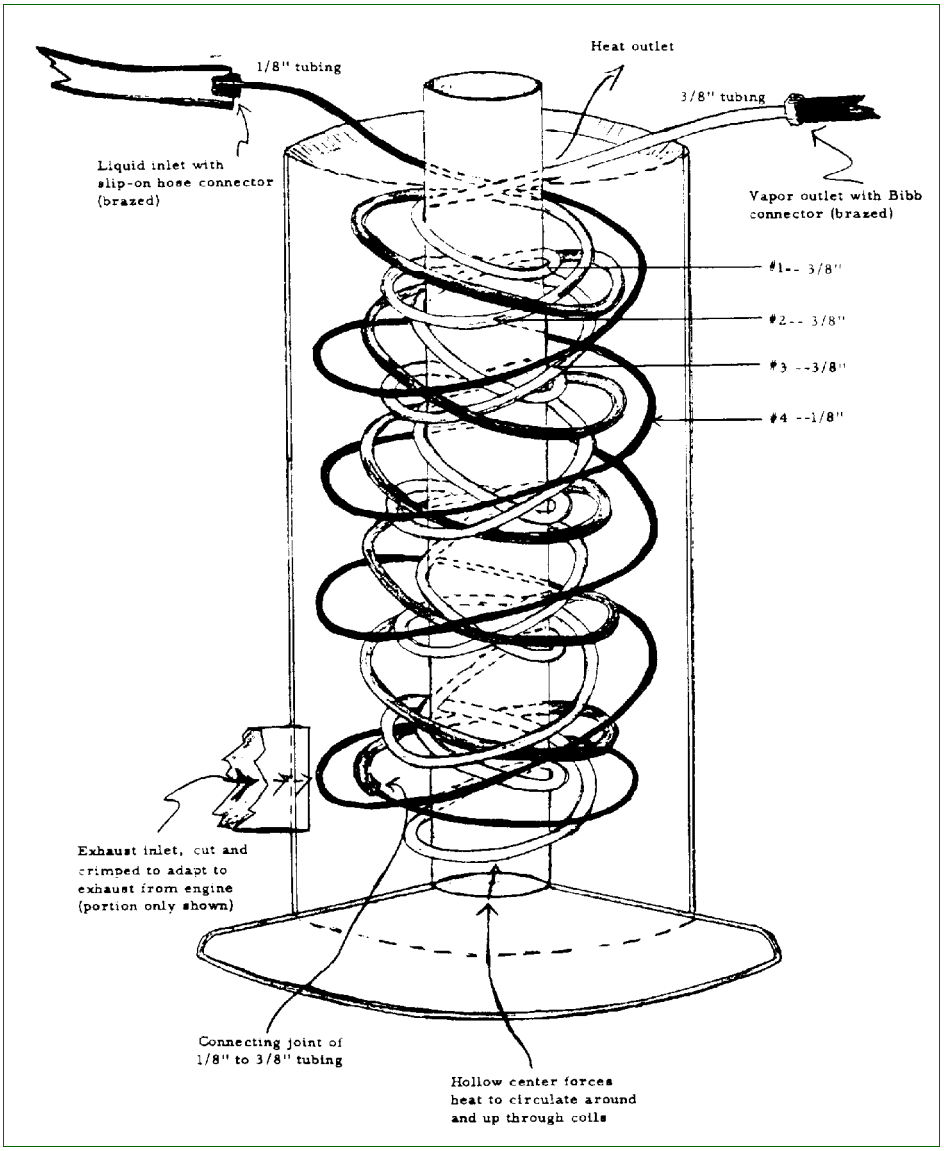


FIGURE 8-1-4: Liquid Fumigant Vaporizer

Air Velocity Measuring Instruments

Anemometer

The cubic feet per minute (cfm) of a fan can be approximated by use of an anemometer or other wind measuring device. Measurements of air movement are taken 12 inches from the face of the fan to be tested. A minimum of three readings should be taken; one from the center and the others from points toward the outside of the fan. Readings are then averaged. If an anemometer is used, each measurement should be for 1 minute, thereby giving the result in feet per minute. If a wind

speed indicator is used, the reading in miles per hour should be converted to feet per minute by multiplying the miles per hour by 5,280 and dividing by 60.

Area of the fan is calculated by first measuring the radius (R)—distance from center of fan to end of a blade. Formula for area is ¼ R^2 where ¼ is equivalent to 3.1416 (22/7). The final answer should be given in cfm. Therefore, if the radius of the blade is given in inches and not feet, the factor 1/144 must be multiplied in to convert square inches to square feet. The full formula would be: Feet per minute × R^2 (in inches) × ¼ × 1/144 = cfm.

EXAMPLE: If average air movement is 1,600 feet for 1 minute from a fan having a 7 inch radius (14 inch diameter), the calculations are as follows:

$$1{,}600 \times 7^2 \times 3.1416 \times 1/144 = 1{,}700 \text{ cfm (approximate)}$$

Velometer

The Velometer is the registered trade name of Illinois Testing Laboratories, Inc., Chicago, Illinois, for their air speed indicators. Readings are taken by either holding the instrument itself or jets (probes) in front of the air stream. Velocities are rapidly determined in units of feet per minute without timing or calculations. Units are especially useful for measuring air flow in ducts and in front of grilles.

Auxiliary Pump

During the fumigation of large enclosures, it is necessary to take numerous gas concentration readings from various locations throughout the enclosure. Thus some sample leads may be over 200 feet long. The fumigant must be pumped to the sampling point before an accurate concentration reading can be made. If the inspector must rely on the pump provided with the gas sampler or thermal conductivity unit to pull the fumigant, a great deal of time will be needed between readings.

The auxiliary pump will reduce sampling time to only the reading time since it pumps the fumigant from many areas and keeps a constant pull. Construction of a unit is relatively simple. Petcocks capable of accepting sample leads are tapped and soldered to a short length of pipe. This pipe is connected to the suction side of the pump. The pipe acts as a manifold. Opening or closing the petcocks allows the drawing of the gas samples as required. An exhaust line of sufficient length should be connected to the pump to ensure the fumigant is removed from the sample area.

It is important that all soldering be done in such a manner as to provide gas tight construction of the petcocks. The pump should be of sufficient size to pull 1 cubic foot per minute through all of the leads on the manifold. Therefore, the more leads, the higher the required capacity of the pump. The whole unit should be mounted on a board large enough to keep vibration to a minimum. The unit weight should be kept down to allow easy transport.

Each sampling line is disconnected from the auxiliary pump in turn, and the petcock closed. Line is then attached to the T/C unit or gas detector. A reading is obtained and line reconnected to the auxiliary pump and the petcock opened.

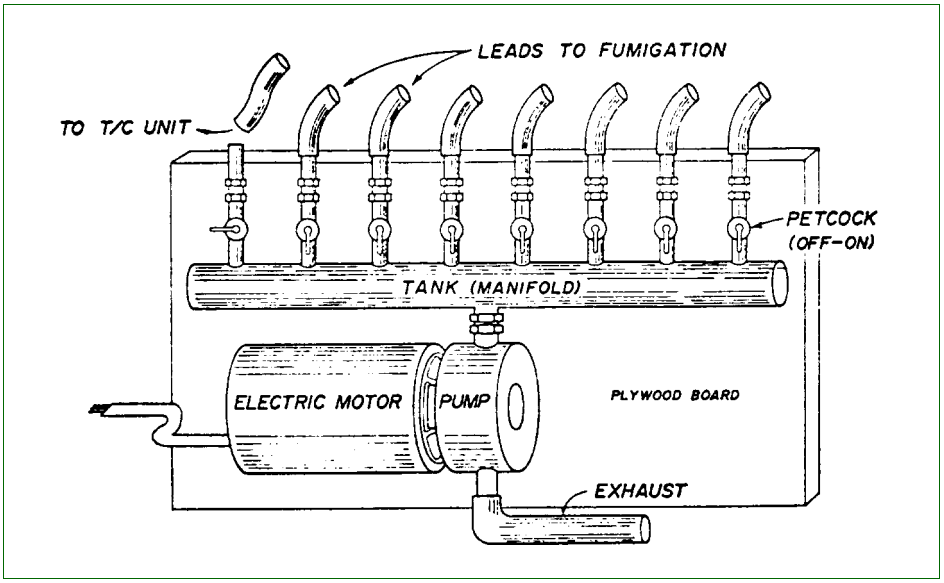


FIGURE 8-1-5: Auxiliary Pump

Open Arm Manometer

The manometer is a U-shaped tube partially filled with kerosene or water. The tube may be of glass or transparent plastic tubing. A ruler calibrated in millimeter (mm) divisions or carefully measured lines on a background is used to measure the difference in level of the kerosene in the two arms (or the level in one arm).

When a fumigant is volatilized in a chamber at atmospheric pressure, a positive pressure is created, which may then be continuously reduced by leakage of the air-fumigant mixture. PPQ approved chambers must be sufficiently tight to retain the fumigant during the exposure period. The manometer is used during the pressure-leakage test as a measure of tightness. An opening (usually 1 inch diameter) should be provided in the chamber for the use of a blower or other means for the introduction of air to create a positive pressure in the

chamber. An additional opening, such as a gas sampling line opening, must be provided for the manometer. The procedure for testing is as follows:

- Close chamber as for fumigation
- Attach one end of the manometer to the chamber opening
- Use vacuum cleaner blower or similar apparatus to create pressure of 25 mm as measured on an open-arm, kerosene or water filled manometer
- Discontinue blower and close its entry
- Observe time for pressure to recede from 25 to 2.5 mm in the open arm

The time lapse for the chamber pressure to recede from 25 to 2.5 mm in the open arm must be 22 or more seconds for minimum approval. Chambers shall be reinspected every 6 months when 22 to 29 seconds are recorded. Chambers which retain the pressure for 30 seconds or longer should be tested annually. (Chambers used for fumigating cherries for export to Japan are required to meet a higher standard—the time lapse for the chamber pressure to recede from 25 to 2.5 mm must be 60 or more seconds for minimum approval.) Inability to develop or maintain adequate pressure indicates considerable leakage. In such cases, the chamber operator may use a smoke bomb or other device in an effort to determine the areas of leakage.

Electronic manometers are also available and may be used in lieu of the Open-arm (U-tube) type.

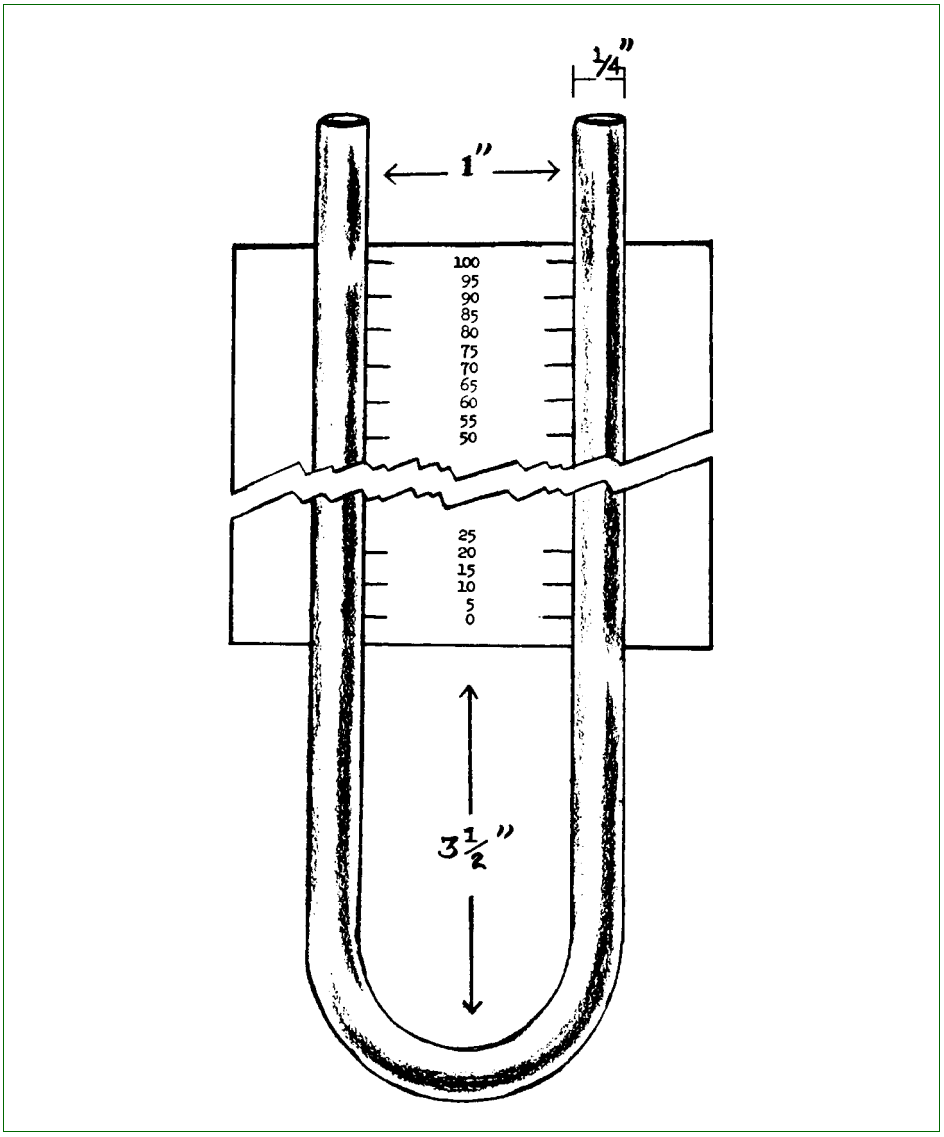


FIGURE 8-1-6: Open-arm Manometer

Vacuum Pump

Mityvac Hand-Held Vacuum Pump

The Center for Plant Health Science and Technology has developed the following procedure to detect blocked monitoring leads with the use of a Mityvac hand-held vacuum pump (for supplier, see *Vacuum Pump*, Appendix 8):

Usage

1. Prior to fumigant introduction, connect the Mityvac hand-held vacuum pump to a monitoring lead.
2. Squeeze the handle on the Mityvac Unit. If the lead is blocked, a vacuum will be indicated on the vacuum gauge of the Mityvac unit. (The handle should be squeezed two or three times for monitoring leads longer than 25 feet. The Mityvac hand-held pump has the capacity to attain and hold 25 inches of Hg vacuum and a minimum of 7 psi pressure.)
3. Disconnect the Mityvac hand-held pump from the monitoring lead, and repeat this procedure for each monitoring lead. (Connect monitoring leads to the gas analyzer prior to fumigant introduction.)

Phosphine Detector

PortaSens Phosphine Detector

Description

Historically, phosphine measurements have been done using detector tubes specific for phosphine (see **Detector Kits or Gas Samplers** in this section). The high cost associated with these tubes have been a deterrent for many ports.

A more accurate, portable unit has been recommended for usage during phosphine fumigations. The Series B16 PortaSens is a portable, battery operated instrument for the measurement of various gas concentrations in ambient air. The instrument can be ordered specifically for phosphine in the 0-1,000 ppm range. Ranges from 0-1 ppm are available also, along with other configurations. The PortaSens is a complete measuring instrument containing an electrochemical sensor, sampling pump, flow cell assembly, microprocessor electronics, and a two line backlit LCD display. The unit is powered by a rechargeable NiCad battery located in the handle, with the charger connection located at the bottom of the handle.

Operation

The PortaSens needs to be calibrated by the Center for Plant Health Science & Technology (CPHST) before usage. After calibration, the instrument is ready to use directly out of the box. Simply remove the instrument from the storage case and press and release the button (instrument switch) on the front of the handle. The LCD display on the front will immediately be activated and the internal pump will begin to pull sample into the flow cell.

The unit comes with a flexible extension wand that screws into the standard inlet fitting. Connect the extension wand and a length of flexible tubing that will reach safely from the item(s) being fumigated to the PortaSens.

Response Time

Response time will vary depending on the gas concentration and ambient temperature. The LCD readout will stabilize when maximum concentration is reached. Readings will be more timely when the monitoring leads are purged using the Mityvac hand held vacuum pump (refer Mityvac Hand-Held Vacuum Pump).

Alarm Function

The PortaSens contains both visual and audible gas concentration alarm functions that are preset at the factory. Refer to B16 PortaSens Operation and Maintenance Manual for specific instructions. For instruments in the 0-1,000 ppm range, the alarm has been disabled to allow for more efficient usage.

Battery Power Supply

The instrument is powered by a rechargeable NiCad battery. With a fully charged battery, the unit will operate continuously for 12 hours at 20°C. Battery capacity will drop with decreasing temperature. Should the battery become weak during operation, the lower line of the LCD display will indicate “LOW BATT.” An audible beeper will begin to sound. At this point, there will be 1 hour of operating time left. When the voltage reaches a level where reliable measurements are no longer possible, the unit will turn itself off. It is good practice to leave the instrument on charge at all times if emergency use is anticipated.

Flow Verification

Proper flow should always be verified before using the PortaSens for leak detection. When the unit is turned on, a pump continuously delivers an air sample to the flow cell. In normal operation, the flow rate is approximately 300 cc/min. In order to allow quick verification of proper flow, a flowmeter is included in the PortaSens kit. Turn the instrument on and connect the sampling wand. Place the tip of the sampling wand into the tubing adapter attached to the flowmeter. Hold the flowmeter in the vertical position and verify that the flow rate is above 150 cc/min.

Power Down

In order to turn the unit off, press and hold the switch for approximately 3 seconds, until the “POWER DOWN” message appears on the display and then release.

9 Glossary

Treatment Manual

Acronyms, Abbreviations, and Terms

a.i.	active ingredient
ACGIH	American Conference of Governmental Industrial Hygienists
ADI	Acceptable Daily Intake
APHIS	Animal and Plant Health Inspection Service
BBEP	Biotechnology, Biologics, and Environmental Protection
bw	body weight
CAS	Chemical Abstracts Service
cc	cubic centimeters
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
ChE	cholinesterase
CHEMTREC	24-hour emergency telephone service for spills
CNS	central nervous system
copra	dried coconuts and whole coconuts without the husk
COR	Contracting Officer's Representative
CPK	creatine phosphokinase
cu.m	cubic meter
CWA	Clean Water Act
DHEW	U.S. Department of Health, Education, and Welfare
DNA	deoxyribonucleic acid
DOT	U.S. Department of Transportation
DW	drinking water
EPA	Environmental Protection Agency
External Feeder	A pest that normally inhabits the outside or outer part of its host. Contrast with hitchhiker and internal feeder.
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
g	grams
GI	gastrointestinal
HDT	highest dose tested
Hgb	hemoglobin
HHS	U.S. Department of Health and Human Services
Hitchhiker	A pest transported by chance and not found inhabiting its host. Contrast with external feeder.
i.m.	intramuscular
Internal Feeder	A pest that normally inhabits the inside or inner part of its host. Contrast with external feeder.
i.p.	intraperitoneal

i.v.	intravenous
kg	kilogram
L	liter
LC50	Lethal Concentration 50; dose lethal to 50% of the animals
LCLO	Lethal Concentration Low; the lowest concentration causing death
LD50	Lethal Dose 50; dose lethal to 50% of the animals
LDLO	Lethal Dose Low; the lowest dose at which death occurred
LDT	lowest dose tested
LEL	lower exposure limit, or lowest-effect level
LOAEL	lowest-observed-adverse-effect-level
m	meter
MED	minimum effective dose
mg	milligram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mmHg	millimeters of mercury; a measure of pressure
MOE	Margin of Exposure
MOS	Margin of Safety
MSDS	Material Safety Data Sheet
MTD	maximum tolerated dose
MTL	median threshold limit
NFPA	National Fire Prevention Association
ng	nanogram
NIOSH	National Institute for Occupational Safety and Health
NMRAL	National Monitoring and Residue Analysis Laboratory
NOAEL	no-observed-adverse-effect level
NOEL	no-observed-effect level
NTP	National Toxicology Program
OIC	Officer-in-Charge
OSHA	U.S. Occupational Safety and Health Administration
p.o.	per os (by mouth)
PEL	permissible exposure limit
PHS	U.S. Public Health Service
ppb	parts per billion
ppm	parts per million
PPQ	Plant Protection and Quarantine
RBC	red blood cell(s)
RfD	Reference Dose
RfDi	Inhalation Reference Dose
RfDo	Oral Reference Dose
s.c.	subcutaneous
STEL	short-term exposure limit

TLV	threshold limit value
TSS	Technical and Scientific Services
TWA	time-weighted average
UCL	upper confidence limit
UEL	upper exposure limit
UF	uncertainty factor
ug	microgram
ug/cu.	micrograms per cubic meter
ug/L	micrograms per liter
USDA	United States Department of Agriculture

Treatment Manual

Appendixes

Contents

Appendix A	Forms **page-A-1-1**
Appendix B	Coast Guard Regulations **page-B-1-1**
Appendix C	Maintenance: Supporting and Updating Manuals **page-C-1-1**
Appendix D	Conversion Tables **page-D-1-1**
Appendix E	Directory of Treatment Facilities **page-E-1-1**
Appendix F	List of Integral Containers Approved for Intransit Cold Treatment **page-F-1-1**
Appendix G	List of Vessels Equipped for Intransit Cold Treatment **page-G-1-1**
Appendix H	Reference Guide to Commercial Suppliers of Treatment and Related Safety Equipment **page-H-1-1**
Appendix I	(Contacts **page-I-1-1**)
Appendix J	(Frequently Asked Questions (FAQ's) **page-J-1-1**)
Appendix K	(Information Resources **page-K-1-1**)

A

Treatment Manual

Appendix A

Forms

Contents

APHIS Form 2061 (Residue Sample for Food or Feed Product) **page-A-1-2**
PPQ Form 429 (Fumigation Record) **page-A-1-11**
PPQ Form 519 (Compliance Agreement) **page-A-1-16**
PPQ Form 523 (Emergency Action Notification) **page-A-1-19**
PPQ Form 449-R (Temperature Recording Installation Report) **page-A-1-24**
PPQ Form 203 (Foreign Site Certificate of Inspection and/or Treatment) **page-A-1-25**
PPQ Form 556 (In Transit Cold Treatment Clearance Report) **page-A-1-26**
APHIS Form 205-R (Instructions and Worksheet for Calibrating Portable Temperature Sensors) **page-A-1-27**
APHIS Form 206-R (Test of the Accuracy of the Permanent RTD Sensors Installed in Hot Water Tanks) **page-A-1-28**
APHIS Form 207-R (Sensor Location Diagram Fruit Weights and Pulp Temperatures) **page-A-1-29**
APHIS Form 208 (Performance Test for Mango Hot Water Immersion Tank) **page-A-1-30**
Calibration of Temperature Probes (Cold Treatment) **page-A-1-31**
Instructions to Captain (Cold Treatment) **page-A-1-32**
Location of Temperature Sensors in Containerized Cargo (Cold Treatment) **page-A-1-33**
Certificate of Loading and Calibration for Cold Treatment in Self Refrigerated Containers (Cold Treatment) **page-A-1-34**
Application for USDA-APHIS Approval of Self-Refrigerated Containers (for use in conducting quarantine in-transit cold treatment under USDA regulations) **page-A-1-35**

This Appendix contains example forms and instructions for completing the forms you may need when conducting or monitoring a fumigation.

APHIS Form 2061 (Residue Sample for Food or Feed Product)

Example

NO CARBONS REQUIRED - PRESS HARD - YOU ARE MAKING 3 COPIES

USDA-APHIS

RESIDUE SAMPLE FOR FOOD OR FEED PRODUCT

INSTRUCTIONS: Use a separate form for each sample. Take one sample before treatment and one after. Submit original under separate cover and yellow copy with sample. Retain pink copy.

1. PPQ STATION									2. COMMODITY									3. COMMODITY LOT SIZE					4. *	5. DATE OF FUMIGATION					
Name *(first 6 letters)*						Code			Name *(first 6 letters)*						Code			No. of Kg.						Month		Day		Year	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

*Sample Taken 0 = Pre-treatment
1 = Post-treatment

6. DATE OF SAMPLE						7. SAMPLE NUMBER						8. PESTICIDE						9. PESTICIDE USE								10. PESTICIDE EXPOSURE PERIOD TIME *(hours)*			11. AERATION TIME *(hours)*		
Month		Day		Year								Name		Code				Rate (g/m³)			Total grams										
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62

12. REMARKS

13. SAMPLE COLLECTOR'S NAME

14. COLLECTOR'S TELEPHONE NO. *(FTS or Comm. no.)*

AC ( )

FOR LABORATORY USE ONLY

15. LABORATORY ACCESSION NUMBER						16. PESTICIDE CODE				17. PRE-TREATMENT SAMPLE										18. **	19. POST-TREATMENT SAMPLE										20. **
										Organic Residue						Inorganic Residue					Organic Residue						Inorganic Residue				
63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	80	91	92	93	94

**Corrected for Recovery Percent 0 = No 1 = Yes

CONFIRMATION

21. METHOD	22. ANALYST

APHIS FORM 2061
(MAR 92)

Replaces APHIS FORM 8006 (1/91) which may be used

*U.S. GPO: 1992-319-827/85079

FIGURE A-1-1: Example of APHIS Form 2061 (Residue Sample for Food or Feed Product)

Purpose

This form is used to provide information on samples of food and feed products sent to the National Monitoring Residue and Analysis Laboratory (NMRAL) for residue analysis (see the following distribution for address). This form provides information on the commodity and the fumigation performed under a FIFRA Section 18 quarantine exemption.

Instructions

Block Number	Instruction
1 Code	Fill in the first six letters of your location. Enter one of the following: 551 for Funded Program Support (regular time) 552 for Reimbursable Program Support (overtime)
2 Code	Fill in the first six letters of the commodity. See the list of codes beginning on page-A-1-3. If there is no code, describe commodity in Remarks.
3	Fill in number of kilograms of shipment.
4	Fill in “0” for pre-treatment and “1” for post-treatment sample.
5	Fill in numbers for day, month, and year.
6	Fill in date sample was taken.
7	Fill in sample number (you assign a number).
8 Code	For methyl bromide, enter MEBR.
9	Fill in dosage rate in grams/cubic meter. Fill in dosage (total amount of fumigant) in grams.
10	Fill in number of hours of exposure.
11	Fill in number of hours for aeration.
12	Fill any remarks.
13	Print your name.
14	Fill in your office telephone number. Use the commercial number.

Distribution

TABLE A-1-1: Distribution of APHIS Form 2061

If:	Then:
Original	Send under separate cover to NMRAL
Yellow copy	Mail to NMRAL with sample
Pink copy	Keep for your files

NMRAL Address:

National Monitoring Residue and Analysis Laboratory
P.O. Box 3209
Gulfport, MS 39505
Phone: (601) 863-8124
Fax: (601) 867-6130

TABLE A-1-2: Root and Tuber Vegetables

Codes	
001	Beet
002	Carrot
003	Dasheen (taro)
004	Horseradish
005	Jerusalem artichoke
006	Parsnip
007	Potato
008	Radish
009	Rutabaga
010	Sugar beet
011	Sweet potato
012	Turnip
013	Yams
019	Other roots and tubers

TABLE A-1-3: Leaves of Root and Tuber Vegetables

Codes	
020	Beet
021	Carrot
022	Turnip
023	Dasheen (taro)
024	Parsnip
025	Rutabaga
026	Sugar beet
039	Leaves of other roots and tubers

TABLE A-1-4: Bulb Vegetables

Codes	
040	Garlic
041	Leek
042	Onion
043	Shallot
049	Other bulb vegetables

TABLE A-1-5: Leafy Vegetables (Other Than *Brassica*)

Codes	
050	Celery
051	Corn salad
052	Dandelion
053	Endive
054	Garden cress
055	Lettuce
056	Spinach
057	Rhubarb
058	Parsley
059	Swiss chard
069	Other leafy vegetables

TABLE A-1-6: *Brassica* (Cole) Leafy Vegetables

Codes	
070	Broccoli
071	Brussels sprout
072	Cabbage
073	Chinese cabbage
074	Cauliflower
075	Collard
076	Kale
077	Kohlrabi
078	Mustard greens
079	Rape greens
089	Other *Brassica* leafy vegetables

TABLE A-1-7: Legume Vegetables

Codes	
090	Beans
091	Peas
092	Lentils
093	Soybeans
094	Fava beans
099	Other legume vegetables

TABLE A-1-8: Foliage of Legume Vegetables

Codes	
100	Beans
101	Peas
102	Soybeans
109	Foliage of other legume vegetables

TABLE A-1-9: Fruiting Vegetables Except Cucurbits

Codes	
110	Eggplant
111	Pepinos
112	Pepper
113	Pimentos
114	Tomatoes
119	Other fruiting vegetables except cucurbits

TABLE A-1-10: Fruiting Vegetables (Cucurbits)

Codes	
120	Citron melon
121	Cucumber
122	Gherkins
123	Melons (includes cantaloupe and muskmelon)
124	Pumpkin
125	Squash
126	Watermelon
139	Other fruiting vegetables (cucurbits)

TABLE A-1-11: Citrus Fruits

Codes	
140	Calamondin
141	Citrus citron
142	Grapefruit
143	Lemon
144	Lime
145	Mandarin
146	Orange
159	Other citrus fruits

TABLE A-1-12: Pome Fruits

Codes	
160	Apple
161	Crab apple
162	Loquat
163	Pear
164	Quince
179	Other pome fruits

TABLE A-1-13: Stone Fruits

Codes	
180	Apricot
181	Cherry
182	Nectarine
183	Peach
184	Plum
185	Prune
199	Other stone fruits

TABLE A-1-14: Small Fruits and Berries

Codes	
200	Blackberry
201	Blueberry
202	Boysenberry
203	Cranberry
204	Currant
205	Dewberry
206	Elderberry
219	Other small fruits and berries

TABLE A-1-15: Cereal Grains

Codes	
220	Barley
221	Buckwheat
222	Millet
223	Oats
224	Popcorn
225	Rice
226	Rye
227	Sorghum
228	Teosinte
229	Triticale
230	Wheat
231	Wild rice
232	Corn
239	Other cereal grains

TABLE A-1-16: Forage, Fodder, and Straw of Cereal Grains

Codes	
240	Barley
241	Corn
242	Sorghum
243	Wheat
259	Other forage, fodder, and straw

TABLE A-1-17: Grass Forage, Fodder, and Hay

Codes	
260	Bermuda grass
261	Bluegrass
262	Fescue
279	Other grass forage

TABLE A-1-18: Nongrass Animal Feeds

Codes	
280	Alfalfa
281	Clover
282	Sainfoin
283	Trefoil
284	Vetch
299	Other nongrass animal feed

TABLE A-1-19: Tree Nuts

Codes	
300	Almond
301	Beechnut
302	Brazil nut
303	Butternut
304	Cashew
305	Chestnut
306	Filbert
307	Hickory
308	Macadamia nut
309	Pecan
410	Walnut
419	Other nuts

TABLE A-1-20: Herbs and Spices

Codes	
420	Anise
421	Borage
422	Basil
423	Camomile
425	Catnip
426	Chives
427	Curry
428	Dill
429	Fennel
430	Horehound
431	Lavender
432	Marigold
433	Marjoram
434	Pennyroyal
435	Rosemary
436	Sage
437	Savory
438	Sweet bay
439	Tansy
440	Tarragon
441	Thyme
442	Woodruff
443	Wormwood
449	Other herbs and spices

TABLE A-1-21: Miscellaneous Fruits

Codes	
500	Kiwi
503	Avocado

PPQ Form 429 (Fumigation Record)

Example

FUMIGATION RECORD USDA-APHIS

1. STATION REPORTING			2. PEST AND INTERCEPTION NUMBER
3. CARRIER	4. DATE OF ARRIVAL	5. DATE INTERCEPTED	6. ORIGIN
7. PLACE OF ARRIVAL		8. DATE CONFIRMED	9. PORT OF LADING
10. FUMIGATION CONTRACTOR		11. DATE FUMIGATION ORDERED	12. COMMODITY
13. FUMIGATION SITE		14. DATE FUMIGATED	15. QUANTITY

16. MARKS	17. B/L NO.	18. ENTRY NO.	19. SHIPPER	20. CONSIGNEE

21. FUMIGANT AND TREATMENT SCHEDULE	22. TEMPERATURE a. Space b. Commodity		23. GAS ANALYZER *(Type and Ser. No.)*
24. ENCLOSURE	25. WEATHER CONDITIONS	26. CUBIC CAPACITY	27. TREATMENT UNDER SECTION 18 EXEMPTION ☐ Yes ☐ No
28. NO. OF FANS	29. TOTAL CFM'S FANS	30. TIME FANS OPERATED	31. FOOD OR FEED COMMODITY ☐ Yes ☐ No
32. GAS INTRODUCTION a. Start b. Finish	33. AMT. GAS INTRODUCED	34. GAS ADDED	35. RESIDUE SAMPLE TAKEN ☐ Yes ☐ No Sample No.

GAS CONCENTRATIONS *(grams per cubic meter (oz./1000 cu. ft.))*
(To be prepared for fumigations when gas concentration readings are required while treatment is in progress.)

36. DATE-TIME	37. PLACEMENT OF TEST LINES: SPACE FRONT A	SPACE CENTER B	SPACE REAR C	COMMODITY D	E	F	G	H	I	J	38. TIME INTERVAL (FROM 32. B)	INSPECTOR'S INITIALS

39. DETECTOR TUBE READINGS (PPM)					

40. REMARKS	41. CALCULATIONS

42. SIGNATURE OF INSPECTOR	DATE	43. SIGNATURE OF REVIEWER	DATE

PPQ FORM 429 (MAR 92) *Replaces APHIS FORM 8030 (JUL 89), which may be used*

FIGURE A-1-2: Example of PPQ Form 429 (Fumigation Record) (Front)

Example (Reverse)

TARPAULIN FUMIGATION

NOTE: ***In preparation for the fumigation and prior to site selection the officer should have determined (1) the immediate pest risk associated with the infested commodity, (2) the temperature requirements for the fumigation, and (3) the permeability of the packaging.***

CHECKLIST OF MATERIALS AND PROCEDURES *(Consider each of the listed items when performing a fumigation.)*

MATERIALS

FUMIGATOR						PPQ
	Tarpaulin		Tarpaulin Supports		Volatilizer	Gas Analazer
	Sand Snakes		Fans		Heat Supply	Drierite
	Water Snakes		Extension Cords		Exhaust Fans	
	Loose Sand		2-3 Prong Plug Adapters		Sampling Tubes	Self Contained (SCBA) Breathing Apparatus
	Burlap / Padding		Fumigant		Scale	Halide Detector
	Masking Tape		Gas Introduction Line		Fumigation Placards	Tape Measure
	Pesticide & Spray Equipment		T/C Gas Analyzer		SCBA - Self Contained Breathing Apparatus	Thermometer
						Gas Detector Kit and Detector Tubes

PROCEDURES *(SECTION III TREATMENT MANUAL)*

PREPARATION				FUMIGATION			
1.	**SITE SELECTION**	3.	**TARPAULIN ENCLOSURE**	4.	**TREATMENT SCHEDULE DETERMINATION**		Introduction Rate
	Ventilated Area	A.	**COVER**		Plant Pest		Check for Leaks
	Sheltered Area		Condition		Commodity Temperature	6.	**SAFETY**
	Impervious Surface		Air Space, Above Load		Space Temperature		Gas Detection Tests
	Non-work Area		Floor Area 30 cm (12") Space Around Load		Volume Determination	7.	**CONCENTRATION READINGS**
	Proximity to Electrical Source		Overlap 45 cm (18") Border		Sorptive Commodity		T/C Gas Analyzer Standardization
	Proximity to Commodity	B.	**SNAKES**		Amount of Fumigant		Time Intervals
2.	**ARRANGEMENT OF COMMODITY & EQUIPMENT**		Contact Along Sides	5.	**FUMIGANT INTRODUCTION**		Gas Distribution
	Stack Size Limitation		Contact Around Corners		Area Clear of Unauthroized Personnel		Maximum / Minimum
	Air Space, Below and Between Load		Overlap 15 cm (6") Minimum		Cover condition	8.	**AERATION (MULTIPLE STACKS)**
	Placement of Tarp. Supports	C.	**SAND**		Fan Operation		Exhaust Fan(s)
	Placement of Padding		Perimeter		Contaminant Gases		Exhaust Tube(s)
	Placement of Fans	D.	**ADHESIVE**		Fumigant Cylinder Weight		Exhausted in a Non-fumigation Area
	Placement of Gas Introdution Line(s)		Perimeter		Gas Line Connections		Negligible Gas Readings Before Tarpaulin Removal
	Placement of Sampling Lines				Volatilizer Heated		Halide or Other Detector Tests

PPQ FORM 429 (Reverse) ☆ U.S. GOVERNMENT PRINTING OFFICE: 1997 417-294/60024

FIGURE A-1-3: Example of PPQ Form 429 (Fumigation Record) (Back)

Purpose

This form is to be used as a station record for all treatments conducted in approved chambers or in temporary enclosures (tarpaulin, in containers, truck vans, railroad cars, ships, warehouses, or other enclosures). Treatments conducted under temporary enclosures require minimum gas concentration readings be reported.

Important

Aircraft fumigation is not authorized.

Block	Instruction
1	Fill in.
2	Fill in scientific name(s) of pest or simply "precautionary" when fumigation is mandatory as a condition of entry or movement. Include station interception number(s) if fumigation is based on pest findings.
3-20	Fill in. In completing Block 12, if the commodity is a fruit or vegetable, enter the common name. The common name is more descriptive. If available, include the variety. By using common names and names of varieties, tolerances to the fumigant can be better predicted.
21	Fill in fumigant (for example, MB, CB, PH, EO, or SF), schedule number, dosage rate, and exposure period (4 lbs/1,000 ft^3 for 12 hours).
22	Fill in beginning temperatures in space under enclosure (a) and commodity temperature (b). Specify Centigrade or Fahrenheit.
23	Fill in type of thermal conductivity unit used (Fumiscope® or Gow-Mac®) and the serial number of the conductivity unit.
24	Fill in chamber, tarpaulin, structure, or type of carrier such as truck van, railroad car, or ship. If a container was used, indicate if covered by tarpaulin. Fill in type of tarpaulin used—single or multiple-use and the thickness (4 mil or 6 mil).
25	If treatment is conducted outside, fill in the weather conditions.
26	Fill in.
27	If commodity is treated under APHIS Section 18 Exemption, check "yes." If commodity is treated at label dosage or less, check "no."
28-30	Fill in.
31	If food or feed, check "yes." If nonfood/nonfeed, check "no."
32	Record time gas introduction started (a) and finished (b). Treatment does not start until gas is completely introduced in the chamber or enclosure.
33	When the fumigant dosage is calculated by weight, fill in the dosage to the nearest quarter pound. If liquid measures are needed, convert from weight to volume by using the conversion table in Appendix D.
34	If additional gas is required, note under Remarks (Block 40) and show calculations (Block 41).
35	Check appropriate box. Sample number refers to Block 7 on APHIS Form 2061 (Residue Sample for Food or Feed Product).
36	Record the date and time you take concentration readings. Treatment schedules specify when to take concentration readings.
37	Fumigants such as methyl bromide may be read and recorded directly from the T/C unit scale. However, readings for fumigants such as sulfuryl fluoride and ethylene oxide must be corrected to get the true concentration reading. Each T/C unit used for fumigants other than methyl bromide is calibrated with a correction factor. The factor is multiplied times the dial reading, to give the actual concentration. Record phosphine gas concentrations as ppm as determined by detector tubes. Specify where the gas sampling line was placed: space or commodity. Use at least three lines. Use additional lines as needed.
38	Fill in.
39	Fill in time as well as the reading. Refer to the section in the manual that is tabbed "Aeration" for guidelines.
40	Note any unusual events that occurred during the treatment. When it is necessary to abort a fumigation, details concerning the termination of the treatment should be reported in this block.

Block	Instruction
41	Show all calculations used in determining the volume of temporary enclosures. Also show calculations when additional gas is added.
42-43	Sign and date.
Reverse Side	Use as a check list.

Distribution

Give the original and one copy to your supervisor for review. The supervisor should keep the original for port files and send one copy to:

USDA, APHIS, PPQ, CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606

PPQ Form 519 (Compliance Agreement)

Example

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE PROGRAMS

COMPLIANCE AGREEMENT

1. NAME AND MAILING ADDRESS OF PERSON OR FIRM	2. LOCATION
Mr. Tom Jones Beat-A-Bug 3458 West 7th Street Philadelphia, PA 19000	All piers/warehouses in the Philadelphia area involved with fresh fruit and vegetable importations

3. REGULATED ARTICLE(S)

Fresh produce entering under Quarantine 56

4. APPLICABLE FEDERAL QUARANTINE(S) OR REGULATIONS

Plant Quarantine Act of 1912
Federal Plant Pest Act of 1957

6. *I/We agree to the following:*

--To provide proof of current pesticide applicators certification upon demand.

--To provide a certified applicator at the fumigation site at times specified by PPQ.

--To provide all necessary equipment (including safety equipment) and labor. Labor and equipment are both subject to the approval of the PPQ certified applicator.

--To follow all safety requirements or procedures of the Occupational Safety and Health Act, Environmental Protection Agency, State, local, or additional requirements specified by the PPQ certified applicator including verification of the training of my employees actually working at the fumigation site.

--To follow all instructions and procedures required by PPQ in the planning, set up, and conduct of the fumigation.

--That the PPQ certified applicator will monitor/supervise the fumigation.

--That the PPQ certified applicator has the authority to approve or disapprove a fumigation at any point if the treatment is or will not be safe or effective or if any of the terms of this agreement are not met.

7. SIGNATURE	8. TITLE	9. DATE SIGNED
Dennis Doller	Fumigator	September 1, 1992

The affixing of the signatures below will validate this agreement which shall remain in effect until cancelled, but may be revised as necessary or revoked for noncompliance.

10. AGREEMENT NO. PENN-3-28

11. DATE OF AGREEMENT September 2, 1992

12. PPQ OFFICIAL (Name and Title)	13. ADDRESS
Victor S. Smith Officer in Charge	USDA-APHIS-PPQ 2432 Lakeview Drive, Room 10 Philadelphia, PA 19000 (215) 555-4980
14. SIGNATURE Victor S. Smith	
15. STATE AGENCY OFFICIAL (Name and Title)	16. ADDRESS
17. SIGNATURE	

PPQ FORM 519
AUG. 1977

REPLACES PPQ 274, 519, 560, AND AQI 53, WHICH ARE OBSOLETE

FIGURE A-1-4: Example of PPQ Form 519 (Compliance Agreement)

Purpose

The PPQ Form 519 is a form that provides a signed, written agreement with fumigators to indicate their understanding of methods, conditions, and procedures necessary for compliance with regulations.

Instructions

Many PPQ ports maintain Compliance Agreements with commercial pesticide applicators. PPQ may maintain compliance agreements, however if they cancel an agreement, PPQ should not ban an exterminator from doing business, or applying regulatory treatments. PPQ may however, discontinue certification of a particular treatment that did not meet the required time, temperature, and concentration levels indicated in the treatment schedule. Similarly, PPQ may not want to begin monitoring a fumigation if the tarp appears inadequate and excessive leakage may lead to a safety problem.

Review compliance agreements at least annually, but preferably twice a year. Amend compliance agreements as appropriate.

If the establishment fails to abide by the conditions of the agreement, then the Port Director may cancel that agreement orally or in writing.

If you make an oral cancellation, confirm it in writing as soon as possible. The establishment has 10 days to appeal the cancellation. Appeals must be made to the Deputy Administrator.

Block	Instructions
1,8,9, 11-13	Fill in.
2	Fill in the location of the specific property(s) for which the agreement is signed.
3	Fill in the specific regulated articles to which the agreement applies.
4	Fill in the titles, parts, and subparts.
5	Check as appropriate.
6	Outline stipulations which apply to the fumigator for each quarantine or regulation affecting the fumigator. Make clear to the fumigator that stipulations in the compliance agreement do not preclude compliance with other sections of the quarantine or regulations. If space in Block 6 is inadequate for listing the stipulations, then write “See Attached Sheets.”
7	Have a responsible official of the fumigator’s sign.
10	Assign a compliance agreement number.
14	Have the PPQ Port Director sign.
15-17	Complete only when State is involved in cooperating with enforcing Federal quarantines.

Distribution

If:	Then:
Compliance agreement affects one work unit	GIVE original to the fumigator, and KEEP a copy for port files in the area where the fumigator is located
Compliance agreement affects more than one work unit	GIVE original to the fumigator, and GIVE copies to all work units affected by the compliance agreement, and KEEP a copy for port files in the area where the fumigator is located

PPQ Form 523 (Emergency Action Notification)

Example

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE

EMERGENCY ACTION NOTIFICATION

1. PPQ STATION
2. DATE ISSUED
3. NAME OF AGRICULTURAL PEST
4. DATE INTERCEPTED
5. SHIPPER
6. NAME AND QUANTITY OF ARTICLE
7. IDENTIFYING MARKS OR NUMBERS *(container no., B/L no., etc.)*
8. TO: *(Consignee or Owner)*
9. LOCATION OF ARTICLES
10. ORIGIN OF ARTICLES
11. CARRIER DATA
Name or ID
Point of Lading
Date of Arrival

Under § 105 of the Federal Plant Pest Act *(7 U.S.C. 150dd)*, the Plant Quarantine Act, as amended *(7 U.S.C. 151 et seq.)*, the Federal Noxious Weed Act of 1974 *(7 U.S.C. 2805)*, or Section 2 of the Act of February 2, 1903 *(21 U.S.C. III)*, and the regulations promulgated pursuant to these statutes, you are hereby notified, as owner or agent of the owner of said carrier and/or premises and/or articles, to apply remedial measures for an injurious agricultural pest as specified in item 3, in a manner satisfactory to and under supervision of an Agricultural Officer. Remedial measures shall be in accordance with the action indicated in item 12 as provided for in the applicable regulations, and shall begin within the specified time indicated in item 13.

AFTER RECEIPT OF THIS NOTIFICATION, ARTICLES AND/OR CARRIERS HEREIN DESIGNATED MUST NOT BE MOVED EXCEPT AS DIRECTED BY AN OFFICER.

CAUTION: Apply chemicals in accordance with all label instructions and applicable regulations.

12. ACTION

13. AFTER RECEIPT OF THIS NOTIFICATION BEGIN SPECIFIED ACTION WITHIN *(Specify No. hours or No. days)*
14. SIGNATURE OF OFFICER

15. ACKNOWLEDGEMENT OF RECEIPT OF EMERGENCY ACTION NOTIFICATION

I hereby acknowledge receipt of the foregoing notification.

SIGNATURE	TITLE	DATE & TIME	CITY & STATE

16. REVOCATION OF NOTIFICATION

ACTION TAKEN

SIGNATURE OF OFFICER
DATE

PPQ FORM 523 (NOV 83) *Replaces PPQ Form 523 (6/78) and PPQ Form 290 (5/77), which are obsolete.*

PART 1 - CONSIGNEE OR OWNER

FIGURE A-1-5: Example of PPQ Form 523 (Emergency Action Notification)

Purpose

PPQ Form 523 is issued for treatments and other remedial measures ordered for carriers, cargoes, or articles arriving in the United States or moving interstate. The PPQ Form 523 also serves as a means to communicate plant pest and animal disease risk situations between ports, Program Support, and International Services personnel in foreign countries.

Instructions

When a suspected pest is found, advise the owner, agent, or ship's captain that a suspected pest has been found. If identification is confirmed, quarantine action will be required. For ships, note the information on the PPQ Form 288 (Ship Inspection Report). Hold all cargo from infested holds pending determination. Take appropriate

safeguards to prevent pest dissemination for infestations of cargo or stores. If it is necessary to discontinue discharge of cargo from the vessel, promptly inform Customs.

Block	Instructions	
1,2,4	Fill in.	
3	Fill in the scientific and common name of the pest. Indicate if identification is tentative; however, final identification is required on copies sent to Program Support. List the interception number.	
5	Fill in the name and address of the firm sending shipment. Avoid the use of intermediate parties such as freight forwarders, etc.	
6	Fill in the name and quantity of article (include description on accompanying documentation and additional terms if needed to clearly describe the article). If plant material is involved, fill in the genus of the plant.	
7	Enter bill of lading, container numbers, air waybill number, vessel hold number, vehicle license number, etc.	
8	Fill in the consignee or owner and address. Use intermediate parties such as the broker or carrier if owner's name is unavailable.	
9	Fill in where the article is located, e.g., location of premises, pier, dock, container yard, hold space, etc.	
10	Fill in the origin of the article.	
11	Name or ID—	Fill in vessel name, airline and flight number, trucking firm and license number, railroad car number, container number, etc.
	Point of Lading—	Fill in foreign port, or place where loaded, e.g., Leghorn, Italy; Jeddah, Saudi Arabia; etc.
	Date of Arrival—	Fill in the date the article arrived at port or point where PPQ Form 523 is issued.
12	List action required; e.g., treatment schedule, return to origin. Include safeguards pending final quarantine action (if any). If more than one action is required, then list actions as a, b, c, etc. If an article is prohibited, then fill in that the article is prohibited per regulation (list title, part, and subpart from the CFR's), and any other reasons in addition to action required.	
13	"Begin Specified Action Within" means the actual beginning of a treatment or emergency action or a good faith effort to begin contract proceedings or preparation for the action. Fill in the time (number of hours or days) action must begin after receipt of this notice. Specify a time for complying with each action listed in Block 12, e.g., a) 2 hours; b) 48 hours.	
14	Sign in this Block.	
15	Obtain the signature of the owner, agent, or person having immediate jurisdiction over the carrier or articles. If someone other than the owner signs, state the name of the company.	
16	Fill in action taken. Be specific that actions listed in Block 12 were carried out. Explain any acceptable deviations from the actions listed in Block 12. Sign and date the original and the copy in the hands of the owner/agent. If the owner/agent copy is not available, then make a copy and deliver it to the owner/agent.	

Use the following table to determine if any special instructions apply:

If issuing PPQ Form 523 for:	And:	Then:
An infested vessel	The vessel is sailing without treatment	SEE special instructions that follow
	The vessel is sailing to a subsequent port for treatment	AMEND Block 16 of the Form to read "Ship authorized movement to (port) for treatment." FORWARD copies of the Form to the next port
	The structural design prevents an adequate fumigation	CONSULT your Regional Director for an alternate treatment and/or cleaning, and NOTE conditions on the Form 523, then GO to "Distribution"
	Treatment will be conducted at the port	GO to "Distribution"
Infested cargo	It is covered by an invalid, inaccurate, or improperly issued phytosanitary certificate, treatment certificate, or military customs certificate	ATTACH a copy of the document to the copy of the Form that you send to Program Support after the treatment is completed, then GO to "Distribution"
	Not covered by any of the certificates described in the cell above	GO to "Distribution"
Other than above	→	GO to "Distribution"

Special Instructions for Infested Vessels Sailing Foreign Without Treatment

When an infested vessel is allowed to sail foreign without treatment, type the following statement on the reverse side of the PPQ Form 523 and reference it in Block 12 on the face of the form.

"The requirements of the Emergency Action Notification shown on the front of this form are suspended upon condition that this vessel shall leave the territorial limits of the United States within ____ hours after receipt of this notice. This vessel shall not reenter any port in the United States unless it has been treated in accordance with the notification and certified by the person who applied the treatment. If the certificate is not presented to the PPQ officer when arriving at a port in the United States, or if the PPQ officer for any other reason is not satisfied that the infestation has been eliminated, the notification shall immediately become effective and treatment required."

Distribution

TABLE A-1-22: Determine Distribution of PPQ Form 523 (Emergency Action Notification)

If:	Then:
Part 1	GIVE to the owner or agent having immediate jurisdiction over the carrier or articles. In the case of vessels, give to the captain.
Part 2	KEEP for your port files.
Part 3	GIVE to the broker or agent (if more than one copy is needed, then make photocopies).
Part 4	SEND to Program Support within 5 days after completion of action. Include the final pest identification and the original of any accompanying documents that attest to actions taken at the point of origin (e.g., phytosanitary certificates, treatment certificates, military customs certificates, certificates of origin, etc.).
Other copies	SEND to Area Director at proposed destination of material for possible follow-up action. SEND to Regional Office or originating office as required locally. SEND to subsequent PPQ office if action is to be completed there (mail one copy, and send one copy accompanying the article or carrier) or if khapra beetle or snails are found on cargo or carrier.

See the Airport and Maritime Operations Manual for instructions on completing a PPQ Form 518.

PPQ Form 449-R (Temperature Recording Installation Report)

TEMPERATURE RECORDING INSTALLATION REPORT USDA-APHIS
(IN-TRANSIT COLD TREATMENT)
(Refer to PPQ Treatment Manual, Sec. III, Part 10)

1. NAME OF VESSEL
2. PORT REPORTING
3. DATE OF INSPECTION
4. POINT OF INSPECTION
5. HULL NUMBER AND SHIPYARD
6. MANUFACTURER'S REP
7. ELECTRICAL CONTRACTOR
8. SHIP'S OFFICER
9. SHIPPING LINE

RECORDING INSTRUMENT

10. MAKE
11. SERIAL NO
12. MODEL NO
13. SCALE DEFLECTION inch/F° mm/C°
14. PRINT INTERVAL
15. TEMPERATURE RANGE to
16. CHART SPEED

22. MAKE
23. SERIAL NO.
24. MODEL NO.
25. SCALE DEFLECTION inch/F° mm/C°
26. PRINT INTERVAL
27. TEMPERATURE RANGE to
28. CHART SPEED

TEMPERATURE SENSORS
(If Unsatisfactory, explain in item 34)

17. LOCATIONS ☐ Satisfactory ☐ Unsatisfactory
18. LABELING ☐ Satisfactory ☐ Unsatisfactory
19. SIZE ☐ Satisfactory ☐ Unsatisfactory
20. REACTION TIME ☐ Satisfactory ☐ Unsatisfactory

TEMPERATURE SENSORS
(If Unsatisfactory, explain in item 34)

29. LOCATIONS ☐ Satisfactory ☐ Unsatisfactory
30. LABELING ☐ Satisfactory ☐ Unsatisfactory
31. SIZE ☐ Satisfactory ☐ Unsatisfactory
32. REACTION TIME ☐ Satisfactory ☐ Unsatisfactory

21. TEMPERATURE READINGS AT 0°C (32°F)

BULB NO	TEST I	TEST II	TEST III	BULB NO	TEST I	TEST II	TEST III

33. TEMPERATURE READINGS AT 0°C (32°F)

BULB NO.	TEST I	TEST II	TEST III	BULB NO	TEST I	TEST II	TEST III

34. REMARKS

35. SIGNATURE
36. DATE

PPQ FORM 449-R (MAR 92) *(Local Reproduction Authorized)* *Replaces APHIS FORM 8049-R (MAR 90), which is obsolete.*

FIGURE A-1-6: PPQ Form 449-R (Temperature Recording Installation Report)

PPQ Form 203 (Foreign Site Certificate of Inspection and/or Treatment)

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE

FOREIGN SITE CERTIFICATE OF INSPECTION AND/OR TREATMENT

1. CERTIFICATE NO.	2. COUNTRY OF ORIGIN
3. DATE LOADED	4. FOREIGN PORT OF EXPORT
5. CARRIER IDENTIFICATION	6. U. S. PORT OF ENTRY
7. SHIPPER *(Name & Address)*	8. CONSIGNEE *(Name & Address - Include Zip Code)*

9. COMMODITY	10. NO. CONTAINERS *(Identify as box, sack, ½ Bruce box, flat, cardboard box, etc.)*	11. CONTAINER IDENTIFICATION MARKS

12. LOCATION OF INSPECTION AND/OR TREATMENT	13. DATE

This certifies that the shipment described above has been inspected and/or treated in accordance with agricultural requirements for entry into the United States.

14. SIGNATURE OF PLANT PROTECTION AND QUARANTINE OFFICER	15. DATE ISSUED

PPQ FORM 203
(AUG 78)

FIGURE A-1-7: PPQ Form 203 (Foreign Site Certificate of Inspection and/or Treatment)

PPQ Form 556 (In Transit Cold Treatment Clearance Report)

U. S. DEPARTMENT OF AGRICULTURE
Animal and Plant Health Inspection Service
Plant Protection and Quarantine Programs

IN TRANSIT COLD TREATMENT CLEARANCE REPORT

INSTRUCTIONS: Refer to PPQ Treatment Manual Sec. III part 10 and CFR 319.56-2d.

1. NAME OF CARRIER	2. PORT OF LOADING	3. PAGE NO. of
4. PORT REPORTING	5. DATE	6. TIME
7. PORT REPORTING	8. DATE	9. TIME

10. CONTENTS OF COMPARTMENTS

COMMODITY	NO. CASES	COMMODITY	NO. CASES	COMMODITY	NO. CASES	COMMODITY	NO. CASES
Apples		Nectarines		Pears		Plums	
Cherries		Oranges		OTHER (Specify)		OTHER (Specify)	
Grapes		Peaches					

INSTRUMENT EXAMINATION		INSTRUMENT EXAMINATION	
11. INSTRUMENT NO.	12. WAS INSTRUMENT LOCKED? YES ☐ NO ☐	17. INSTRUMENT NO.	18. WAS INSTRUMENT LOCKED? YES ☐ NO ☐
13. PRINTING INTERVAL	14. CHART SPEED *(in. or cm/24 hours)*	19. PRINTING INTERVAL	20. CHART SPEED *(in. or cm/24 hours)*
15. ACTUAL LENGTH OF RECORD	16. CALCULATED LENGTH OF RECORD	21. ACTUAL LENGTH OF RECORD	22. CALCULATED LENGTH OF RECORD

23. CALIBRATION RECORD SATISFACTORY ☐ | IF NOT SATISFACTORY - WHY | SIGNED BY

TEMPERATURE RECORD

24. IDENTIFY COMPARTMENTS													
25. Initial fruit temp. recorded		MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.
26. Loading completed		DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME
27. TREATMENT COMMENCED	2.2°C(36°F)												
	1.7°C(35°F)												
	1.1°C(34°F)												
	0.6°F(33°F)												
	0°C(32°F)												
28. Total No. days treatment to time of clearance		TEMP.	DAYS	TEMP.	DAYS	TEMP.	DAYS	TEMP.	DAYS	TEMP.	DAYS	TEMP.	DAYS
29. Pulp temperatures *(manual check by PPQ officer)*		MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.
30. Recorded temperatures		BULB NO.	TEMP.	BULB NO.	TEMP.	BULB NO.	TEMP.	BULB NO.	TEMP.	BULB NO.	TEMP.	BULB NO.	TEMP.

31. CARGO STOWAGE SATISFACTORY ☐ | IF NOT, SPECIFY WHY | 32. SIGNATURE OF OFFICER

PPQ FORM 556
AUG. 1977

REPLACES PPQ FORM 556(9/74) WHICH MAY BE USED

FIGURE A-1-8: PPQ Form 556 (In Transit Cold Treatment Clearance Report)

APHIS Form 205-R (Instructions and Worksheet for Calibrating Portable Temperature Sensors)

INSTRUCTIONS AND WORKSHEET FOR CALIBRATING PORTABLE TEMPERATURE SENSORS

USDA - APHIS

1. DATE		
2. NAME OF FACILITY	3. SIGNATURE OF PERSON CALIBRATING SENSORS	4. NAME OF PERSON CALIBRATING SENSORS *(Type or Print)*

INSTRUCTIONS

These instructions are for calibrating the portable temperature sensors that will be used in performance tests of hot water tanks.

(A) Assign each portable sensor a number. *(Write sensor numbers on pieces of duct tape or tag, and attach them near the "dry" end of each sensor.)*

(B) Submerge the "wet" end of the sensors into a circulating hot water bath in a temperature range of 115° to 120°F *(46.1° to 48.9°C)*, in close proximity to the bulb of a submersible certified glass mercury thermometer. Both must be submerged to the same depth. The mercury thermometer *(with demarcations readable to the nearest tenth of a degree)* shall be used as the standard against which the portable sensors are to be compared.

(C) Record the temperatures obtained from each portable sensor and the mercury thermometer, in succession. Compute the difference in the two temperatures, if any, and record this also.

(D) If the temperature shown by the portable sensor falls within five-tenths of a degree *(F) (or +/- 0.3°C)* of the true temperature shown on the certified mercury thermometer, then this sensor is considered to be within the tolerance, and may be used in the performance test. Any sensors reading outside of this range do not meet APHIS standards for accuracy, and should not be used. Recommend that they be destroyed.

	TEMPERATURE *(Specify °C or °F)*			
5. PORTABLE SENSOR NO.	6. SENSOR READING	7. MERCURY READING	8. DIFFERENCE *(Add/Subtract)*	9. REMARKS

RETURN COMPLETED FORM TO THE METHODS DEVELOPMENT CENTER THAT WILL ISSUE A CERTIFICATE.

APHIS FORM 205-R
(NOV 93)

FIGURE A-1-9: APHIS Form 205-R (Instructions and Worksheet for Calibrating Portable Temperature Sensors)

APHIS Form 206-R (Test of the Accuracy of the Permanent RTD Sensors Installed in Hot Water Tanks)

TEST OF THE ACCURACY OF THE PERMANENT RTD SENSORS INSTALLED IN HOT WATER TANKS

USDA - APHIS

1. DATE		
2. NAME OF FACILITY	3. SIGNATURE OF PERSON TESTING SENSORS	4. NAME OF PERSON TESTING SENSORS *(Type or Print)*

INSTRUCTIONS

These instructions describe the procedure for testing the accuracy of the permanent RTD temperature sensors installed in the hot water tanks, which are wired to a recorder located in the Control Room.

(A) First, calibrate all available portable sensors against the certified glass mercury thermometer standard. *(See separate instructions and worksheet for performing this procedure - APHIS FORM 205.)*

(B) Select the portable sensor that shows the least deviation from the certified mercury standard. This particular sensor will now be used as a tool for testing the accuracy of each of the permanent RTD sensors installed on the tanks.

(C) Using a 6-foot rod *(such as a broom handle or PVC pipe)* and duct tape, fasten the "wet" end of the portable sensor wire to one end of the rod, being careful not to cover the metal sensor tip with tape. *(The use of a metal rod should be avoided because if it comes in direct contact with the portable sensor, it may cause false readings.)* Tape the sensor wire also to the center, and to the opposite end of the rod, to remove the slack.

(D) Raise the water temperature in the tanks to 115°F to 120°F *(46.1° to 48.9°C)*, and run the pump to ensure uniform distribution of heat. Inspect the sides of the tank to locate the exact position of each permanent RTD sensor. Using the portable sensor and rod assembly, dip it into the hot water until the portable sensor comes in close proximity to the tank's sensor. *(NOTE: Each basket position should have its own sensor.)* Plug the portable sensor into a hand-held digital thermometer, and read the display. Compare this number with the display on the data logger or strip chart recorder in the control room. *(You may need an assistant for this purpose.)* Record the results from the chart on this form. Repeat the procedure for each permanent sensor in the tank.

(E) Decision: If the temperature shown on the display in the control room matches the temperature shown on the hand-held digital thermometer *(as calibrated)*, then the permanent sensor in the tank is acceptable. If the two temperatures do not match exactly, but are within five-tenths of a degree *(F)* of each other *(+/- 0.3°C)*, then this small amount of deviation is considered to be within tolerance. Any permanent sensors that fail this standard must be repaired or replaced.

5. HAND-HELD DIGITAL THERMOMETER USED FOR THE STANDARD *(Portable Sensor Number Used: _____.)*				6. MAKE & MODEL OF THE RECORDER USED IN CONTROL ROOM FOR TEMPERATURE DISPLAY		
7. TANK NO. AND PERMANENT RTD SENSOR NO. *(Basket Position)*	8. READING OBTAINED *(°F or °C)* *(Hand-held)*	9. CORRECTION FACTOR *(Determined Previously)* (+/-)	10. TRUE READING (°F or °C)	11. READING OBTAINED *(°F or °C)* *(In Control Room)*	12. DIFFERENCE BETWEEN COLUMN 10. AND COLUMN 11. (°F or °C)	13. REMARKS

RETURN COMPLETED FORM TO THE METHODS DEVELOPMENT CENTER THAT WILL ISSUE A CERTIFICATE.

APHIS FORM 206-R (NOV 93)

FIGURE A-1-10: APHIS Form 206-R (Test of the Accuracy of the Permanent RTD Sensors Installed in Hot Water Tanks)

APHIS Form 207-R (Sensor Location Diagram Fruit Weights and Pulp Temperatures)

SENSOR LOCATION DIAGRAM FRUIT WEIGHTS AND PULP TEMPERATURES

USDA-APHIS

1. DATE		
2. NAME OF FACILITY	3. TANK NUMBER	4. TEST NUMBER

INSTRUCTIONS

Show sensor numbers, and their approximate location within each basket. *(Use three or four sensors per basket.)* Place an asterisk (*) beside fruit pulp sensors. *(Use one or two per test.)* Indicate, by arrow, the direction of water flow in the tank. *(If the tank is of an unusual shape (e.g., round) please use the reverse side of this form to draw a diagram, showing position of baskets and sensors.)*

BASKET NO. 1	BASKET NO. 2	BASKET NO. 3	BASKET NO. 4	BASKET NO. 5

5. WEIGHT (g) OF 10 FRUITS SELECTED AT RANDOM		6. WEIGHT (g) OF 5 LARGEST FRUITS	7. FRUIT PULP TEMPERATURES (Taken at random)	8. NET WEIGHT OF A TYPICAL FIELD CRATE OF MANGOES
				9. NUMBER OF FIELD CRATES PER LOADED BASKET
MEAN WT. =	(g)	MEAN WT. =	MEAN TEMP. =	

10. REMARKS

APHIS FORM 207-R (OCT 95) (Previous edition is obsolete)

FIGURE A-1-11: APHIS Form 207-R (Sensor Location Diagram Fruit Weights and Pulp Temperatures)

APHIS Form 208 (Performance Test for Mango Hot Water Immersion Tank)

USDA-APHIS

PERFORMANCE TEST FOR MANGO HOT WATER IMMERSION TANK

1. DATE OF TEST	
2. NAME OF FACILITY	3. LOCATION
4. NAME OF FACILITY MANAGER (Type or print)	
5. TELEPHONE NUMBER ( )	6. FAX NUMBER ( )
7. FRUIT VARIETY	8. STAGE OF RIPENESS

9. TEMPERATURES AT START OF TEST

9A. THERMOSTATIC SET POINT	9B. WATER IN THE TANK	9C. FRUIT PULP (Average)	9D. AMBIENT AIR

10. SIGNATURE OF INSPECTOR	11. NAME OF INSPECTOR (Type or print)

12. NOTES

BASKET NO.: _____ TANK NO.: _____ TEST NO.: _____

Readings taken at specific times (minutes) before calibration adjustment (if any). Use 1 or 2 pulp sensors per tank. Indicate pulp sensors with an asterisk (*)

PORTABLE SENSOR NO. (Use at least 3)	CALIBRATION ADJUSTMENT		0-1	1-2	2-3	3-4	5	30	60	75	90
		TIME									
		TEMP.									
		TIME									
		TIME									
		TIME									
		TEMP.									
		TIME									
		TEMP.									

APHIS FORM 208 (OCT 95) (Previous edition is obsolete) Page 1 of 2

Calibration of Temperature Probes (Cold Treatment)

CALIBRATION OF TEMPERATURE PROBES

Vessel: _____

Date of Calibration: _____ Date Loaded: _____

Hatch & Compartment	Temperature Probe No.	Calibration at 0.0°C			Probe Temperature of Fruit at Completion of Loading
		Test #1	Test #2	Correction °C/°F	

Signature: _____

FIGURE A-1-12: Calibration of Temperature Probes (Cold Treatment)

Instructions to Captain (Cold Treatment)

United States Department of Agriculture USDA Animal Plant Health Inspection Service

Instructions to the Master of the
M/V_____

The fruit loaded on board this vessel in the refrigerated compartments _____ or containers (list container numbers on attachment) and identified by the enclosed documents is to receive cold treatment while enroute to the United States in accordance with the requirements of Foreign Plant Quarantine Notice 319.56-2-d of the United States Department of Agriculture.

The treatment consists of two parts:

(1) Cooling the fruit down to the selected temperature of cold treatment.
(2) Holding the fruit at or below the selected cold treatment temperature for the stipulated number of days.

The temperature recording instrument must be in operation during the entire precooling and treatment period so as to provide a continuous record of the fruit pulp and air temperatures. Printouts of each sensor (air and pulp) are required at least once every hour during the precooling and treatment. All equipment must be in working order when leaving the Port of Departure or the treatment will fail. Both pulp and air sensor readings *MUST* remain within the prescribed treatment schedule in order to achieve a successful cold treatment. The recording shall not be terminated until so directed by the USDA clearance official at the first port of destination in the United States.

The vessel's officer, responsible for the instruments for the intransit cold treatment, should continuously review the temperature record and sign the chart or log sheet at least once in each 24 hour period, noting the date and time.

One set of the accompanying documents should be turned over to the clearance official, and one is for your information and use.

The Treatment schedule to be used for this shipment as required per CFR 319.56 is listed below.

To be filled in and initialed by issuing official:

FRUIT TEMPERATURE Temp. Fahrenheit	FRUIT TEMPERATURE Temp. Celsius	NO. OF DAYS

Signature_____Date_____
(Please sign and print.)

Title_____

Revised 04/20/00

APHIS-Protecting American Agriculture An Equal Opportunity Employer

FIGURE A-1-13: Certificate of Loading and Calibration for Cold Treatment in Self Refrigerated Containers (Cold Treatment)

Location of Temperature Sensors in Containerized Cargo (Cold Treatment)

LOCATION OF TEMPERATURE SENSORS IN CONTAINERIZED CARGO

NAME OF VESSEL _____

CONTAINER NUMBER _____

PROBE 1 _____

_____

_____

PROBE 2 _____

_____

_____

PROBE 3 _____

_____

_____

SIGNATURE: _____ DATE: _____

TITLE: _____

FIGURE A-1-14: Location of Temperature Sensors in Containerized Cargo (Cold Treatment)

Certificate of Loading and Calibration for Cold Treatment in Self Refrigerated Containers (Cold Treatment)

CERTIFICATE OF LOADING AND CALIBRATION FOR COLD TREATMENT IN SELF REFRIGERATED CONTAINERS

COUNTRY OF ORIGIN: _____

LOCATION OF LOADING: _____

NAME OF CARRIER: _____

CONTAINER NUMBER: _____

COMMODITY: _____ NO OF CASES:

TYPE OF AIR DELIVERY: _____

TYPE OF LOADING PATTERN: _____

RECORDING INSTRUMENT TYPE: _____

SERIAL NUMBER: _____

PRINT INTERVAL: _____

SENSOR CALIBRATION (at 32° F, (0° C))

SENSOR NO.	TEST 1	TEST 2	CORRECTION FACTOR

RECORDER START TIME: _____

START LOADING: END LOADING:

PULP TEMPERATURE AT LOADING: _____

CONTAINER SEAL NUMBER: _____

CERTIFYING OFFICIAL: SIGNATURE:

FIGURE A-1-15: Certificate of Loading and Calibration for Cold Treatment in Self Refrigerated Containers (Cold Treatment)

Application for USDA-APHIS Approval of Self-Refrigerated Containers (for use in conducting quarantine in-transit cold treatment under USDA regulations)

Application for USDA-APHIS Approval of Self-Refrigerated Containers
(for use in conducting quarantine in-transit cold treatments under USDA regulations)

Instructions:
(1) Review the regulatory requirements spelled out in the attachment.
(2) This form is arranged in four parts. You must answer all of the questions asked. Approval shall be denied or delayed if any items are left blank. (Note: If some items are not applicable, write "N/A.")
(3) Send the completed form to:
Oxford Plant Protection Center
USDA APHIS PPQ
901 Hillsboro Street
Oxford, North Carolina 27565
Fax: (919) 693-3870 Tel: (919) 693-3870
e-mail: bonnie.floyd@usda.gov

This form was completed by:
(1) Name: _____
(2) Title: _____
(3) Signature: _____
(4) Name of Company: _____
(5) Type of Company *(Check all that apply):*
Container manufacturer _____ Shipping line Owner
Shipper _____ Other (please specify)_____
(6) Address: _____
_____
(7) Fax: _____ (8) Telephone _____ (9) e-mail:

Part I. The Container Itself (or Series of Containers)
A. Container Identification
1. Owner's Operating Numbers: _____ through _____
2. Manufacturer's Serial Numbers: _____ through
3. ABS D.T. Numbers: _____ through _____
4. Date of Manufacture: _____
5. Container Line: _____
B. Container Size
1. External dimensions: (in feet) Length Height: _____ Width: _____
2. Internal cubic capacity: cubic feet ___ _ cubic meters_____
C. Insulation
1. Type of insulation used: _____
2. Thickness (in inches): _____
D. Heat gain: _____

Page 1 of 2
Revised 3/00

FIGURE A-1-16: Application for USDA-APHIS Approval of Self-Refrigerated Containers (for use in conducting quarantine in-transit cold treatment under USDA regulations)

Part II. The Refrigeration Unit

A. Make and Model: _____
B. Defrost Cycle: Is it fully adjustable (e.g., 3, 6, 9, 12, 24 hours)? _____
C. Cooling Capacity
   1. Full Cool: _____ BTU _____ Kcal
   2. Partial cool: _____ BTU _____ Kcal
D. Age of Equipment (if not new): _____
E. Air Flow
   1. Top delivery _____ Bottom Delivery _____ Other (specify) _____
   2. Delivery method: _____
   3. Air flow rate (cubic feet/minute)
      @ 0 inches of water: _____ @ 0.75 inches of water

Part III. The Controller and Recorder

A. Make and Model
   1. Controller: _____ Type: _____
   2. Recorder: _____ Type: _____
B. Adjustment Capability: _____
C. Age of Equipment (if not new): _____
D. Is the temperature record printed on chart paper during the voyage, or is it stored and later downloaded by computer after the voyage is completed? _____
E. Frequency of recording *(Note: There must be an indication of the temperature and time from each sensor, at least once an hour.)* _____
F. Location of the unit:
   Inside the container _____ Outside the container _____
   If the controller or printer are accessible from the outside (without opening doors), will this unit be locked or sealed while in use? _____

Part IV. The Temperature Sensors

A. Number of Sensors installed: *(Note: The minimum number is three.)* _____
B. Description of sensors
   1. Length (in inches): _____
   2. Diameter (in inches): _____
   3. Type: _____
C. If required, can the controller/recorder accommodate several additional sensors?
   If so -- 1. What type? _____ 2. How many?
D. Response time: _____
E. Scale: The temperature recording will be in : Fahrenheit _____ Centigrade _____
F. Accuracy *(Note: Sensors must print at least in tenths of a degree, and must be accurate to within +/- 0.3 degrees C, or +/- 0.5 degrees F.)* _____
G. Length of cable wires leading from controller to sensors *(Note: The wires must be long enough to reach fruits in all parts of the container.)* _____

Additional comments (if any) _____

Page 2 of 2
Revised 3/00

FIGURE A-1-17: Application for USDA-APHIS Approval of Self-Refrigerated Containers (for use in conducting quarantine in-transit cold treatment under USDA regulations)

General Requirements for Approval of Integral Containers Used for Cold Treatment

Attachment. General Requirements for Approval of Integral Containers Used for Cold Treatment

Containers must have adequate refrigeration, insulation, and thermostatic control to precool and uniformly hold fruit temperatures at 2.2° C (36° F) or below for the entire treatment period.

Standards for Temperature Recording Instruments

Recording instruments to be used for cold treatments conducted in self-refrigerated containers must be approved by the Oxford Plant Protection Center. When applying for approval, the specifications of the recorder and sensors must be submitted.

The readings of the instrument have to be accurate to within plus or minus 0.3° C, or plus or minus 0.5° F of the true temperature range of +27° F to +37° F, with a resolution of 0.1° F or C.

Sensors also will have an outer sheath of 0.25 inch (6.4 mm) diameter or less. The sensing element must be located within the first inch (2.5 cm) of the sensor.

Sensors must be capable of collecting temperature data at least once every hour, and recording or storing data for up to 30 days.

System should have a visual display so that temperatures can be reviewed manually during the treatment, and for ease of calibration.

Printout must identify each sensor and indicate time and temperature. An identification number has to be printed so that the recorder and printout can be matched.

If the recorder is to be carried inside the container, the data should be accessible without opening the container.

At least three sensors are necessary for each container.

FIGURE A-1-18: General Requirements for Approval of Integral Containers Used for Cold Treatment.

B

Treatment Manual

Appendix B

Coast Guard Regulations

This Appendix contains information reprinted from 46CFR, October 1, 1997.

Title 46—Shipping
Chapter 1—Coast Guard, Dept. of Transportation

Part 147A—Interim Regulations For Shipboard Fumigation

MINIMUM REQUIREMENTS

General

Sec. 147A.1 Purpose.
Sec. 147A.3 Applicability..
Sec. 147A.5 General requirement.
Sec. 147A.7 Definitions..
Sec. 147A.9 Persons in charge of fumigation and the vessel; designation..
Sec. 147A.10 Notice to Captain of the Port.

Before Fumigation

Sec. 147A.11 Person in charge of fumigation; before fumigation..
Sec. 147A.13 Person in charge of the vessel; before fumigation..

During Fumigation

Sec. 147A.21 Person in charge of fumigation; during fumigation.
Sec. 147A.23 Person in charge of vessel; during fumigation..
Sec. 147A.25 Entry.

After Ventilation

Sec. 147A.31 Removal of fumigation material and warning signs..

SPECIAL REQUIREMENTS FOR FLAMMABLE FUMIGANTS

Sec. 147A.41 Person in charge of fumigation; flammable fumigants..
Sec. 147A.43 Other sources of ignition; flammable fumigants..

AUTHORITY: 46U.S.C. 170; (49 U.S.C. 1655(b)(1)); 49CFR 1.46(b).
SOURCE: CGD 74-144, 39 FR 32998, Sept. 13, 1974, unless otherwise noted.

General

Sec. 147A.1 Purpose.

The purpose of this part is to prescribe the requirements for shipboard fumigation that are critical for the health and safety of the crew and any other person who is on board a vessel during fumigation. These are interim rules pending further study and promulgation of comprehensive regulations on shipboard fumigation.

Sec. 147A.3 Applicability.

This part prescribes the rules for shipboard fumigation on vessels to which 49 CFR parts 171-179 apply under 49 CFR 176.5.

Sec. 147A.5 General requirement.

No person may cause or authorize shipboard fumigation contrary to the rules in this part.

Sec. 147A.7 Definitions.

As used in this part:

(a) Qualified person means a person who has experience with the particular fumigant or knowledge of its properties and is familiar with fumigant detection equipment and procedures, or an applicator who is certified by the Environmental Protection Agency if his certification covers the fumigant that is used.

(b) Fumigant means a substance or mixture of substances that is a gas or is rapidly or progressively transformed to the gaseous state though some nongaseous or particulate matter may remain in the space that is fumigated.

(c) Fumigation means the application of a fumigant on board a vessel to a specific treatment space.

Sec. 147A.9 Persons in charge of fumigation and the vessel; designation.

(a) The person, including any individual, firm, association, partnership, or corporation, that is conducting a fumigation operation shall designate a person in charge of fumigation for each operation.

(b) The operator of each vessel shall designate a person in charge of the vessel for each fumigation operation.

Sec. 147A.10 Notice to Captain of the Port.

Unless otherwise authorized by the Captain of the Port, at least 24 hours before fumigation the operator of the vessel shall notify the Coast Guard Captain of the Port, for the area where the vessel is to be fumigated, of the time and place of the fumigation, and the name of the vessel that is to be fumigated.

Before Fumigation

Sec. 147A.11 Person in charge of fumigation; before fumigation.

(a) The person in charge of fumigation shall notify the person in charge of the vessel of:

(1) The space that is to be fumigated;

(2) The name, address, and emergency telephone number of the fumigation company;

(3) The dates and times of fumigation;

(4) The characteristics of the fumigant;

(5) The spaces that are determined to be safe for occupancy paragraph (b)(1)(i) of this section;

(6) The maximum allowable concentration of fumigant in spaces, if any, that are determined to be safe for occupancy under paragraph (b)(1)(i) of this section;

(7) The symptoms of exposure to the fumigant; and

(8) Emergency first aid treatment for exposure to the fumigant.

(b) The person in charge of fumigation shall ensure that:

(1) A marine chemist or other qualified person who has knowledge of and experience in shipboard fumigation evaluates the vessel's construction and configuration and determines:

(i) Which spaces, if any, are safe for occupancy during fumigation; and

(ii) The intervals that inspections must be made under Sec. 147A.21(a)(1);

(2) No persons or domestic animals are in the space that is to be fumigated or the spaces that are designated as unsafe for occupancy under paragraph (b)(1)(i) of this section;

(3) There is proper and secure sealing to confine the fumigant to the space that is to be fumigated, including blanking off and sealing any ventilation ducts and smoke detectors;

(4) The personal protection and fumigation detection equipment for the fumigant that is to be used is on board the vessel;

(5) Warning signs are:

(i) Posted upon all gangplanks, ladders, and other points of access to the vessel;

(ii) Posted on all entrances to the spaces that are designated as unsafe for occupancy under paragraph (b)(1)(i) of this section; and

(iii) In accordance with 49 CFR 173.9(c) or section 8.10 of the General Introduction of the International Maritime Dangerous Goods Code. The word “unit" on the warning sign may be replaced with “vessel,” “barge,” “hold,” or “space,” as appropriate.

(6) Watchmen are stationed at all entrances to:

(i) Spaces that are not determined to be safe for occupancy under paragraph (b)(1)(i) of this section; or

(ii) The vessel, if no spaces are determined to be safe for occupancy under paragraph (b)(1)(i) of this section.

Sec. 147A.13 Person in charge of the vessel; before fumigation.

(a) After notice under Sec. 147A.11 (a)(5), the person in charge of the vessel shall notify the crew and all other persons on board the vessel who are not participating in the fumigation of the spaces that are determined to be safe for occupancy under Sec. 147A.11(b)(1)(i).

(b) If no spaces are determined to be safe for occupancy under Sec. 147A.11 (b)(1)(i), the person in charge of the vessel shall ensure that the crew and all persons who are not participating in the fumigation leave the vessel and remain away during fumigation.

During Fumigation

Sec. 147A.21 Person in charge of fumigation; during fumigation.

(a) Until ventilation begins, or until the vessel leaves port, the person in charge of fumigation shall ensure that a qualified person inspects the vessel as follows:

(1) He must use detection equipment for the fumigant that is used to ensure that the fumigant is confined to:

(i) The space that is fumigated, if partial occupancy is allowed under Sec. 147A.11(b)(1)(i); or

(ii) The vessel, if no space is determined to be safe for occupancy under Sec. 147A.11(b)(1)(i).

(2) He must make inspections at the intervals that are determined to be necessary by the marine chemist or qualified person under Sec. 147A.11 (b)(1)(ii).

(b) If leakage occurs, the person in charge of fumigation shall:

(1) Notify the person in charge of the vessel that there is leakage;

(2) Ensure that all necessary measures are taken for the health and safety of any person; and

(3) Notify the person in charge of the vessel when there is no danger to the health and safety of any person.

(c) After the exposure period, if the vessel is in port, the person in charge of fumigation shall ensure that fumigators or other qualified persons ventilate the space that is fumigated as follows:

(1) Hatch covers and vent seals must be removed, other routes of access to the atmosphere must be opened, and if necessary, mechanical ventilation must be used.

(2) Personal protection equipment that is appropriate for the fumigant that is used must be worn.

(d) If ventilation is completed before the vessel leaves port, the person in charge of fumigation shall:

(1) Ensure that a qualified person, who is wearing the personal protection equipment for the fumigant that is used if remote detection equipment is not used, tests the space that is fumigated and determines if there is any danger to the health and safety of any person, including a danger from fumigant that may be retained in bagged, baled, or other absorbent cargo;

(2) Notify the person in charge of the vessel of this determination; and

(3) If it is determined that there is a danger:

(i) Ensure that all measures are taken that are necessary for the health and safety of all persons; and

(ii) Notify the person in charge of the vessel when there is no danger to the health and safety of any person.

Sec. 147A.23 Person in charge of vessel; during fumigation.

(a) The person in charge of the vessel shall ensure that the crew and all other persons on board the vessel who are not participating in the fumigation restrict their movement during fumigation to the spaces that are determined to be safe for occupancy under Sec. 147A.11(b)(1)(i).

(b) The person in charge of the vessel shall ensure that the crew and all other persons who are not participating in the fumigation follow any instructions of the person in charge of fumigation that are issued under Sec. 147A.21(b)(2) or (d)(3)(i) and that the vessel does not leave port if he is notified under:

(1) Section 147A.21(b)(1) that there is leakage, unless the person in charge of fumigation notifies him under Sec. 147A.21(b)(3) of this subpart that there is no danger; or

(2) Section 147A.21(d)(2) that there is a danger after ventilation, unless the person in charge of the fumigation notifies him under Sec. 147A.21(d)(3)(ii) that there is no danger.

(c) If fumigation is not completed before the vessel leaves port, the person in charge of the vessel shall ensure that personal protection and fumigant detection equipment for the fumigant that is used is on board the vessel.

(d) If the vessel leaves port before fumigation is completed, the person in charge of the vessel shall ensure that a qualified person makes periodic inspections until ventilation is completed and this person shall use detection equipment for the fumigant that is used to determine if:

(1) There is leakage of fumigant; or

(2) There is a concentration of fumigant that is a danger to the health and safety of any person.

(e) If the qualified person determines under paragraph (d) of this section that there is leakage or a concentration of fumigant that is a danger to the health and safety of any person, the person in charge of the vessel shall take all measures that are, in his discretion, necessary to ensure health and safety of all persons who are on board the vessel. If the danger is due to leakage, he shall also ensure that qualified persons immediately ventilate in accordance with paragraphs (c)(1) and (2) of Sec. 147A.21.

(f) If the vessel leaves port during the exposure period, the person in charge of the vessel shall ensure that the space that is fumigated is ventilated by qualified persons after the exposure period in accordance with paragraphs (c) (1) and (2) of Sec. 147A.21.

(g) If ventilation is completed after the vessel leaves port, the person in charge of the vessel shall ensure that a qualified person, who is wearing the personal protection equipment for the fumigant that is used if remote detection equipment is not used, tests the space that is fumigated to determine if there is a danger to the health and safety of any person, including a danger from fumigant that may be retained in bagged, baled, or other absorbent cargo. If the qualified person determines that there is a danger, the person in charge of the vessel shall take all measures that are, in his discretion, necessary to ensure the health and safety of all persons who are on board the vessel.

Sec. 147A.25 Entry.

(a) No person may enter the spaces that immediately adjoin the space that is fumigated during fumigation unless entry is for emergency purposes or the space is tested and declared safe for human occupancy by a marine chemist or other qualified person and is inspected under Sec. 147A.21(a)(2) or Sec. 147A.23(d).

(b) If entry is made for emergency purposes:

(1) No person may enter the space that is fumigated or any adjoining spaces during fumigation unless he wears the personal protection equipment for the fumigant that is in use;

(2) No person may enter the space that is fumigated unless the entry is made by a two person team; and

(3) No person may enter the space that is fumigated unless he wears a lifeline and safety harness and each life-line is tended by a person who is outside the space and who is wearing the personal protection equipment for the fumigant that is in use.

After Ventilation

Sec. 147A.31 Removal of fumigation material and warning signs.

After ventilation is completed and a marine chemist or other qualified person determines that there is no danger to the health and safety of any person under Sec. 147A.21(d) or Sec. 147A.23(g), the person in charge of fumigation, or, if the vessel has left port, the person in

charge of the vessel, shall ensure that all warning signs are removed and fumigation containers and materials are removed and disposed of in accordance with the manufacturer's recommendations.

Special Requirements for Flammable Fumigants

Sec. 147A.41 Person in charge of fumigation; flammable fumigants.

(a) The person in charge of fumigation shall ensure that:

(1) Before the space that is to be fumigated is sealed, it is thoroughly cleaned, and all refuse, oily waste, and other combustible material is removed;

(2) Before fumigation, all fire fighting equipment, including sprinklers and fire pumps, is in operating condition; and

(3) Before and during fumigation, electrical circuits that are in the space that is fumigated are de-energized.

(b) [Reserved]

Sec. 147A.43 Other sources of ignition; flammable fumigants.

While the space that is fumigated is being sealed or during fumigation, no person may use matches, smoking materials, fires, open flames, or any other source of ignition in any spaces that are not determined to be safe for occupancy under Sec. 147A.11(b)(1)(i).

C

Treatment Manual

Appendix C

Maintenance: Supporting and Updating Manuals

Contents

Introduction **page-C-1-1**
Issuing Revisions **page-C-1-1**
Keeping Manuals Current **page-C-1-2**
Knowing What Is Revised **page-C-1-2**
Knowing Your Responsibility **page-C-1-3**
Ordering Manuals **page-C-1-3**
Updating Distribution Lists **page-C-1-4**
Change of Address **page-C-1-5**
Correcting Errors and Suggesting Improvements **page-C-1-5**
Manual Order Form **page-C-1-7**
Distribution Update Sheet **page-C-1-9**

Introduction

Just as it is cheaper and less time consuming over time to properly maintain a piece of equipment, so it is with a manual. The Agency must maintain and modify manuals properly. Without an orderly procedure for maintaining manuals, they are likely to fail, significantly reducing the effectiveness of the programs they support. So, to maintain manuals, an orderly procedure is critical. Here then is a description of how Plant Protection and Quarantine (PPQ) will support the manuals. Also, here are directions for you to follow in maintaining the integrity of the manuals issued to you.

Issuing Revisions

PPQ will revise this manual by distributing immediate updates. We will schedule new editions at fixed intervals—at least every 5 years. If more than 50 percent of some section changes, we will issue a new section. We will **not** issue a new page solely to correct a minor typographical error. Errors will be corrected only when they would lead to an incorrect action.

PPQ will issue all revisions as either “add a page” or “replace a page.” However, if information in the manuals might result in an error on the job, PPQ will post an update on PPQ's electronic bulletin board. For example, if PPQ's Permit Unit issues a permit for the entry of a new

fruit or vegetable, this unit will post the information. If you do **not** have access to the PPQ Bulletin Board, you should receive a copy of the posting through your work unit.

Keeping Manuals Current

There are three ways to track revisions for your manuals:

- Update Record
- Transmittal memos
- Control data

The *Update Record* is the next page after the title page of this manual. If you miss a transmittal, the *Update Record* alerts you. Also, during an audit, this record lets your supervisor know how up-to-date your manual is. Record all the transmittals you receive in the *Update Record*.

PPQ will mail all revisions with a transmittal memo. PPQ will number these consecutively—allowing you to know if you've missed a transmittal. Filing these memos to assure that you've received all the previous issuances is best. File transmittals immediately upon receiving them. If two or more transmittals accumulate, add the earliest first. PPQ Headquarters may audit how well the manuals are kept during port reviews.

Besides having numbered transmittals, each page in the manual has control data. This is positioned at the bottom of the page. The revised pages' control data alerts you to whether you have the most up-to-date version. The control data looks like this:

03/99-01
ES

month, year and transmittal number
(The first transmittal issued for the year always begins with 01)

Knowing What Is Revised

The transmittal will explain the revision's purpose and give you directions for making the revision—adding or replacing pages.

Except changes to the index, PPQ will mark all revisions with arrows, (—>) or change bars (|). Deleted material will be marked with angle brackets (<). If no other changes occur, material moved from the bottom of one page to the top of the next page will **not** be marked.

Knowing Your Responsibility

To enhance professionalism, keep your manuals current. If you fail to update your manual, you run the risk of making a costly error. The incorrect action you take might result in the outbreak of an exotic pest or disease. Or, an error may result in additional costs to an importer.

Therefore, please do the following:

1. Read the revisions when you receive them.
2. Add or replace the revised pages the day you receive them.
3. If a practice exercise is included, complete it.
4. File transmittal memos in your manual.
5. If you miss a transmittal, order another one.
6. Let the manuals unit know when it has made an error.
7. Give the manuals unit your suggestions for improvements

Ordering Manuals

Management and Budget's Printing, Distribution, and Mail Section is responsible for storing and distributing PPQ's manuals and their associated updates. Their address is as follows:

USDA, APHIS, MRP-BS, RWBS
Printing, Distribution, and Mail Section
4700 River Road, Suite 1A01
Riverdale, MD 20737-1229

If you need to replace or order additional manuals, manual parts, or transmittals, use E-mail, facsimile, telephone, or use the Manual Order Form in the section.

Part Number	Date	Title	Quantity
M319.8	11/82	Foreign Cotton and Covers	10
7CFR 354.1	01/85	Overtime Services—Hourly Rate Increases	03
	03/88	Plant Import: Nonpropagative Trans.	
		No. 01/94-01	02

When ordering, include the following information (if information is missing, shipment may be delayed or order may not be filled):

- Your organization
- Your P.O. Box (if you have one)
- Your street address (include your room number)
- City, State, and Zip Code
- Contact person
- Telephone numbers

To order by telephone, call Area Code (301) 734-5524 (MRP-BS/RWBS, Riverdale, MD)

To mail or send a facsimile of the Order Form, fill out the *Mail Order Form* in this section. Please be sure to include all the necessary information. Make sure you frank or put a stamp on the form. Order by Transmittal Number (for example, 12/95-05). Never order by page number. The facsimile number for MRP-BS/RWBS is Area Code (301) 734-8455.

Updating Distribution Lists

To Change the Number of Manuals You Are Receiving or to Have Manuals:

To change number of manuals received, use the *Distribution Update Sheet* in this section. Follow these directions for completing the form:

1. Using M390.1120, list the distribution code(s) you want changed.
2. Enter total number of copies you need.
3. Get the Officer–in–Charge's or Operations Supervisor's signature.
4. Attach an old mailing label (it has the necessary access or organization structure code).
5. Fold and mail or send a facsimile of the *Distribution Update Sheet*

NOTICE

If any of the above information in 1-4 above is missing, HSB will return your request. If you don't have an old label, then wait until you get one. HSB cannot make the change without the access code. Your access code appears on every mailing label sent from HSB in Riverdale, MD.

Change of Address

To change your mailing address, use the *Distribution Update Sheet* in this section. Follow these directions for completing the form:

1. Attach an old mailing label (it has the necessary access code).
2. Print or type the new address as it should appear.
3. Fold and mail or send a facsimile of the *Distribution Update Sheet*.

Correcting Errors and Suggesting Improvements

If you detect an error, report it using a comment sheet that's included with this manual. Or, if it is easier, call, send an E-mail message, or transmit a facsimile to Phillip B. Grove or anyone else in the manuals unit:

Commercial number: (240) 629-1936

Facsimile number: (301) 663-3240

E-mail address: philip.b.grove@aphis.usda.gov

Do the same if you want to suggest an improvement or question a procedural change. If your improvement is substantive, you might want to submit a formal suggestion, using the required form.

Manual Order Form

I am missing the following manuals or transmittals. (If any information is missing, orders will not be filled.)

Manual or Transmittal Number	Dated:	Title:	Quantity:

Please send to:

Name:

Organization:

PO Box or Street Address:

City/State/Zip Code:

Telephone Number:

Fold, Staple, Affix Postage, and Drop in the Mail

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE

USDA, APHIS, MRP-BS, RWBS

Printing, Distribution, and Mail Section
4700 River Road, Suite 1A01
Riverdale MD 20737

Distribution Update Sheet

1. List Distribution code(s) to be changed: The distribution code for the ECM is ECM. (If you are making a change to another manual, see a list of distribution codes in M390.1120, revised February 1982)

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

2. Number of copies you get now _____ Number of copies you want to get _____

3. New or corrected address:

_____

_____

_____

_____

4. The address on the attached label is to be deleted ☐ Yes ☐ No

Attach mailing label below.

NOTE: If you do not have a mailing label, wait until you receive one. This request will be returned to you if there is no old label attached.

This Distribution Update Sheet is to be submitted by the person at your location who is responsible for the distribution of manuals.

FOLD, STAPLE, AFFIX POSTAGE, AND DROP IN THE MAIL.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE

USDA, APHIS, MRP-BS, RWBS

Printing, Distribution, and Mail Section
4700 River Road, Suite 1A01
Riverdale MD 20737

D

Treatment Manual

Appendix D

Conversion Tables

TABLE D-1-1: Conversion Tables

To convert from:	To:	Multiply by:
Acres (a)	Hectares (ha)	0.4047
Acres (a)	Square meters (m^2)	4,047.0
Celsius	Fahrenheit	9/5 (then add 32)
Centimeters, cu. (cm^3)	Cubic inches (in^3)	0.061
Centimeters, sq. (cm^2)	Square inches (in^2)	0.155
Centimeters (cm)	Inches (in)	0.3937
Fahrenheit	Celsius	First, subtract 32, then multiply by $^5/_9$
Feet, cubic (ft^3)	Liters (L)	28.32
Feet, cubic (ft^3)	Cubic meters (m^3)	0.0283
Feet, square (ft^2)	Square meters (m^2)	0.0929
Feet, square (ft^2)	Sq. centimeters (cm^2)	929.0
Feet (ft)	Centimeters (cm)	30.48
Feet (ft)	Meters (m)	0.3048
Gallons (gal)	Liters (L)	3.785
Grams (g)	Ounces (oz)	0.0353
Hectares (ha)	Acres (a)	2.471
Inches (in)	Centimeters (cm)	2.54
Inches, square (in^2)	Sq. centimeters (cm^2)	6.4516
Inches, cubic (in^3)	Cu. centimeters (cm^3)	16.387
Kilograms (kg)	Pounds (lb)	2.205
Kilograms (kg)	Ounces (oz)	35.27
Kilometers, sq. (km^2)	Square miles (mi^2)	0.3861
Kilometers, sq. (km^2)	Acres (a)	247.1
Kilometers (km)	Miles (mi)	0.6214
Liters (L)	Gallons (gal)	0.2642
Liters (L)	Quarts (qt)	1.0567
Meters, cubic (m^3)	Cubic feet (ft^3)	35.314
Meters, cubic (m^3)	Cubic yards (yd^3)	1.308
Meters (m)	Feet (ft)	3.281
Meters (m)	Yards (yd)	1.0936
Meters, sq. (m^2)	Square inches (in^2)	1,550.00
Meters (m)	Inches (in)	39.37
Meters, sq. (m^2)	Square feet (ft^2)	10.764

TABLE D-1-1: Conversion Tables

To convert from:	To:	Multiply by:
Miles, square (mi^2)	Hectares (ha)	258.99
Miles, square (mi^2)	Sq. kilometers (km^2)	2.5899
Miles, statute (mi)	Meters (m)	1,609.347
Miles, statute (mi)	Kilometers (km)	1.609
Milliliters (ml)	Liquid ounces (lq oz)	0.0338
Nautical miles	Meters (m)	1,852.00
Ounces, fluid (fl oz)	Milliliters (ml)	29.57
Ounces (oz)	Kilograms (kg)	0.0284
Ounces (oz)	Grams (g)	28.35
Pounds (lb)	Kilograms (kg)	0.4536
Pounds (lb)	Grams (g)	453.6
Quarts (qt)	Liters (L)	0.9464
Tons, short (2000 lb)	Metric tons (t)	0.9072
Tons, Metric (t)	Tons, short	1.102
Yards, cubic (yd^3)	Liters (L)	764.6
Yards, cubic (yd^3)	Cubic meters (m^3)	0.765
Yards (yd)	Meters (m)	0.9144
Yards (yd)	Centimeters (cm)	91.44

Miscellaneous:

Ounces (weight) per 1,000 cu. ft. = grams per cu. meter (g/m3)
Pounds per acre (lb/a) × 1.1206 = kg/ha
Ounces (liquid) per acre × 73.14 = ml/ha
Gallons per acre (gal/a) × 9.3527 = liters per hectare (L/ha)
Pressure per square inch (PSI) × 6.894757 = kilopascals (kPa)
Inches mercury × 3.38 = kilopascals (kPa)
Grams per cu. meter (g/m^3) = ounces per 1,000 cu. ft. ($oz/1,000\ ft^3$)
Kilogram per hectare (kg/ha) × 0.8924 = pounds per acre
Milliliters per hectare × 0.01367 = ounces (lq.) per acre
Liters per hectare (L/ha) × 0.1069 = gallons per acre
Kilopascals (kPa) × 0.145038 = pounds per square inch (PSI)
Grams per liter × 0.008345 = pounds per gallon
Kilopascals (kPa) × 0.29586 = inches mercury

E

Treatment Manual

Appendix E

Directory of Treatment Facilities

The Center for Plant Health SCience & Technology (CPHST) or your local Plant Protection and Quarantine (PPQ) Office now maintain the Directory of Treatment Facilities.

NOTICE

If you have any questions regarding the status of treatment facilities, contact the CPHST at Commercial Area Code (919) 513-2495 or fax (919) 513-1995

F

Treatment Manual

Appendix F

List of Integral Containers Approved for Intransit Cold Treatment

This directory is updated quarterly. Call the Center for Plant Health Science & Technology (CPHST) or your local Plant Protection and Quarantine (PPQ) Office for a current list of approved containers.

NOTICE

If you have any questions regarding the status of a self-refrigerated container, contact Oxford Plant Protection Laboratory at Commercial Area Code (919) 693-5151 or fax (919) 693-3870.

G

Treatment Manual

Appendix G

List of Vessels Equipped for Intransit Cold Treatment

This directory is updated quarterly. Call the Center for Plant Health Science & Technology or your local Plant Protection and Quarantine (PPQ) Office for a current list of approved vessels.

NOTICE

If you have questions regarding the status of vessels, contact Oxford Plant Protection Laboratory at Commercial Area Code (919) 513-2496 or fax (919) 513-1995 for the current status of the vessel

H

Treatment Manual

Appendix H

Reference Guide to Commercial Suppliers of Treatment and Related Safety Equipment

This list is not intended to be all inclusive; only domestic suppliers are shown. Many large companies have branch offices. This list is intended to be a reference guide to the availability of fumigation equipment and supplies and is furnished solely for the convenience of potential users, particularly PPQ plant inspection stations. No endorsement is intended of the particular items listed, and no discrimination is intended toward those products or companies that may not be listed.

Products

Aeration Duct, Flexible **page-H-1-6**
Aerosol Insecticides (continued) **page-H-1-7**
Air Pump, Auxiliary **page-H-1-7**
Air-Purifying Respirator* **page-H-1-8**
Aluminum Phosphide **page-H-1-9**
Applicator (Dispenser) for Methyl Bromide **page-H-1-11**
Ascarite II **page-H-1-12**
Balances, Portable (for weighing individual fruit) **page-H-1-12**
Batch Systems (complete installations) **page-H-1-13**
Blower **page-H-1-16**
Bubble Fumigation System **page-H-1-17**
Cascade Air Tank Recharging System (for SCBA) **page-H-1-17**
Chain Hoist (Electronic) (For hot water immersion treatments) **page-H-1-17**
Consultants (For hot water immersion treatments) **page-H-1-18**
Curtains (air, safeguarding) **page-H-1-19**
Digital Thermister Instrument (hand-held for hot water immersion treatments) and Portable Sensors (used in Performance Test) **page-H-1-20**
Drierite® (anhydrous calcium sulfate) **page-H-1-20**
Exhaust Duct (Tube), Flexible **page-H-1-21**
Fans **page-H-1-21**
Fruit Crates, (Plastic for hot water immersion treatments) **page-H-1-22**
Fruit Sizing Equipment (Automatic) **page-H-1-22**
Fumigation Chamber, NAP **page-H-1-22**
Fumigation Chamber, Vacuum **page-H-1-22**
Fumigators, Commercial **page-H-1-23**
Fungicides **page-H-1-23**
Gas Analyzers **page-H-1-25**
Gas Detector Tube (colorimetric) and Apparatus **page-H-1-26**

Gas Drying Tube (for Drierite®) **page-H-1-28**
Germicides/Disinfectants **page-H-1-28**
Halide Gas Leak Detector **page-H-1-29**
Incinerators **page-H-1-30**
Magnesium Phosphide **page-H-1-30**
Manometer (used in pressure leakage test) **page-H-1-31**
Metam-sodium **page-H-1-32**
Methyl Bromide **page-H-1-32**
Moisture Meter (for wood) **page-H-1-34**
Newsletters and Trade Journals **page-H-1-35**
Personal Air Sample Pump **page-H-1-35**
Safety Equipment **page-H-1-36**
Scale (portable platform type) **page-H-1-37**
Sealing Tape **page-H-1-38**
Self-Contained Breathing Apparatus (SCBA) **page-H-1-38**
Smoking Candle **page-H-1-40**
Snakes (sand snakes, watersnakes, Sewn on one end) **page-H-1-40**
Soil Fumigants **page-H-1-41**
Spill Recovery Materials **page-H-1-41**
Steam Boilers (For hot water immersion treatment) **page-H-1-42**
Steam Generators **page-H-1-42**
Steam Sterilizers/Autoclaves **page-H-1-43**
Sulfuryl Fluoride (Vikane) **page-H-1-43**
Supplied-Air Respirators **page-H-1-45**
Tarpaulins (made to order) **page-H-1-45**
Temperature Recorders for Hot Water Immersion Treatment **page-H-1-50**
Temperature Sensors (RTD, 100 ohm) **page-H-1-53**
Thermocouple Wire **page-H-1-54**
Thermometers **page-H-1-54**
Thermometers, Glass-Mercury, Certified Precision (used as a calibration standard) **page-H-1-55**
Tubing, Gas-Sampling **page-H-1-56**
Vacuum Pump **page-H-1-57**
Vapam **page-H-1-57**
Volatilizer (heat exchanger) for Methyl Bromide **page-H-1-57**
Warning Signs and Placards **page-H-1-58**

Suppliers

Acme Protection Equipment Co. **page-H-1-8**
Agri-Machinery, Inc. (A.M.I.) **page-H-1-13**
Agroindustrias Integradas, S.A. de C.V. **page-H-1-13**
Aldrich Chemical Company, Inc. **page-H-1-12**
Allied Electronics **page-H-1-20**
Alnor Instrument Co. **page-H-1-31**
American Optical Corporation **page-H-1-8**
Analytical Technology, Inc. **page-H-1-25**
Anatole J. Sipin Co., Inc. **page-H-1-36**
Ansul **page-H-1-41**
APHIS/NOAA Centralized Warehouse **page-H-1-26**
Arlington Scale Co., Inc. **page-H-1-37**

Atlantic Scale Co., Inc. **page-H-1-37**
B&G Equipment Company **page-H-1-17**
Barnant Company **page-H-1-7**
Biesterfeld U.S. Inc. **page-H-1-6**, **page-H-1-33**
Brooklyn Thermometer Co., Inc. **page-H-1-54**
Buckman Laboratories, Inc. **page-H-1-41**
Burlington Scientific Corp. **page-H-1-9** **page-H-1-30**
Calderas Astro, S.A. de C.V. **page-H-1-13**
Carlton Industries, Inc. **page-H-1-58**
Cesco Safety Products **page-H-1-38**
Chemonics **page-H-1-18**
Champion America, Inc. **page-H-1-58**
Chessell Corporation **page-H-1-50**
Crystal Chemical Inter-America **page-H-1-23**
Cole-Parmer Instrument Co. **page-H-1-7**, **page-H-1-54**, **page-H-1-56**
Columbus McKinnon Corp. **page-H-1-17**
Conax Buffalo Corp. **page-H-1-53**
Consolidated Plastics Co. **page-H-1-56**
Consultecnia **page-H-1-14**, **page-H-1-19**, **page-H-1-50**
Contech **page-H-1-50**
Control Instrument Services, Inc. **page-H-1-51**
Construcciones Pyrsa **page-H-1-14**
Consultecnia **page-H-1-14**,
Cooper Instrument Corp. **page-H-1-20**, **page-H-1-54** **page-H-1-54**
Crowell Manufacturing Company **page-H-1-57**
Crystal Chemical Inter-America **page-H-1-23**
Davis Instruments **page-H-1-31**, **page-H-1-40**
Degesch America, Inc. **page-H-1-9** **page-H-1-11**, **page-H-1-29**, **page-H-1-30**, **page-H-1-33**, **page-H-1-38**, **page-H-1-58**
Delmhorst Instrument Company **page-H-1-34**
Dica de Mexico, S.A. **page-H-1-14**, **page-H-1-19**
Diseños y Maquinaria Jer, S.A. de C.V(“Jersa”) **page-H-1-14**
Dow Agro Sciences **page-H-1-43**
Drexel Chemical Co. **page-H-1-23**
Dwyer Instruments, Inc. **page-H-1-32**
Eastern Scales NJ **page-H-1-37**
Electro Scientific Industries **page-H-1-53**
Enterprise S.A. de C.V. **page-H-1-51**
Equipos Agroindustriales de Occidente, S.A. de C. V. **page-H-1-14**
Equipos Industriales Guadalajara **page-H-1-51**
ETC Biophysics **page-H-1-43**
Fisher Scientific **page-H-1-12**, **page-H-1-20**, **page-H-1-32**, **page-H-1-56**
FMC Corp. AG **page-H-1-24**
Fruit Technologies **page-H-1-22**
Frutico International **page-H-1-14**, **page-H-1-19**
Fulton Boiler Works, Inc. **page-H-1-42**
Fumigants and Pheromones **page-H-1-35**
Fumigation Service & Supply Inc. **page-H-1-6**, **page-H-1-11**, **page-H-1-29**, **page-H-1-31**, **page-H-1-33**, **page-H-1-40**, **page-H-1-38**, **page-H-1-42**
Gaffney Engineering Co. **page-H-1-18**
Gaskets, Inc. **page-H-1-21**
General Services Administration **page-H-1-29**
Georgia-Pacific Corp. **page-H-1-28**

Georgia Steel & Chemical Company, Inc. **page-H-1-36**
Gilmore, Inc. **page-H-1-6**, **page-H-1-9**
Gow-Mac Instrument Company **page-H-1-25**
Great Lakes Chemical Corp. **page-H-1-33**,
Griffolyn Company, Division **page-H-1-46**
Guiar Industrial, S.A. de C.V. **page-H-1-15**, **page-H-1-51**
H. T. McGill Company **page-H-1-11**
Helena Chemical Co. **page-H-1-10**, **page-H-1-31**, **page-H-1-33**
Honeywell, Inc. **page-H-1-51**
HSC Corporation **page-H-1-8**
ICD Group, Inc. **page-H-1-10**, **page-H-1-33**
IDA, Inc. **page-H-1-10**
Illinois Testing Labs, Inc. **page-H-1-57**
Inchema, Inc. **page-H-1-10**
Industrial Equipment & Engineering Co. **page-H-1-15**, **page-H-1-52**
Industrial Safety Company **page-H-1-36**
Instrumentacion y Control Industrial **page-H-1-52**
Interscan Corp. **page-H-1-26**
Kerian Machines, Inc. **page-H-1-22**
Key Chemical and Equipment Co., Inc. **page-H-1-26**
Lab Safety Supply **page-H-1-26**, **page-H-1-38**
Lignomat **page-H-1-35**
Loveland Industries, Inc. **page-H-1-10**
Lurex Scientific **page-H-1-28**
Marman USA, Inc. **page-H-1-6**, **page-H-1-10**, **page-H-1-31**, **page-H-1-33**, **page-H-1-43**
Matheson Gas Products **page-H-1-27**
McMaster-Carr Supply Co. **page-H-1-8**
Mine Safety Appliances Co. (MSA) **page-H-1-8**
Nanmac Corporation **page-H-1-52**
National Draeger, Inc. **page-H-1-27**, **page-H-1-39**, **page-H-1-45**
National Instruments, Inc. **page-H-1-52**
Neal Systems, Inc. **page-H-1-26**
Neotronics of North America **page-H-1-32**
Neuberger Messinstrumente Gmbh **page-H-1-53**
New Pig Corp. **page-H-1-42**
Neward Enterprises, Inc. **page-H-1-57**
North Bay Produce, Inc. **page-H-1-18**
Nova-Chem, Inc. **page-H-1-6**, **page-H-1-10** **page-H-1-31**, **page-H-1-34**, **page-H-1-43**
Ohaus Corporation **page-H-1-13**
Omega Engineering, Inc. **page-H-1-54**, **page-H-1-55**
Oregon-California Chemicals, Inc. **page-H-1-41**9
Center for Plant Health Science and Technology **page-H-1-18**
Pest Control **page-H-1-35**
Pest Control Technology **page-H-1-35**
Pest Fog Sales **page-H-1-12**, **page-H-1-58**
Pestcon Systems, Inc. **page-H-1-11**, **page-H-1-34**
Phifer Wire Products, Inc. **page-H-1-37**
Poly-Flex, Inc. **page-H-1-46**
Power Plastics **page-H-1-17**
Prentiss Drug & Chem. Co., Inc. **page-H-1-7**
Process Technologies, Inc. **page-H-1-53**
Produce Sorters Internationale **page-H-1-15**

Protech Safety Equipment **page-H-1-27**
Proyect Asesoria Industrial **page-H-1-15**
Red Panther Chemical Co. **page-H-1-7**
Rexnord Electronic Products **page-H-1-39**
Rhone-Poulenc Ag Co. **page-H-1-25**
Roxan, Inc. **page-H-1-27**
William B. Cresse, Inc. **page-H-1-53**
Scott Air Aviation **page-H-1-39**
Scott Aviation **page-H-1-9**, **page-H-1-17**, **page-H-1-30**, **page-H-1-45**
Sensidyne, Inc. **page-H-1-27**
Silsa, S.A. de C.V. **page-H-1-16**
Sioux Steam Cleaner Corporation **page-H-1-42**
SKC, Inc. **page-H-1-27**
Slack Associates, Inc. **page-H-1-23**
Southern Agricultural Insecticides, Inc. **page-H-1-7**, **page-H-1-34**, **page-H-1-43**
Southern Mill Creek Products Co., Inc. **page-H-1-7**, **page-H-1-34**, **page-H-1-44**
Spectrex Corp. **page-H-1-36**
Superior Signal Co., Inc. **page-H-1-40**
Survivair **page-H-1-39**
Thermo Electric **page-H-1-55**
Thomas Scientific **page-H-1-12**, **page-H-1-56**
"3M Occupational Health & Safety" on **page-1-H-45**
Turner Brass Works **page-H-1-29**
UCB Chemicals Corp. **page-H-1-24**, **page-H-1-41**
Union Carbide Corp, Linde Div. **page-H-1-28**
Uniroyal Chemical Co., Inc. **page-H-1-23**
United Suppliers, Inc. **page-H-1-11**
Upright, Inc. **page-H-1-42**
Vacudyne Corporation **page-H-1-58**, **page-H-1-23**
Vacuum Research Corp. **page-H-1-52**
Vestrol Laboratories Div. of Chemed Corp. **page-H-1-28**
Vuscamante North **page-H-1-12**
W. A. Hammond Drierite Co. (Manufacturer) **page-H-1-20**
W. W. Grainger, Inc. **page-H-1-16**, **page-H-1-30**
Whitton Technology, Inc. **page-H-1-30**
William B. Cresse, Inc. **page-H-1-16**, **page-H-1-53**
William W. Meyer & Sons, Inc. **page-H-1-16**
ZENECA Ag Products **page-H-1-24**, **page-H-1-41**

Aeration Duct, Flexible

(specify diameter and length)

Biesterfeld U.S. Inc.
500 Fifth Avenue, # 4232
New York, NY 10110
tel (212) 782-0500 (resmethrin)

Fumigation Service & Supply Inc.
10540 Jessup Boulevard
Indianapolis, IN 46280-1438
tel (800) 992-1991
fax (317) 867-5757

Gilmore, Inc.
152 Collins Street
Memphis, TN 38112
tel (901) 323-5870 (resmsthrin)
fax (901) 454-0295

Marman USA, Inc.
500 N. Westshore Blvd., # 405
Tampa, FL 33609
tel (813) 286-2503 (resmethrin)

Nova-Chem, Inc.
P.O. Box 22685
Tampa, FL 33622
tel (813) 287-1348 (resmethrin)
fax (813) 287-1348

Niles Biological Control Laboratory
USDA/APHIS/PPQ
2534 S11th Street
Niles, MI 49120
tel:(616) 683-3563
fax:(616) 683-9608
(10% d-phenothrin)

Otis Plant Protection Center
USDA/APHIS/PPQ
tel (508) 559-5354 or
tel (508) 563-9303
fax:(508) 564-4398
(10% d-phenothrin)

Prentiss Drug & Chem. Co., Inc.
CB 2000
Floral Park, NY 11001
tel (516) 326-1919

Red Panther Chemical Co.
P.O. Box 530
Clarksdale, MS 38614
tel (662) 627-4731 (resmethrin)

Southern Agricultural Insecticides, Inc.
P.O. Box 218
Palmetto, FL 34220
tel (941) 722-3285 (resmethrin)
fax (941) 723-2974
e-mail www.southernag.com

Aerosol Insecticides (continued)

Southern Mill Creek Products Co., Inc.
5414 North 59th Street
Tampa, FL 33610
tel (813) 635-0707 (resmethrin)
fax (813) 630-9536)

Air Pump, Auxiliary

Barnant Company
28W092 Commercial Avenue
Barrington, IL 60010
tel (800) 637-3739 or
(708) 381-7050
fax (847) 381-7053

Cole-Parmer Instrument Co.
625 East Bunker Court
Vernon Hills, IL 60061
tel (800) 323-4340/(847) 323-4340
fax (847) 247-2929
e-mail www.colepalmer.com
("Air Cadet" Vacuum/Pressure Pump; Single-J7530-40; Dual J7530-60)

McMaster-Carr Supply Co.
P.O. Box 740100
Atlanta, GA 30374-0100
tel (404) 346-7000
fax(404) 349-9091
(Hand-held Mityvac vacuum/pressure pump, zinc alloy, cat. no. 9963K12)
Air-Purifying Respirator*

(gas masks with cartridge for organic vapors)

Acme Protection Equipment Co.
1201-99 Kalamazoo Street
South Haven, MI

American Optical Corporation
Safety Products Division
South Bridge, MA 01550
AO Quantifit in small (#R 4000), medium (#R 5000), or large (#R 6000) with cartridge (#R 58)

* Gas masks are no longer used by PPQ. They are listed here for information only. When fumigating, use SCBA.

HSC Corporation
P.O. Box 192
Buchanan, MI 449107
H.S. Cover (H_sC) model 1482 with G100 and F104 pesticide cartridge

Air-Purifying Respirator (continued)

Mine Safety Appliances Co. (MSA)
P.O. Box 427
600 Penn Center Boulevard
Pittsburgh, PA 15235
MSA CompII in various sizes, MSA #46968 with GMP Pesticide Combination Cartridge (MSA #464025)
MSA Belt-Mounted Respirator (MSA #461000)
MSA Chin Style Pesticide Mask (MSA #448983)
MSA Industrial Size Mask (MSA #457100)
MSA Fumigant Masks 1 —Phosphine and hydrogen sulfide (MSA #457069); hydrocyanic acid (cyanide) (MSA #457084); methyl bromide (MSA #457081); sulfuryl fluoride (MSA #457097)

Scott Aviation
A Division of A-T-O
Lancaster, NY 14086
Model 64 and 64 w/cartridge #65-OVP (full-face piece), or #652-L; cartridge #642-OV; filter #642-F retainer #642-FR

Willson Division
INCO Safety Products Co.
P.O. Box 622
Reading, PA 19603
Willson Chin Style gas mask (#2100/2200 w/ 61F pesticide canister)
Willson #1600 & #1700 w/#R15 filter, #R683 retainer and #R21 organic vapor cartridges.
Willson #1200 w/#R filter, #R683 retainer, and #R21 cartridges

Aluminum Phosphide

Burlington Scientific Corp.
71 Carolyn Blvd.
Farmingdale, NY 11735
tel (631) 694-4700

Degesch America, Inc.
P.O. Box 116
Weyers Cave, VA 24486
tel (540) 234-9281
fax (540) 234-8225

Fumigation Service & Supply Inc.
10540 Jessup Boulevard
Indianapolis, IN 46280-1438
tel (800) 992-1991
fax (317) 867-5757

Gilmore, Inc.
152 Colluns Street
Memphis, TN 38112
tel (901) 323-5870
fax (901) 454-0295

Aluminum Phosphide (continued)

Helena Chemical Co.
434-T Feen Road
P.O. Box 837
Cordelia, GA 31015
tel (912) 273-6243
tel (912) 273-0837
fax (912) 273-8293

ICD Group, Inc.
641 Lexington Avenue
New York, NY 10022
tel (212) 644-1260 or
tel (212) 644-1500

IDA, Inc.
2215 West Street, 2nd Floor
Germantown, TN 38138
tel (901) 757-8056

Inchema, Inc.
213T Old appan Road
Old Tappan, NJ 07675
tel (201) 664-6035
fax (201) 664-5938

Loveland Industries, Inc.
P.O. Box 1289
Greeley, CO 80632-1289
tel (303) 356-8926

Marman USA, Inc.
500 N. Westshore Blvd. #405
Tampa, FL 33609
tel (813) 287-1348

Nova-Chem, Inc.
P.O. Box 22685
Tampa, FL 33622
tel (813) 286-2503
fax (813) 287-1348

Pest Fog Sales Corp.
1424 Bonita St.,
PO Box 3703
Corpus Christi, TX 78463
tel (512) 884-8214 or
tel (800) 395-2345
fax: (512) 884-5903

Pestcon Systems, Inc.
P.O. Box 3510
(3001 104th Street)
Des Moines, IA 50322-0510
tel (515) 284-4606

United Suppliers, Inc.
Box 538
Eldora, IA 50627
tel (515) 858-2341
fax (515) 858-5493
Applicator (Dispenser) for Methyl Bromide
(sight gauges calibrated in ml, grams, or pounds)

Degesch America, Inc.
P.O. Box 45136
(14802 Park Almeda Drive)
Houston, TX 77245
(5 lbs. applicator w/ 1/4 lb. divisions)
tel (713) 433-4777

Fumigation Service & Supply Inc.
10540 Jessup Boulevard
Indianapolis, IN 46280-1438
tel (800) 992-1991
fax (317) 867-5757

H. T. McGill Company
Box 18, 206
Houston, TX

Applicator (Dispenser) for Methyl Bromide (continued)

Pest Fog Sales
P.O. Box 3703
(1424 Bonita)
Corpus Christi, TX 78463
tel (512) 884-8214
fax (512) 884-5903

Vuscamante North
(Attn.: Sr. Maurilio Plata)
307 Montemorelos
Neuvo Leon, Mexico
tel 82-63-33-58

Ascarite II

(granules of sodium hydroxide-coated silica used to remove carbon dioxide from gas samples)

Aldrich Chemical Company, Inc.
1001 West Saint Paul Avenue
Milwaukee, WI 53233
tel (800) 558-9160 or
tel (414) 273-3850
fax (800) 962-9591

Fisher Scientific
P.O. Box 14989
(1241 Ambassador Boulevard)
St. Louis, MO 63178
tel (800) 766- 7000
fax (800) 926-1166

Thomas Scientific
P.O. Box 99
(99 High Hill Road at I 295)
Swedesboro, NJ 08085-0099
tel (800) 345-2100 or
tel (800) 345-2000
fax: (800) 345-5232 or
fax (856) 467-3087
Balances, Portable (for weighing individual fruit)

Balances, Portable (for weighing individual fruit)

Ohaus Corporation
29 Hanover Road
Florham Park, NJ 07932
tel (973) 377-9000
fax (973) 593-0359
(Portable balance for weighing individual fruits, Model LS 2000)
Batch Systems (complete installations)

Batch Systems (complete installations, hot water immersion treatments)

Agri-Machinery, Inc. (A.M.I.)
3489 American Boulevard
Orlando, FL 32810
tel (407) 299-1592
fax(407) 299-1489
(2-tank system with 4 baskets each, with Honeywell strip chart recorder)

Agroindustrias Integradas, S.A. de C.V.
Calle Cernicalo, No. 590
Col. Mor, S.H.C.P. 44490
Guadalajara, Jalisco
Mexico
tel (52) 810-7422
fax(52) 810-7422

Calderas Astro, S.A. de C.V.
Jose Herrera, No. 607-B
C.P. 36350
San Francisco del Rincon
Guanajuato, Guan.
Mexico
tel (474) 31274
fax(474) 32698

Construcciones Pyrsa
Depto. de Ingenieria
Anil No. 100
Col. Los Pinos
Celaya, Guanajuato
Mexico
tel 91-461-20946

Consultecnia
3a Calle 28-70, Zona 1
Quetzaltenango
Apartado Postal 537-1
Guatemala
tel (502)02-781-496

Dica de Mexico, S.A.
Corretera - Navolato, km 8
Culiacan, Sinaloa
Mexico
tel (52) 4-32-23

Diseños y Maquinaria Jer, S.A. de C.V("Jersa")
Emiliano Zapata, No. 51-A
Cuatitlan Izcalli
Estado do Mexico, C.P. 54710
Mexico
tel (52) 5-873-84-09 or 77
tel (52) 5-873-85-22
fax(52) 5-871-20-02

Equipos Agroindustriales de Occidente, S.A. de C. V.
Avenida Washington, No. 1370
Guadalajara, Jalisco
Mexico
tel (52) 11-04-66
fax(52) 11-44-67

Frutico International
P.O. Box 35-A
Avenida Vallarta 2095
Culiacan, Sinaloa
Mexico
tel (52) 671-490-30
tel (52) 671-490-80

Guiar Industrial, S.A. de C.V.
Rayon No 989
Colonia Moderna, Sector Juarez
Guadalajara, C.P. 44190, Jalisco
Mexico
tel (91-36) 10-10-06
tel (91-36) 10-19-49
fax (91-36) 10-19-52
("System Model No. 63-89")

Industria de Maquinas Agricolas GB Ltda.
Via Anhanguera, Km 150
Limeira / Sao Paulo
Brazil CEP 13480-970-Cx. Pt. 385
tel (55-19) 451-1811
fax(55-19) 451-5854

Industrial Equipment & Engineering Co.
(I.E.& E.)
2045 Sprint Blvd.
Apopka, FL 32703
tel (407) 293-9212

Produce Sorters Internationale
7403 West Sunnyview Avenue
Visalia, CA 93291
tel (559) 651-7840
fax (559) 651-7845

Proyect Asesoria Industrial
Av. Los Diplomaticos 1318
San Salvador, El Salvador
or
8a Avenida 33-10, Zona 11
Guatemala, Guat.
tel (503) 701731/707217
tel (503) 701749/802221
fax (503) 701731/259145
fax (502-2) 767439

Pyrsa de Celaya
Calle Violeta No. 1204
Colonia Las Flores
Celaya, Guanajuato, Mexico
tel:(52-4) 61-270-72

Silsa, S.A. de C.V.
Avenida Acueducto
597 Planta Alta
Colonia Tecoman
07330 Mexico 14, D.F.
Mexico
fax(52) 754-32-27

William B. Cresse, Inc.
1091 NW 23rd Street
Miami, FL 33127
tel (305) 633-0977
tel (305) 633-6508
(Batch system with 2 tanks of 3 baskets each.)

Blower

(used in pressure leakage test; may also be used to evacuate a fumigation chamber)

W. W. Grainger, Inc.
(e-mail www.grainger.com)
(outlets in various cities, including the following:)

308 Allwood Road
Clifton, NJ 07012
tel (201) 777-7700
also
816 Ramseur Street
Durham, NC 27701
tel (919) 688-1002
also
4820 Signet Drive
Raleigh, NC 27604
tel (919) 790-0888

William W. Meyer & Sons, Inc.
P.O. Box 105
(8261 Elmwood Avenue)
Skokie, IL 60077
tel (847) 673-0312

Bubble Fumigation System

(inflatable tarpaulin)

B&G Equipment Company
6120 Route 611
Plumsteadville, PA 18949-0130
tel (800) 544-881 / (215) 766-8811

Power Plastics
Station Road
Thirks, N. Yorkshire Y07 1P2
England
tel 0845-525503
fax 0845-525483

Cascade Air Tank Recharging System (for SCBA)

Mine Safety Appliance Co. (MSA)
P.O. Box 427
600 Penn Center Boulevard
Pittsburgh, PA 15235

Scott Aviation
A Division of A-T-0 Inc.
Lancaster, NY 14086
tel (716) 683-5100

Chain Hoist (Electronic) (For hot water immersion treatments)

Columbus McKinnon Corp.
Industrial Products Division
140 John James Audubon Parkway
Amherst, NY 14228
tel (716) 689-5400
(Lodestar electronic chain hoist, capacity to 3 tons)

Chemonics
PROEXAG Project
5a Av. 15-45, Zona 10
Edificio Centro Empresarial
Torre l, 9 Nivel
Guatemala, Guatemala
tel (502) 2-33-70-82 or 83
fax (502) 2-33-70-84
(Post-harvest advice; international consulting)

Consultants (For hot water immersion treatments)

C.C. Coutinho Consulting
Av. Princess Leopddina, 238
Ap. 101 D
Graca - Ed Olga Pontes
Cep 40150-080 Salvador, Bahia
Brazil
tel (55-81) 99-98-42-84
fax (55-81) 8-62-29-93
e-mail <cosam@uol.com.br>

Gaffney Engineering Co.
5530 NW 97th Street
Gainesville, FL 32653
tel (352) 373-7955
(Engineering consulting)

North Bay Produce, Inc.
10a Calle 1-4, Zona 9
Guatemala, Guat.
tel (502-2) 342-295 or 6
fax (502-2) 344-974
(Legal and technical advice)

Center for Plant Health Science and Technology
USDA-APHIS-PPQ-CPHST
Treatment Support & Certification
1017 Main Campus Drive, Suite 2500
Raleigh, NC 27606
tel (919) 513-2496
fax(919) 513-1995
(APHIS technical contact; approval of plans and drawings)

Societe d'Entretien & d'Installation (SODEIN)
Route de Carrefour #83
(P.O. Box 995)
Port-au-Prince, Haiti
(Installation of temperature recording equipment, especially the Chessel 346)

Consultecnia
3a Calle 28-70, Zona 1
Quetzaltenango
Apartado Postal 537-1
Guatamala
tel (502) 02-781-496

Dica de Mexico, S.A.
Carretera a Navolato, Km 8
Culiacan, Sinaloa
Mexico
tel (52) 4-32-23

Frutico International
P.O. Box 35-A
Avenida Vallarta 2095
Culiacan, Sinaloa
Mexico
tel (52) 671-490-30
tel (52) 671-490-80

Curtains (air, safeguarding)

W.W. Granger, Inc.
(branch offices in many cities)
www.grainer.com

Digital Thermister Instrument (hand-held for hot water immersion treatments) and Portable Sensors (used in Performance Test)

Allied Electronics
5979 NW 151st Street
Miami Lakes, FL 33014
tel (305) 558-2511
tel (800) 433-5700
fax (305) 558-1130
(Additional sales outlets in other cities) (Instruments include Cooper Instrument Corp's Model TM99A, and. Thermister sensors with submersible 10 or 20 ft. cord,
Catalog No. 2010.)

Cooper Instrument Corp.
33 Reeds Gap Road
Middlefield, CT 06455
tel (860) 349-3473
fax(860) 349-5155
(Note: This company manufactures the Cooper instruments sold by Allied Electronics, but does not sell directly to retail customers.)

Drierite® (anhydrous calcium sulfate)

Aldrich Chemical Company, Inc.
1001 West Saint Paul Avenue
Milwaukee, WI 53233
tel (414) 273-3850

Fisher Scientific
P.O. Box 14989
St. Louis, MO 63178
tel (314) 991-2400

W. A. Hammond Drierite Co. (Manufacturer)
138 Dayton Avenue
Xenia, OH 45385
tel (937) 376-2927

Exhaust Duct (Tube), Flexible

(stock sizes available in diameters of 12, 16, and 24 inches. Available in 10 and 20 feet lengths, which may be attached by a ring coupling.)

Gaskets, Inc.
301 Highway 1600
Rio, WI 53960
tel (920) 992-3137

Super Vacuum Mfg. Co., Inc.
1303 E 11
Loveland, CO 80537
tel (970) 667-5146

Fans

Pest Fog Sales Corp.
1424 Bonita St.
PO Box 3703 Corpus Christi, TX 78463
tel (512) 884-8214 or
tel (800) 395-2345
fax (512) 884-5903
(18-inch fumigation fan)

Super Vacuum Mfg. Co., Inc.
1303 E 11
Loveland, CO 80537
tel (970) 667-5146
For use in a chamber or under tarpaulin, or during exhaust. Specify blade size, horsepower, and CFM.

Fruit Crates, (Plastic for hot water immersion treatments)

No listings

Fruit Sizing Equipment (Automatic)

Hortagro International b. v.
P.O. Box: 4050
8901 EB Leeuwarden
Holland
tel: (058) 21-23-795
fax: (058) 21-25-344
(Mechanical weight sizer with conveyor belt)

Kerian Machines, Inc.
Highway 81 South
(P.O. Box 311)
Grafton, ND 58237
tel (701) 352-0480
fax(701) 352-3776
(Roller type of sizing equipment)

Fumigation Chamber, NAP

(large fumigation chambers must be custom built by engineering contractors)

Fruit Technologies
Walla Walla & Wenatchee, WA
tel (509) 662-0700
fax(509) 664-3743

Fumigation Chamber, Vacuum

(steel; can also be used for fumigation at normal atmospheric pressure)

Cos-Med Group
(a.k.a. ETO Sterilization, Inc.)
250 Brunswick Avenue
Linden, NJ
tel (401) 822-3400 (in Rhode Island)

Slack Associates, Inc.
540 South Longwood Street
Baltimore, MD 21223-2797
tel (410) 566-2520

Vacudyne Corporation
375 East Joe Orr Road
Chicago Heights, IL 60411

Fumigators, Commercial

See listings in local telephone directories (yellow pages) under the heading "Pest Control Services"

Fungicides

Bordeaux Mixture (hydrated lime + copper sulfate)

Uniroyal Chemical Co., Inc.
Benson Road
Middlebury, CT 06762
tel (203) 573-2000
fax (203) 573-3394
Product name: Nutra-Spray
Captan

Crystal Chemical Inter-America
1523 N. Pest Oak Road
Houston, TX 77055
tel (713) 956-6196
fax(713) 956-6835
Product name: Captanex

Drexel Chemical Co.
1700 Channel Avenue
Memphis, TN 38113
tel (901) 774-4370
fax(901) 774-4666
Product name: Drexel Captan

ZENECA Ag Products
1800 Concord Pike
Wilmington, DE 19897
tel (800) 759-4500
fax (302) 886-1552

Fungicides (continued)

Ferbam

FMC Corp. AG
Chemical Group
1735 Market Street
Philadelphia, PA 19103
tel (215) 299-6661
fax (215) 299-6256
Product Name: Carbamate

UCB Chemicals Corp.
5505-A Robin Hood Road
Virginia Beach, VA 23513
tel (804) 473-9775
Product names: Carbamate WDG, Ferbam 76 WDG, Ferbam Granuflo

Mancozeb

Elf Agrochem North America, Inc.
Agrochemicals Group
2000 Market Street, 21st Floor
Philadelphia, PA 19103
tel (215) 419-7219
fax (215) 419-5012
Product name: Penncozeb 80 WP

Rohn and Haas Co.
100 Independence Mall W.
Philadelphia, PA 19106
tel (215) 592-3000
fax (215) 592-2797
Product name; Dithane

Thiram

UCB Chemicals Corp
5505-A Robin Hood Road
Virginia Beach, VA 23513
tel (804) 473-9775
Product Names: Tech TMTD, Thianosan, THiLor, Thipel, Thiram Granuflo, Thiram 65, Thiram 75-WDG
Zineb

Rhone-Poulenc Ag Co.
P.O. Box 12014
Research Triangle Park, NC 27709
tel (919) 549-2000
Product Names: Cuprothex Super Mix

Gas Analyzers

Analytical Technology, Inc.
680 Hollow Road, Box 879
Oaks, PA 19456
tel (800) 959-0299 or
tel (610) 917-0991
fax (610) 917-0992
(Porta-Sens Phosphine Detector)

Gas Analyzers (continued)

Gow-Mac Instrument Company
Mailing Address:
P.O. Box 25444
Lehigh Valley, PA 18002-5441
tel (610) 954-9000
fax (610) 954-0599
(Fumigant Thermal Conductivity Analyzer Model)
Shipping/Receiving Address:
277 Brodhead Road
Bethlehem, PA 18017-8600

Interscan Corp.
21700 Nordoff Street
(P.O. Box 2496)
Chatsworth, CA 91313
(Interscan Model GF 1900 pyrolysis unit, sensitive to SF at 0–50 ppm.)
tel:(818) 882-2331
fax:(818) 341-0642

Key Chemical and Equipment Co., Inc.
13195 49th Street North, #A
Clearwater, FL 34622
tel (727) 572-1159
fax(727) 572-4595
(Fumiscope, Model D)

Neal Systems, Inc.
122 Terry Drive
Newtown, PA 18940
tel (215) 968-7577
fax (215) 968-6480
(Porta-Sens Phosphine Detector)

Pest Fog Sales Corp.
1424 Bonita St.
PO Box 3703 Corpus Christi, TX 78404
tel: (512) 884-8214 or
tel (800) 395-2345
fax: (512) 884-5903

Gas Detector Tube (colorimetric) and Apparatus

APHIS/NOAA Centralized Warehouse
(must order by Fedstrip procedure)
FTS: 758-6222 (Draeger tubes)

Lab Safety Supply
A Division of Science Related Materials, Inc.
401 South Wright Road
Janesville, WI 53546
tel (800) 356-0783
tel (608) 754-2345
(Draeger tubes)

Matheson Gas Products
932 Paterson Plank Road
East Rutherford, NJ 07073-2173
tel (201) 933-2400 (Kitagawa tubes)

National Draeger, Inc.
P.O. Box 120
Pittsburgh, PA 15230-0120
tel (800) 922-5518 (Draeger tubes)
fax (800) 922-5519

Pest Fog Sales Corp.
1424 Bonita St.
PO Box 3703
Corpus Christi, TX 78463
tel (800) 395-2945 or
tel (512) 884-8214
fax (512) 884-5903

Protech Safety Equipment
37 East 21st Street
Linden, NJ 07036
tel (908) 862-1550 (Draeger tubes)

Roxan, Inc.
5425 Lockhurst Drive
Woodland Hills, CA 91367
tel (800) 228-5775 (except CA, AK)
tel (818) 703-6108 (CA, AK)
(Sensidyne/Gastec tubes and apparatus)

Sensidyne, Inc.
12345 Starkey Rd., Suite E
Clearwater, FL 33543
tel (727) 530-3602 (Sensidyne/Gastec tubes and apparatus)

SKC, Inc.
863 Valley View Road
Eighty Four, PA 15330-9614
tel (800) 752-8472
tel (412) 941-1369
fax (800) 752-8476

Union Carbide Corp, Linde Div.
National Specialty Gases Office
40 Veronica Avenue
Somerset, NJ 08873-3498
tel (732) 937-4900
(Sensidyne/Gastec tubes and apparatus)

Gas Drying Tube (for Drierite®)

Lurex Scientific
P.O. Box 2420
South Vineland, NJ 08360
tel (609) 794-2121
(glass tube) – Catalog # 301-7501

Germicides/Disinfectants

Vestrol Laboratories Div. of Chemed Corp.
St. Louis, MO 63110
Product: 1 Stroke Environ

Georgia-Pacific Corp.
P.O. Box 1236
300 W. Laurel Street (98225)
Billingham, WA 98227
tel (800) 385-4348 or
tel (360) 733-4410
fax (206) 676-7217
Product: Formaldehyde
Order from GSA
(NSN 6810-00-664-7121 or
NSN 6810-00-664-0402)
Product: Soda Ash
Order from GSA
(NSN 6810-00-270-8177)
Product: Sodium Hydroxide

Germicides/Disinfectants (continued)

Order from GSA (NSN 6810-00-281-254 or NSN 6810-00-240-2121)
Product: Sodium Hypochlorite
Available from APHIS-VS
Product: Sodium Orthophenate
(Also available as bleach in almost all grocery stores. Trade names include Clorox and others.)

Halide Gas Leak Detector

Degesch America, Inc.
Houston Division
P.O. Box 451036
Houston, TX 77245
tel (713) 433-4777
fax (713) 433-0877

Fumigation Service & Supply Inc.
10540 Jessup Boulevard
Indianapolis, IN 46280-1438
tel (800) 992-1991
fax (317) 867-5757
(Stocks both propane and audible types)

General Services Administration
(Optional Schedule #63, Part 2
Catalog no. 4940-00-756-1207)

Pest Fog Sales Corp.
1424 Bonita St.
PO Box 3703
Corpus Christi, TX 78404
tel (512) 884-8214 or
tel (800) 395-2345
fax: (512) 884-5903

Turner Brass Works
Sycamore, IL

W. W. Grainger, Inc. (e-mail www.grainger.com)
(outlets in various cities, including the following:)

308 Allwood Road
Clifton, NJ 07012
tel (201) 777-7700 also

816 Ramseur Street
Durham, NC 27701
tel (919) 688-1002 also

4820 Signet Drive
Raleigh, NC 27604
tel (919) 790-0888

Scott Aviation
225 Erie Street
Lancaster, NY 14086

Incinerators

Whitton Technology, Inc.
Air Burners Products Div.
4390 Cargo Way
Palm City, FL 34990
tel (561) 622-9626
fax (561) 220-7302
e-mail info@airburners.com
(Air Curtain Incinerators)

Magnesium Phosphide

Burlington Scientific Corp.
222 Sherwood Avenue
Farmingdale, NY 11735
tel (516) 678-4414

Degesch America, Inc.
P.O. Box 116
Weyers Cave, VA 24486
tel (703) 234-9281
fax (703) 234-8225

Fumigation Service & Supply, Inc.
10540 Jessup Boulevard
Indianapolis, IN 46280-1438
tel (800) 992-1991
fax (317) 867-5757

Helena Chemical Co.
434-T Fern Road
P.O. Box 837
Cordelia, GA 31015
tel (912) 273-6243 or
tel (912) 273-0837
fax (912) 273-8293

Marman USA, Inc.
500 North Westshore Blvd. #405
Tampa, FL 33609
tel (813) 286-2503

Nova-Chem, Inc.
P.O. Box 22685
Tampa, FL 33629
tel (813) 286-2503
fax (813) 287-1348

Manometer (used in pressure leakage test)

Alnor Instrument Co.
7555 North Linder Avenue
Skokie, IL 60077
tel (847) 677-3500
Model 530 (1–10 inches of water) (electronic)

Davis Instruments
4701 Mount Hope Drive
Baltimore, MD 21215
tel (410) 243-4301
fax (410) 358-0252
e-mail www.davisontheweb.com
(U-tube or electronic)

Dwyer Instruments, Inc.
102 Indiana Highway 212
Michigan City, IN 46360
tel (219) 879-8000
(flex-tube type)

Fisher Scientific
52 Fadem Road
Springfield, NJ 07081
(also other locations)
tel (800) 766-7000
fax (800) 926-1166
(tube or electronic)

Neotronics of North America
4331 Thurmond Tanner Road
Flowery Branch, GA 30542
tel (770) 967-2196
Model No. 530 (0–19.99 inches of water)

Metam-sodium

Amvac Chemical Corp.
4100 E. Washington Blvd.
Los Angeles, CA. 90023
also
2110 Davie Blvd.
Los Angeles, CA 90040)
tel (323) 264-3910
fax (213) 268-1028

Methyl Bromide

(100%)

Ameribrom, Inc.
52 Vanderbilt Ave.
New York, NY 10017
tel: (212) 286-4000
fax: (212) 286-2275

Biesterfeld U.S., Inc.
500 Fifth Avenue #4230
New York, NY 10110-4296
tel (212) 782-0500

Degesch America, Inc.
Houston Division
P.O. Box 451036
Houston, TX 77245
tel (713) 433-4777
fax (713) 433-0877

Fumigation Serv. & Supply Inc.
10540 Jessup Boulevard
Indianapolis, IN 64280-1438
tel (800) 992-1991
fax (317) 867-5757

Great Lakes Chemical Corp.
P.O. Box 2200
West Lafayette, IN 47906
tel (765) 497-6100 (Indiana)
tel (901) 645-2698 (Ramer, TN)
tel (800) 428-7947

Helena Chemical Co.
434-T Fenn Road
P.O. Box 837
Cordelia, GA 31015
tel (912) 273-6243
tel (912) 273-0837
fax (912) 273-8293

ICD Group, Inc.
61 Lexington Avenue
New York, NY 10022
tel (212) 644-1260
tel (212) 644-1500

Marman USA Inc.
500 North Westshore Blvd. #405
Tampa, FL 33609
tel (813) 286-2503

Nova-Chem, Inc.
P.O. Box 22685
Tampa, FL 33622
tel (813) 286-2503
fax (813) 287-1348

Pest Fog Sales Corp.
1424 Bonita St.
PO Box 3703 Corpus Christi, TX 78463
tel: (512) 884-8214 or (800) 395-2945
fax: (512) 884-5903

Pestcon System, Inc.
P.O. Box 3510
(3001 104th Street)
Des Moines, IA 50322-0510
tel (515) 284-4606

Southern Agricultural Insecticides Inc.
P.O. Box 218
Palmetto, FL 34220
tel (941) 722-3285
fax (941) 723-2974
e-mail www.southernag.com

Southern Mill Creek Products Co., Inc.
5441 North 56th Street
Tampa, FL 33610
tel (813) 635-0707
fax (813) 630-9536

Moisture Meter (for wood)

Delmhorst Instrument Company
P.O. Box 68
(51 Indian Lane East)
Towaco, NJ 07082
tel (800) 222-0638
fax (973) 334-2657
e-mail www.delmhorst.com
Order: Moisture Meter G30
Electrode 26ES
Type 496 pin
Above comes as package in carrying case.

Lignomat
14345 N.E. Morris Court
Portland, OR 97230
tel (503) 257-8957
fax (5030256-3844
e-mail lignomat.com

Newsletters and Trade Journals

(containing articles on fumigation)

Fumigants and Pheromones
(free newsletter)
Fumigation Serv. & Supply Inc.
10505 North College Avenue
Indianapolis, IN 46280

Pest Control
(monthly for professional pest control operators)
Advanstar Communications Inc.
P.O. Box 6215
Duluth, MN 55806-9833
tel (218) 723-9477
fax (218) 723-9417

Pest Control Technology
(monthly for professional pest control operators)
4012 Bridge Avenue
Cleveland, OH 44101
tel (216) 961-4130
fax (216) 961-0364

Personal Air Sample Pump

Important

This equipment is not for routine use at ports.

Anatole J. Sipin Co., Inc.
505 8th Avenue
New York, NY 10018
tel (212) 695-5706
(Model SP-15 wide range personal sampler, pump, with charcoal tube inserts)

Spectrex Corp.
3580 Haven Avenue
Redwood City, CA 94063
tel (650) 365-6567 or (800) 822-3940
fax (650) 365-5845
e-mail www.spectrex.com
Quaternary Ammonium

Georgia Steel & Chemical Company, Inc.
10810 Guilford Road, Suite 104
Annapolis Jct., MD 20701
tel (800) 296-0351
fax (301) 470-6313
e-mail www.georgiasteelco.com
(Clean-Gear, Breathing Mask Cleaning Towelette

Mine Safety Appliances Company (MSA)
P.O. Box 427
(600 Penn Center Blvd.)
Pittsburgh, PA 15230
(Cleaner-Sanitizer II, part no. 34337)

Safety Equipment

Industrial Safety Company
1390 Neubrecht Road
Lima, OH 45801
tel (800) 537-9721
tel (419) 227-6030
fax (419) 228-5034
e-mail www.indlsafety.com
(Safety guards for belt and chain drives; fan guards; fire extinguishers; safety equipment in general).

Scale (portable platform type)

(for weighing gas cylinders) (in addition to the following, also see Yellow Pages)

Arlington Scale Co., Inc.
P.O. Box 1058
(47 Johnston Avenue)
Kearny, NJ 07032
tel (201) 998-3242

Atlantic Scale Co., Inc.
136 Washington Avenue
Nutley, NJ 07110
tel (973) 661-7090
fax (973) 661-3651
e-mail www.atlanticscale.com

Scale (portable platform type) (continued)

Eastern Scales NJ
1053 Pennsylvania Avenue
Linden, NJ 07036
tel (908) 486-4433
tel (732) 381-8007

Phifer Wire Products, Inc.
P.O. Box 1700
Tuscaloosa, AL 35403
tel (800) 633-5955
tel (205) 345-2120
fax (205) 759-4450
e-mail www.phifer.com
(Fiberglass insect screening of various mesh sizes and colors)

Sealing Tape

Degesch America, Inc.
Houston Division
14802 Parkalmeda
Houston, TX 77045
tel (713) 433-4777
fax(713) 433-0877

Fumigation Serv. & Supply Inc.
16950 Westfield Park Road
Westfield, IN 46074
tel (800) 992-1991
fax (317) 867-5757
e-mail www.insectsltd@aol.com
(ARMAK sealing tape)

Self-Contained Breathing Apparatus (SCBA)

Cesco Safety Products
P.O. Box 1237
Kansas City, MO 64141
tel (913) 814-7300

Georgia Steel & Chemical Company, Inc.
10810 Gilford Road
Annapolis Jct. MD. 20701
tel 1-800-296-0351
(CLEAN-GEAR, Breathing mask cleaning towelette)

Lab Safety Supply
401 S. Wright Road
Janesville, WI 53546-8729 (shipping address)
or
P.O. Box 1368
Janesville, WI 53547-1368
tel (608) 754-2345
tel (800) 356-6964
e-mail www.labsafety.com

Mine Safety Appliances Co. (MSA)
P.O. Box 427
600 Penn Center Boulevard
Pittsburgh, PA 15235

Pest Fog Sales Corp.
1424 Bonita St.
PO Box 3703 Corpus Christi, TX 78463
tel: (512) 884-8214 or (800) 395-2945
fax: (512) 884-5903

National Draeger, Inc.
Box 120
Pittsburgh, PA 15230
tel (412) 787-8383
e-mail www.draeger-usa.com

Rexnord Electronic Products
45 Great Valley Parkway
Malvern, PA 19355
tel (215) 647-7200

Scott Air Aviation
A Division of A-T-O Inc.
225 Erie Street
Lancaster, NY 14086
tel (716) 683-5100
Scott Air-Pak 11a (#900,000)
Presur-Pak 11a (#900,014)
Scott Air-Pak 4.5 (#900,450)
Presur-Pak (#900,455)

Survivair
3001 S. Susan Street
Santa Ana, CA 92704
tel (888) 277-7222
fax (714) 850-0299
e-mail scba@survivair.com
URL www.survivair.com

Smoking Candle

(Used in pressure leakage test. Candles of various sizes.)

Purchase only candles that emit white smoke. If candles that emit colored smoke are used, their residue will stain the interior walls of the fumigation chamber, skin, and clothing. Store candles in a dry, cool place.

Davis Instruments
4701 Mount Hope Drive
Baltimore, MD 21215
tel (410) 243-4301
fax (410) 358-0252
e-mail www.davisontheweb.com

Superior Signal Co., Inc.
178 Greystone Road
Spotswood, NJ 08884
tel (732) 251-8800
fax (732) 251-9442
e-mail www.superiorsignal.com

Snakes (sand snakes, watersnakes, Sewn on one end)

Fumigation Serv. & Supply Inc.
10540 Jessup Boulevard
Indianapolis, IN 46280-1438
tel (800) 992-1991
fax (317) 867-5757

Pest Fog Sales Corp.
1424 Bonita St.
PO Box 3703 Corpus Christi, TX 78404
tel: (512) 884-8214 or (800) 395-2945
fax: (512) 884-5903

Soil Fumigants

(Metam-sodium, Vapam, etc.)

Buckman Laboratories, Inc.
1256 N. McLean Boulevard
Memphis, TN 38108
tel (901) 278-0330
fax (901) 276-5343
Product name: Busan 1020

Oregon-California Chemicals, Inc.
29454 Meadowview Road
Junction City, OR 97448
tel (541) 689-4413
fax (541) 689-5026
Product name: Sectagon

UCB Chemicals Corp.
2000 Lake Park Drive
Smyrna, GA 30080
tel (800) 426-3820
e-mail www.ucb.be.com
Products: Metam 32.7, Metam 42, Ucetam

ZENECA Ag Products
1800 Concord Pike
Wilmington, DE 19897
tel (800) 759-4500
fax (302) 886-1553
Product name: Vapam
e-mail www.zenecaagproducts.com

Spill Recovery Materials

(products to absorb spills of hazardous materials)

Ansul
Spill Control Products Group
One Stanton Street
Marinette, WI 54143
(Product: Spill-X)
tel (800) 346-3626
e-mail www.ansul.com

Fumigation Service & Supply Inc.
10540 Jessup Boulevard
Indianapolis, IN 46280-1438
tel (800) 992-1991
fax (317) 867-5757

New Pig Corp.
One Pork Avenue
Tipton, PA 16684-0304
tel (800) 468-4647
e-mail www.newpig.com

Upright, Inc.
10715 Kahlmayer Drive
St. Louis, MO 66132
(Product: absorbant pillows and socks) (Free samples available)
tel (800) 248-7007
email www.uprightinc.com
tel (314) 961-3711

Steam Boilers (For hot water immersion treatment)

Fulton Boiler Works, Inc.
P.O. Box 257
Pulaski, NY 13142
tel (315) 298-5121
fax (315) 298-6398
e-mail www.fulton.com
(oil-fired, gas-fired, or combination)

Steam Generators

Sioux Steam Cleaner Corporation
One Sioux Plaza
Beresford, SD 57004-1500
tel (605) 763-3333
tel (888) 763-8833
fax (605) 763-3334
e-mail siouxstm@bmtc.net

Steam Sterilizers/Autoclaves

ETC Biophysics
Environmental Tectonics Corp.
125 James Way
South Hampton, PA 18966
tel (215) 355-9100
e-mail www.etcusa.com

Sulfuryl Fluoride (Vikane)

Dow Agro Sciences
9330 Zionsville Road
Indianapolis, IN 46268
tel (317) 337-4389
fax (317) 337-4330

Marman USA, Inc.
500 North Westshore Blvd. #405
Tampa, FL 33609
tel (813) 286-2503

Nova-Chem, Inc.
P.O. Box 22685
Tampa, FL 33622
tel (813) 286-2503
fax (813) 287-1348

Pest Fog Sales Corp.
1424 Bonita St.
PO Box 3703 Corpus Christi, TX 78463
tel: (512) 884-8214 or (800) 395-2345
fax: (512) 884-5903

Southern Agricultural Insecticides Inc.
P.O. Box 218
Palmetto, FL 34220
tel (941) 722-3285
fax (941) 723-2974
e-mail www.sothernag.com

Southern Mill Creek Products, Co., Inc.
5441 North 59th Street
Tampa, FL 33610
tel (813) 635-0707
fax (813) 630-9536

Supplied-Air Respirators

Mine Safety Appliances Co (MSA).
600 Penn Center Boulevard
P.O. Box 427
Pittsburgh, PA 15235
(Airline respirator)

National Draeger, Inc.
Box 120
Pittsburgh, PA 15230-0120
tel (800) 922-5518
fax (800) 922-5519
(Airline respirator)

Scott Aviation
A Division of A-T-0, Inc.
Lancaster, NY 14086
Scott #900,034 Supplied Airline respirator with self-contained air supply
Scott #801, 548 Type C Supplied-air pressure demand respirator

3M Occupational Health & Safety
Products Division
220-7W 3M Center
St. Paul, MN 55101
3M #W-2804 pesticide helmet and other Whitecap systems

Willson Division
INCO Safety Products Company
P.O. Box 622
Reading, PA 19603
Willson #1810 and #1820 half-mask respirator
Willson #1850 and #1860 full-face piece respirator

Tarpaulins (made to order)

Tarpaulins for fumigation are made by many companies. Consult the Yellow Pages.

Elastec
401 Shearer Blvd
Cocoa, FL 32922
tel:(321) 636-5783
fax:(321) 636-5787
e-mail www.elastec.com

Griffolyn Company, Division
Division of Reed Industries, Inc.
P.O. Box 33248
(10020 Mykawa Road)
Houston, TX 77233
tel (713) 507-4200
Inflatable tarpaulin: See “Bubble Fumigation System”

Poly-Flex, Inc.
2000 West Marshall Drive
Grand Prairie, TX 75051-9983
tel (800) 527-3322, Ext. 308

Raven Industries
PO box 5107
Sioux Falls, SD 57117-5107
tel: (605) 335-0174
fax: (605)331-0333
e-mail www.ravenind.com

Temperature Recorders (Portable Type) for Cold Treatment in Self-regulated Containers

Remonsys Limited
The Stables, Church Hanborough
Witney, OXON OX29 8AB
United Kingdom
tel (44) 1993 886996
fax (44) 1993 886997
(Autolog Time/Temperature Monitor,
AUTOLOG 2000 Data Logger)

Control One
26 Lafayette Street
Stamford, CT 06902
tel (203) 359-0909
fax (203) 327-7295
(Control One)

Controlyne, Inc.
25 North Fullerton Ave.
Montclair, NJ 07042-3412
tel (800) 766-5737
fax (973) 746-2286
(ACR SmartReader 8 Logger)

Cox Recorders
69 McAdenville Road
Belmont, NC 28012
tel (704) 825-8146
fax (704) 825-4498
(Cox/Escort (Memory Logger))
(Cox Tracer temp. logger)

Sensitech, Inc. (formerly Ryan Instr.)
707 Drew Avenue
Lanoka Harbor, NJ 08734
tel (609) 971-7176
fax (732) 946-0533
(Data Mentor, RTM 2000 CTU)

Wescor Environ. (Omnidata)
P. 0. Box 361
Logan, UT 84323-0361
tel (435) 753-8311
fax (435) 753-8177
(Datapod)

DeltaTrak
9260 Isaac Street, Suite D
Santee, CA 92171
tel (925) 467-5940
fax (800) 962-6776
(DeltaTrak T-8, DeltaTrak CDX-100, CDX-300, CDX-22000)

Metrosonics, Inc.
P. 0. Box 23075
Rochester, NY 14692
Tel. (716) 334-7300
Fax- 716-334-2635
(DocuTemp 714A)

Science/Electronics
521 Kiser Street
Dayton, OH 45404-1641
Tel. (937) 224-4444
Fax (937) 224-4434
(Grant Squirrel Meter/Logger)

Kaye Instruments
15 DeAngelo Drive
Bedford, MA 01730
Tel. (781) 275-0300
Fax -781-275-9024
(Model DR-2B Digistrip II

Temperature Recorders (Built-in Type) for Cold Treatment in Self-regulated Containers

Matrix Dynamics
501 Doylestown Road
Lansdale, PA 19446
tel (215) 393-9780
fax (215) 393-9783
(Road Warrior 1, HACCP Warrior)

Carrier Transicold Division
Carrier Corporation
United Technologies
P. 0. Box 4805
Syracuse, NY 13221
tel (315) 432-6000
fax (315) 432-7583
(Micro Link 2 DataCorder, Micro Link 2i Controller/DataCorder, Micro Link 3 DataCorder)

Daikin Industries Ltd.
Sakai Plant, Kanaoka Factory
1304, Kanaoka-Cho.
Sakai, Osaka 591-8511
Japan
tel (81) 722 59-9724
fax (81) 722 51-6833
(Decos III Microproc. Temp Controller, Decos III A, Decos IIIB & C)

Mitsubishi Heavy Industries
3-1 Asahimachi
Nishibiwgima-Cho
Nishikasugai-Gun, Aichi,
452-8561 Japan
tel (81) 52 503 9312
fax (81) 52 503 2638
(MMCCIII & MMCC IIIA, MMCC IIIA-47B)

Klinge Corporation
4075 E. Market Street
P. 0. Box 3608
York, PA 17402
tel (717) 840-4500
fax (717) 840-4501
(ThermLogger II)

Brandstedt Controls Corporation
8990 NW 105 Way
Medly, FL 33178
tel (305) 885-0099
fax (305)885-1499
(WR 1095 Data Recorder)

Sabroe Reefer Cooling Inc.
524B South Walnut Street
Wilmington, DE 19901
tel (302) 426-0700
fax (302) 426-0701
(MP-2000, MP-3000)

Thermo King Corporation
314 West 90th Street
Minneapolis, MN 55420
tel (612) 887-2307
fax (612)-885-3581
(Thermoguard PA Microprocessor Temperature Controller, MP-D Microprocessor Controller, Thermoguard PA+ Microprocessor Controllers)

Temperature Recorders for Hot Water Immersion Treatment

Agri-Machinery, Inc. (A.M.I.)
3489 All American Boulevard
Orlando, FL 32810
tel (407) 299-1592
fax (407) 299-1489
(Honeywell strip chart recorders)

Chessell Corporation
One Pleasant Run
Newton, PA 18940
tel (215) 968-0660
fax (215) 968-0662
e-mail www.chessel.com
(Chessel strip-unit recorder, Model 346)

Consultecnia
3a Calle 28-70, Zona 1
Quetzeltenango
Apartado Postal 537-1
Guatemala
tel (502) 02-781-496
(ASICS temperature recorder)

Contech
Avenida Circunvalacion #1590
Jardines del Country, C.P. 44210
Guadalajara, Jalisco
Mexico
tel (523) 823-2831
fax (523) 823-2831
(contech data logger)

Control Instrument Services, Inc.
3607 Ventura Drive East
Lakeland, FL 33811
tel (863) 644-9838
fax (863) 644-8608
e-mail www.cisinc.org
(Honeywell strip chart recorders)

Enterprise S.A. de C.V.
Rodriguez Saro 424
Colonia del Valle
03100 Mexico D.F.
Mexico
tel (905) 534-6028
fax (905) 524-6426
(Honeywell and Molytek 2702 temperature recorders)

Equipos Industriales Guadalajara
Aguador No. 3959-A
Int. 5 Fracc. La Calma
C.P. 45070, Zapopan, Jalisco
Mexico
tel (52-3) 634-52-64
fax (52-3) 632-35-20
(Honeywell instruments)

Guiar Industrial, S.A. de C.V.
Rayon No. 989
Colonia Moderna
Sector Juarez
Guadalajara, C.P. 44190, Jalisco
Mexico
tel (91-36) 10-10-06
tel (91-36) 10-19-49
fax (91-36) 10-10-52
(Honeywell instruments)

Honeywell, Inc.
Industrial Automation & Control Div.
1100 Virginia Drive
Ft. Washington, PA 19034
tel (215) 641-3000
fax (215) 641-4428
e-mail www.honeywell.com
(Honeywell instruments)

Industrial Equipment & Engineering Co.
(I.E.& E.)
2045 Sprint Blvd.
Apopka, FL 32703
tel (407) 293-9212
(Honeywell instruments)

Instrumentacion y Control Industrial
Santa Martha No. 269
Zapopan, Jalisco
Mexico
tel/fax (52-3) 636-5145
(National and Honeywell Instruments)

Measurement Dynamics LLC
125 Titus Ave.
Warrington PA 18976
tel: (800) 656-1114
fax: (215) 343-4670

Vacuum Research Corp.
2419 Smallman Street
Pittsburgh, PA 15222
tel (412) 261-9030
fax(412) 261-7220
e-mail www.vacuumresearchcorp.com
(Molytek temperature recorder, Model 2702)

Nanmac Corporation
9 Mayhew Street
Framingham, MA 01702
tel (508) 872-4811
fax (508) 879-5450
e-mail www.nanmac.com
(Nanmac data logger, Model H30-1)

National Instruments, Inc.
P.O. Box 840909
Dallas, TX 75284-0909
tel (512) 794-0100
fax (512) 683-5794
e-mail www.ni.com
(National Instruments)

Neuberger Messinstrumente Gmbh
Steinerstr 16, D-8000
Munchen, Germany
tel (089) 72402-0
(Neuberger strip chart recorder)

Process Technologies, Inc.
P.O. Box 82070
Tampa, FL 33682
tel (813) 949-9553
fax (813) 949-8108

William B. Cresse, Inc.
1091 NW 23rd Street
Miami, FL 33127
tel (305) 633-0977
fax (305) 633-6508
(Honeywell strip chart recorder)
Temperature Sensors (RTD, 100 ohm)

Conax Buffalo Corp.
2300 Walden Avenue
Buffalo, NY 14225
tel (716) 684-4500
fax (716) 684-7433
e-mail www.conaxbuffalo.com

Electro Scientific Industries
139 N.W. Science Park Drive
Portland, OR 97229
tel (503) 641-4141
fax (503) 671-5551
(Dekabox Delade Resister instrument, Model No. DB62, which may be used in the calibration of RTD sensors)

Thermocouple Wire

Omega Engineering, Inc.
Box 4047
(1 Omega Drive)
Stamford, CT 06907-0047
tel (203) 359-1660
fax (877) 329-6634
e-mail www.omega.com
(Type "T" thermocouple wire)
Catalog No. PR-T-24

Thermometers

Brooklyn Thermometer Co., Inc.
90 Verdi Street
Farmingdale, NY 11735
tel (631) 694-7610
fax (631) 694-6329
e-mail www.brooklynthermometer.com
(officially calibrated glass thermometers)

Cole-Parmer Instrument Co.
625 East Bunker Court
Vernon Hills, IL 60061
tel (800) 323-4340 or
tel (847) 323-4340
fax(847) 247-2929
e-mail www.colepalmer.com
(digital thermometers, hand-held)

Cooper Instrument Corp.
33 Reeds Gap Road
Middlefield, CT 06455-0450
tel (860) 347-2256
fax (860) 349-8994
e-mail www.cooperinstrument.com
Electro-Therm hand-held digital thermometer. Instrument model Tm-99a (Electro Therm), general purpose air/surface probes, 12 feet in length, cat # 20-10, puncture probe #1075

Omega Engineering, Inc.
Box 4047
(1 Omega Drive)
Stamford, CT 06907-0047
tel (203) 359-1660
fax (877) 329-6634
e-mail www.omega.com

Thermo Electric
Saddle Brook, NJ 07662
tel (201) 843-5800
Micromite indicator/calibrator;
Model 3115-1-T-0-1-0-0
Probe for Micromite;
Model T-18-G-304-0-36-4M1

Thermometers, Glass-Mercury, Certified Precision (used as a calibration standard)

Brooklyn Thermometer Co., Inc.
90 Verdi Street
Farmingdale, NY 11735
tel (631) 644-7610
fax(631) 694-6329
e-mail www.brooklynthermometer.com
(Certified precision glass-mercury bath thermometers, C or F scale.)
(Catalog available)

Cole-Parmer Instrument Co.
625 East Bunker Court
Vernon Hills, IL 60661
tel (847) 549-7600
tel (800) 323-4340
fax(847) 247-2929
e-mail www.colepalmer.com

Tubing, Gas-Sampling

(polyethylene or polypropylene)

Cole-Parmer Instrument Co.
625 East Bunker Court
Vernon Hills, IL 60061
tel (800) 323-4340
fax (847) 247-2929
e-mail www.coleparmar.com

Consolidated Plastics Co.
8181 Darrow Road
Twinsburg, OH 44087
tel (800) 321-1980
fax (330) 425-3333

Fisher Scientific
P.O. Box 14989
St. Louis, MO 61378
tel (800) 766-7000
fax (800) 926-1166

Pest Fog Sales Corp.
1424 Bonita St.
PO Box 3703 Corpus Christi, TX 78463
tel: (512) 884-8214 or (800) 395-2945
fax: (512) 884-5903

Thomas Scientific
P.O. Box 99
Swedesboro, NJ 07085
tel (800) 345-2100
tel (800) 345-2000
fax (800) 345-5232
fax (856) 467-3087

Vacuum Pump

(air compressor) (for use with vacuum fumigation chambers)

Central Scientific Co.
Sargent Walsh
911 Commerce Court
Buffalo Grove, IL 60080
tel (847) 451-0524
fax (800) 676-2540
e-mail www.sargentwalsh.com

Crowell Manufacturing Company
318-319 Franklin Avenue
Brooklyn, NY

Neward Enterprises, Inc.
Distributor: McMaster-Carr
P.O. Box 740100
Atlanta, GA 30374-0100
tel(404) 346-7000
(Mityvac hand-held vacuum pump)
Cost: $69 (zinc-alloy pump #9963K12)

Vapam

(See Metam-sodium)

Velometer

(useful for measuring air velocity from fans and blowers)

Illinois Testing Labs, Inc.
420 North LaSalle Street
Chicago, IL
Volatilizer (heat exchanger) for Methyl Bromide

(coiled copper tube in hot water bath)

Degesch America, Inc.
Houston Division
14802 Parkalmeda
Houston, TX 77045
tel (713) 433-4777
fax (713) 433-0877

Pest Fog Sales
P.O. Box 3703
(1424 Bonita)
Corpus Christi, TX 78463
tel (512) 884-8214
tel (800) 395-2345
fax (512) 884-5903

Vacudyne Corporation
375 East Joe Orr Road
Chicago Heights, IL 60441
tel (708) 757-5200
fax (708) 757-7180
e-mail www.vacudyne.com

Warning Signs and Placards

Carlton Industries, Inc.
Highway 71 West
P.O. Box 280
La Grange, TX 78945
tel (979) 242-5055
fax (979) 242-5058

Champion America, Inc.
P.O. Box 3092
Stroney Creek, CT 06405
tel (203) 315-1181
fax (800) 336-3707
e-mail www.champion-america.com

Pest Fog Sales Corp.
1424 Bonita St.
PO Box 3703 Corpus Christi, TX 78463
tel: (512) 884-8214 or (800) 395-2945
fax: (512) 884-5903

I

Treatment Manual

Appendix I

Contacts

Background

This is one of three proposed new appendixes. Please read the following information before you comment on these additions to the Treatment Manual.

Documenting the knowledge of Subject-Matter-Experts for the Treatment Manual helps to develop and maintain the knowledge base necessary to treat commodities and minimize a pest risk. However, managing this knowledge base so you will have the right information at the right time to help make the right decision is more complicated than just giving you access to explicit, documented information. You may also need tacit information and knowledge that is not documented. After all, when you need an immediate answer to a question, do you remember it from training, look for it in the Treatment Manual, or do you ask someone? To get this information and knowledge, you may have to contact decision makers, subject-matter-experts, or someone in administrative support. Also, you will have to know where to go for other information resources.

Purpose

To assure a more comprehensive knowledge base that will give you the right information at the right time to help you make decisions, I would like to propose the following new appendixes to the Treatment Manual:

- Appendix I- Contacts
- Appendix J- Frequently Asked Questions
- Appendix K- Information Resources

My proposal can make this information available through the Treatment Manual; however, I need your comments and support to develop and maintain this resource for the manual users.

Request for comments

Read my comments on how to organize these proposed appendixes before you respond to the following questions.

- Would the information in Appendix I-Contacts improve the performance of your work?
- Would the information in Appendix J- Frequently Asked Questions improve the performance of your work?
- Would the information in Appendix K- Information Resources improve the performance of your work?
- What specific information would you need in the proposed appendixes? (For example, the e-mail address and fax number of the contact.)
- How would you develop and maintain these appendixes to be useful to the manual users?

Send your comments to:

Phillip B. Grove
USDA, APHIS, PPQ
69 Thomas Johnson Drive
Suite 100
Frederick, MD 21702-4301

Tel: 240-629-1936
Fax: 310-663-3240
e-mail: philip.b.grove@aphis.usda.gov

Proposed Appendix Organization

The proposed appendixes should be organized around the tasks we do and work-related subjects. This list of tasks would become our organizational taxonomy and help locate people whose knowledge can help you make decisions about policy and the tasks that you are currently working on. For the convenience of the manual user, the organizational taxonomy for treatment issues could be integrated into the existing index of the Treatment Manual.

The appendix for contacts should identify subject-matter-experts, decision makers for policy, decision makers for operations, and administrative support people.

An appendix for FAQ's is necessary because it would save time in answering questions that have already been asked. The Appendix of Frequently Asked Questions should be the first place to go if you have a question.

The appendix for information resources should list a bibliography of references, and where to locate them, including web site URL's.

J

Treatment Manual

Appendix J

Frequently Asked Questions (FAQ's)

This is a proposed new appendix. Go to Appendix I- Contacts for background information before you comment on this addition to the Treatment Manual.

K

Treatment Manual

Appendix K

Information Resources

This is a proposed new appendix. Go to appendix I- Contacts for background information before you comment on this addition to the Treatment Manual.

Index

A

Acalypha
Accident or spill emergency kit 7-3-17
treatment schedule
See also Pesticide spills
treatment T570-1
Hot water dip at 110°F for 50 minutes. (Tolerance not established.) 5-6-20

Achimenes
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Aconitum
treatment T570-2
Hot water dip at 110°F for 50 minutes. (Tolerance not established.) 5-6-20

Acorns
treatment T302-g-1
MB at NAP—tarpaulin, chamber, or van container 5-4-8

Acronyms and abbreviations 9-1-1 to 9-1-3

Actinidia
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Aeration
chamber fumigation 2-5-4 to 2-5-7
determining need for 2-4-28
determining when to release the commodity 2-4-33 to 2-4-40, 2-5-5 to 2-5-7
materials needed 2-4-30
normal atmospheric pressure chambers 2-5-5 to 2-5-6
of fruits, vegetables, and cut flowers 2-4-35 to 2-4-36
of nonsorptive, containerized cargo 2-4-30
of nonsorptive, noncontainerized cargo 2-4-33 to 2-4-34
of sorptive, containerized commodities 2-4-38 to 2-4-40
of sorptive, noncontainerized cargo 2-4-36 to 2-4-38
phosphine 2-10-1
procedure determination 2-4-30, 2-5-4
requirements for 2-4-6
responsibility for
chamber fumigation 2-5-4
ship fumigation 2-6-12
structure fumigation 2-7-15
tarpaulin fumigation 2-4-29
securing the area 2-4-30 to 2-4-31
ship fumigation 2-6-13 to 2-6-14
structure fumigation 2-7-15 to 2-7-16
tarpaulin fumigation
methyl bromide 2-4-29 to 2-4-40
vacuum fumigation chambers 2-5-6
wearing respiratory protection 2-4-31

Aerosols
application of 2-11-1
dosages 2-11-1
safety precautions 2-11-4

Aframomum melegueta 5-2-27, 5-2-28

Agapanthus
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Agriolimacidae
treatment T201-l
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-6

Air purifying respirators 8-1-12
See also Respiratory protection

Air velocity measuring instruments
anemometer 8-1-26
velometer 8-1-27

Aircraft
application of micronized dusts 2-11-2 to 2-11-3
treatment T409-a 5-5-24 to 5-5-28

Alarm systems
requirements for hot water immersion treatment 3-3-12

Aleurocanthus woglumi
fruit treatment schedule 5-2-25
plant treatment schedule 5-3-12

Alfalfa
treatment T520-1-1
Dust with 75 percent Thiram at the rate of 166 grams per 50 kilograms of seed (3.3g/

kg). 5-6-14

Allium
treatment T552-1
Presoak bulbs in water at 75°F for 2 hours, then at 110°F–111°F for 4 hours. 5-6-14

Allium schoenoprasum 5-2-27, 5-2-28

Allium tuberosum 5-2-27, 5-2-28

Allspice 5-2-27, 5-2-28

Aloe
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Alpha grass
treatment T303-a
MB at NAP—chamber only 5-4-14

Aluminum phosphide
measurment of phosphine 8-1-23
See also Phosphine
threshold limit value for phosphine 8-1-12
use in atmospheric fumigation chambers 6-3-2

Amaryllis
treatment T552-1
Presoak bulbs in water at 75°F for 2 hours, then at 110°F–111°F for 4 hours. 5-6-14, 5-6-18

American Bureau of Shipping 6-4-2

Amorphophallus
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Ampelodesma mauriticus
treatment T303-a
MB at NAP—chamber only 5-4-14

Ampelopsis
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Amphulariidae
treatment T201-q
Hot water treatment 112°F for 10 minutes 5-3-3

Anastrepha ludens
treatment T106-a-1
Vapor heat 5-2-60

Anastrepha spp.
methyl bromide fumigation
treatment schedule 5-2-18, 5-2-25, 5-2-36
vapor heat treatment schedules 5-2-60

Anchusa
treatment T553-2
Hot water at 118°F for 30 minutes. 5-6-15

Anemometer 8-1-26

Anemone
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Anethum graveolens 5-2-27, 5-2-28

Angelica 5-2-27, 5-2-28

Angelica archanagelica 5-2-27, 5-2-28

Animal and Plant Health Inspection Service 2-3-2, 3-3-3
financing of commercial ventures 6-5-10
preclearance program for foreign treatment facilities 6-5-5 to 6-5-10
preclearance program for vessels used for intransit cold treatment 6-4-2 to 6-4-4

Anise 5-2-27, 5-2-28

anise seed 5-2-27, 5-2-28

Anise star 5-2-27, 5-2-28

Annatto 5-2-27, 5-2-28

annual marjoram 5-2-27, 5-2-28

Anthemis nobilis 5-2-27, 5-2-28

Anthriscus cerefolium 5-2-27, 5-2-28

Anthronomus grandis
treatment T301-a-3
MB (“Q” label only) at NAP—tarpaulin 5-4-4

Ants
treatment schedules for nonplant products 5-5-38

Aphelenchoides besseyi
treatment T564-1
Presoak in water at 68°F for 1 hour followed by hot water soak at 110°F for 1 hour. Next, dip in a cold solution of 0.25 percent Thiram 5-6-18

Aphelenchoides subtenuis
treatment T565-2
Hot water at 110°F for 4 hours. (Should be done immediately after digging.) 5-6-18

Aphids
treatment T201-g-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-5

APHIS
See Animal and Plant Health Inspection Service

Apicum graveolens 5-2-27, 5-2-28

Appendix
Maintenance- Supporting and Updating the Export Certification Manual C-1-1 to C-1-5, D-1-1 to D-1-2, E-1-1, F-1-1, G-1-1, H-1-1 to H-1-58, I-1-1 to ??, J-1-1 to ??, K-1-1 to ??
Plants in Growing Media C-1-1, E-1-1, F-1-1, G-1-1, H-1-1, I-1-1, J-1-1

Apple 5-2-56
maximum loading temperature 3-7-9
methyl bromide fumigation treatment schedule 5-2-3
T107-a cold treatment schedule 5-2-67
T107-b cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T107-d cold treatment schedule 5-2-68
T108-a fumigation plus cold treatment 5-2-70
T108-b MB at NAP — tarpaulin or chamber followed by cold treatment 5-2-72

Application of manual 1-1-3

Apricot 5-2-56
T107-a cold treatment schedule 5-2-67
T107-b cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T107-e cold treatment schedule 5-2-68
T108-a fumigation plus cold treatment 5-2-70
treatment T101-a-3
MB at NAP—tarpaulin or chamber 5-2-3

Aquatic plants
treatment T201-q
Hot water treatment 112°F for 10 minutes. 5-3-3

Arionidae
treatment T201-l
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-6

Armoracea
treatment T553-3
Hot water at 118°F for 30 minutes. 5-6-15

Artemisia absinthium 5-2-27, 5-2-28

Artemisia dracunculus 5-2-27, 5-2-28

Ascarite
use in T/C units 8-1-3, 8-1-6

Ascochyta
treatment T513-1
Defoliate if leaf-borne only 5-6-11

Asparagus 5-2-56
treatment T101-b-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-2-3 to 5-2-4, ?? to 5-2-32

Asphalt surfaces
effect of malathion sprays 2-6-5
treatment T402-b-3-2
Malathion spray at 2 gal/1,000 ft2 or to the point of runoff. 5-5-3

Astilbe
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Astilbe roots
treatment T202-b
MB (“Q” label only) in 26" vacuum 5-3-20

Astilbe spp.
treatment T553-2
Hot water at 118°F for 30 minutes. 5-6-15
treatment T564-1
Presoak in water at 68°F for 1 hour followed by hot water soak at 110°F for 1 hour. Next, dip in a cold solution of 0.25 percent Thiram 5-6-18

Atmospheric fumigation chambers
approval process 6-3-2
auxillary equipment 6-3-5
chamber 6-3-2
circulation and exhaust systems 6-3-3
description of ?? to 6-3-2
forced-air circulation plan 6-3-9
fumigant dispensing system 6-3-4
gas-tight construction 6-3-3
generalized plan 6-3-7, 6-3-8
pressure-leakage test 6-3-4 to 6-3-5
U tube manometer 6-3-4 to 6-3-5, 6-3-6, 8-1-28 to 8-1-30

Australia
asparagus treatment schedule 5-2-4

Automobiles
treatment schedule for golden nematode contamination 5-5-18

Auxillary pump 8-1-27 to 8-1-28
illustration 8-1-28

Avocado 5-2-56
T107-a cold treatment schedule 5-2-67
T108-a fumigation plus cold treatment 5-2-70

Avocadoes
countries prohibited from exporting to the United States 5-2-75
treatment T101-c-1
MB at NAP—tarpaulin or chamber 5-2-4
treatment T203-m
MB (“Q” label only) at 26" vacuum 5-3-26

Azalea
treatment T201-a-2
MB (“Q” label only) in 26" vacuum 5-3-7
treatment T501-1
Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bor-

deaux dip or spray. 5-6-3

Azaleodendron
treatment T501-2
Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray. 5-6-3

B

B. hirta 5-2-27, 5-2-28

B. nigra 5-2-27, 5-2-28

Bactrocera cucurbitae
high temperature forced air treatment schedule 5-2-50 to 5-2-55
methyl bromide fumigation treatment schedule 5-2-4
vapor heat treatment schedules 5-2-60 to 5-2-65

Bactrocera dorsalis
high temperature forced air treatment schedule 5-2-50 to 5-2-55
methyl bromide fumigation treatment schedule 5-2-4
vapor heat treatment schedules 5-2-60 to 5-2-65
water treatment schedule 5-2-47

Bactrocera tryoni
fumigation followed by cold treatment schedule ?? to 5-2-71

Bags and bagging material
treatment T306
Bags and Bagging Material, Covers 5-4-16 to 5-4-18
treatment T503-1-1
Soak in formaldehyde for 1 hour, 1 pint of commercial formaldehyde to 10 gallons of water. 5-6-5

Baled hay
treatment T311
Phosphine at NAP 5-4-25

Baled straw
treatment schedule 3-4-2

Balm 5-2-27, 5-2-28

Banana roots
treatment T202-c
Hot water 110°F for 30 minutes as pretreatment followed by 120°F for 60 minutes. 5-3-21

Bananas 5-2-56
treatment T101-d-1
MB at NAP—tarpaulin or chamber 5-2-4

Barges
treatment schedule for golden nematode contamination 5-5-18

Baris lepidii
treatment T101-l-2
MB in 15" vacuum—chamber 5-2-28

Basil 5-2-27, 5-2-28

Batch system 3-3-4

bay leaf 5-2-27, 5-2-28

Beans 5-2-56
methyl bromide fumigation treatment schedule 5-2-25 to 5-2-26
treatment T101-e-1
MB at NAP—tarpaulin or chamber 5-2-5

Beets 5-2-56
treatment T101-g-1MB chamber, 15" vacuum—chamber 5-2-5

Begonia
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T559-1
Dip in hot water at 118°F for 5 minutes. 5-6-17

Belize
papaya treatment T103-d-2
High temperature forced air 5-2-54 to 5-2-55

Bell peppers
treatment T106-b-1
Vapor heat 5-2-60

Berberis
treatment T201-a-2
MB (“Q” label only) in 26" vacuum 5-3-7

Black currants
countries prohibited from exporting to the United States 5-2-75

Blackberries 5-2-56
treatment T101-h-1
MB at NAP—tarpaulin or chamber 5-2-6

Bletilla hyacinthina
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T564-1
Presoak in water at 68°F for 1 hour followed by hot water soak at 110°F for 1 hour. Next, dip in a cold solution of 0.25 percent Thiram 5-6-18

Blowers
See Fans

Blueberries 5-2-56

treatment T101-i-1
MB at NAP—tarpaulin or chamber 5-2-6

Boilers
requirements for hot water immersion treatment 3-3-6

Boll weevil
treatment T301-a-3
MB (“Q” label only) at NAP—tarpaulin 5-4-4

Bombay, India
treatment schedules for brassware 5-5-40

Bootanomyia spp.
treatment T203-o-1
MB (“Q” label only) in 26" vacuum 5-3-32

Borage 5-2-27, 5-2-28

Borago officinalis 5-2-27, 5-2-28

Borers
plant material treatment schedule 5-3-4, 5-3-7, 5-3-11 to 5-3-14
plant products treatment schedule 5-4-8, 5-4-15, 5-5-14
wood products treatment schedules 5-5-11, 5-5-15

Brachycerus spp.
garlic treatment schedule 5-2-22
plants treatment schedule 5-3-21

Brachyrhinus larvae
treatment T202-b
MB (“Q” label only) in 26" vacuum 5-3-20

Brassica junceca 5-2-27, 5-2-28

Brassica spp.
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-7, 5-2-18

Brassware
treatment schedule 5-5-40

Breadfruit
treatment T102-c
Warm, soapy water and brushing 5-2-46

Break bulk cargo
arranging for fumigation 2-3-8
fan arrangement 2-3-8
gas introduction line placement 2-3-8
gas sampling tube placement 2-3-8

Brevipalpus chilensis
methyl bromide fumigation treatment schedule 5-2-31, 5-2-32
water treatment schedule 5-2-46 to 5-2-47, 5-2-50 to ??

Bribery 6-5-9

Broccoli
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-7

Bromeliads
treatment T201-e-2
MB (“Q” label only) at 15" vacuum 5-3-4
treatment T507-1
Remove infected leaves and treat all plants of same species in shipment with Ferbam or Captan following label directions. 5-6-8

Broomcorn
treatment schedules 5-4-23
treatment T566-1
Hot water at 102°F. 5-6-19

Bruchidae
seeds treatment schedule 5-3-31
vegetables treatment schedule 5-2-5, 5-2-21 to 5-2-22, 5-2-32, 5-2-37, 5-2-39

Bruchophagus spp.
treatment T203-o-3
MB (“Q” label only) in 26" vacuum 5-3-33

Brussels sprouts
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-8

Bulb nematodes
treatment T552-1
Presoak bulbs in water at 75°F for 2 hours, then at 110°F–111°F for 4 hours. 5-6-14
treatment T567-1
Dip in hot water at 113°F for 4 hours. 5-6-19

Bulb scale mite
treatment T202-i-1
MB (“Q” label only) at NAP 5-3-24

Bulbs
treatment schedules 5-3-20 to 5-3-21
treatment T552-1
Presoak bulbs in water at 75°F for 2 hours, then at 110°F–111°F for 4 hours. 5-6-14

Bulinidae
treatment T201-q
Hot water treatment 112°F for 10 minutes. Elodea densa and Cabomba caroliniana plants not tolerant to this treatment. 5-3-3

Bulk fumigation 2-10-6 to 2-10-7

Bulk material
fan operation 2-2-3

Bulkheads

treatment T402-b-3-1
Malathion spray at 2 gal/1,000 ft2 or to the point of runoff. 5-5-3

Bumet 5-2-27, 5-2-28

C

Cabbage
T101-n-2 treatment schedule 5-2-19
T101-n-2 treatment T101-j-1
MB at NAP—tarpaulin or chamber 5-2-9

cabbage 5-2-56

Cabbageworms
treatment T403-f
MB at NAP 5-5-13

Cacti
treatment T201-f-1
MB ("Q" label only) at NAP—tarpaulin or chamber) 5-3-4 to 5-3-5
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Cacti fruits
treatment T101-d-3
MB at NAP—tarpaulin or chamber 5-2-43

cactus fruit 5-2-56

Calendula officinalis 5-2-27, 5-2-28

Calibration certificate 3-7-17, 3-7-19

Calibration of Temperature Sensors record 3-7-7

Calla
treatment T556-1
Dip in hot water at 122°F for 30 minutes. 5-6-16

Calliopsis
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Camellia
treatment T201-b-1
MB ("Q" label only) at NAP—tarpaulin or chamber 5-3-9
treatment T509-1-1
Light infection
Remove infected leaves and dip or spray plant with 4-4-50 Bordeaux. Dry quickly and thoroughly before release. 5-6-9

Camomile 5-2-27, 5-2-28

Campanula
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Canada
treatment schedule for pines 5-3-16

Cantaloupe 5-2-56
treatment T101-k-1
MB at NAP—tarpaulin or chamber 5-2-11

Caper buds 5-2-27, 5-2-28

Capparis spinosa 5-2-27, 5-2-28

Carambola
T107-c cold treatment schedule 5-2-68
T107-f cold treatment schedule 5-2-69
treatment
Use T105-a-1 Irradiation 5-2-58

Caraway 5-2-27, 5-2-28

Carbon dioxide
effects and removal from gas samples 8-1-3, 8-1-7

Cardamom 5-2-27, 5-2-28

Cargo
golden nematode contamination treatment schedule 5-5-18
non-food, non-feed commodities treatment schedules 5-5-6 to 5-5-13

Cargo compartments
application of micronized dusts 2-11-3

Carposina niponensis
treatment T109-a-1
(apples in plastic field bins at maximum load factor 50 percent or less) Cold treatment followed by MB at NAP—tarpaulin or chamber 5-2-74

Carrots 5-2-56
treatment T101-l-1
MB at NAP—tarpaulin or chamber—chamber 5-2-12

Carum carvi 5-2-27, 5-2-28

Caryedon spp.
treatment T203-b
MB ("Q" label only) in 26" vacuum 5-3-31
treatment T203-o-4-1
MB ("Q" label only) in 26" vacuum 5-3-33

Cassava
treatment T101-n-1
MB at NAP—tarpaulin or chamber 5-2-12

Cassia bark 5-2-27, 5-2-28

Cassia buds 5-2-27, 5-2-28

Casuarina
treatment T203-o-1
MB ("Q" label only) in 26" vacuum 5-3-32

Catnip 5-2-27, 5-2-28

Cattleya fly
treatment T201-d-3
MB ("Q" label only) in 15" vacuum 5-3-14

Cauliflower
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-13

Cecidomyid galls
treatment T201-d-4
Excised in all cases 5-3-14

Cedrus
treatment T201-b-1
MB ("Q" label only) at NAP—tarpaulin or chamber 5-3-9

Celeriac
treatment T101-n-1
MB at NAP—tarpaulin or chamber 5-2-14

Celery 5-2-56

Celery and celery root
treatment T101-n-1
MB at NAP—tarpaulin or chamber 5-2-14

Celery seed 5-2-27, 5-2-28

Cerambycids
treatment T404-b-1-1
MB at NAP—tarpaulin or chamber 5-5-14
treatment T404-b-5-1
Chlorpyrifos spray 5-5-13

Ceratitis capitata
cold treatment schedule 5-2-67
fumigation followed by cold treatment schedule 5-2-70 to 5-2-71
high temperature forced air treatment schedule 5-2-52 to 5-2-55
methyl bromide fumigation treatment schedule 5-2-4, 5-2-7, 5-2-18, 5-2-24, 5-2-29, 5-2-43 to 5-2-49
vapor heat treatment schedules 5-2-60 to 5-2-65
water treatment schedule 5-2-47 to 5-2-49

Cercospora spp.
treatment T501-3
Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray. 5-6-3

Certificate of Approval
for vapor heat treatment equipment 3-5-3

Certificate of calibration 3-7-10

Certificate of Loading and Calibration for Cold Treatment in Self-Refrigerated Containers
document 3-7-19

Certified glass-mercury thermometer 3-3-8

Certifying facilities
atmospheric fumigation chambers ?? to 6-3-9
cold treatment ?? to 6-4-9
hot water immersion facilities 6-5-1 to 6-5-10
vacuum fumigation chambers ?? to 6-2-4

Certifying officers 3-7-9

Cestrum
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Chamber fumigation
methyl bromide
aerating the chamber 2-5-4 to 2-5-5
conducting the fumigation 2-5-2 to 2-5-4
materials needed 2-5-2

Chart recorders
APHIS approved models 3-3-10
calculating chart speed 3-7-12
checking operation 3-7-6
clearing shipments cold treated in transit 3-7-10 to 3-7-16
for intransit cold treatment of ships 3-7-3
obtaining chart length 3-7-13
specifications 3-3-11

Chayote 5-2-56
treatment T101-p-1
MB at NAP—tarpaulin or chamber 5-2-15

Chemical dip
treatment schedule for plants 5-3-13, 5-3-19

Chemical treatments
aerosols 2-11-1, 2-11-4
dips 5-3-13 to 5-3-19
dusts 2-13-1
fumigants
authorized fumigants 2-2-2
characteristics of ideal fumigant 2-2-1
methyl bromide 2-3-1 to 2-3-8
mode of action 2-2-2
phosphine 2-10-1 to 2-10-9
physical properties 2-2-4
supervision of quarintine treatments 2-2-2 to 2-2-4
toxicity of 2-2-1
micronized dusts 2-11-2 to 2-11-4
overview 2-1-1
sprays 2-14-1

Cherimoya
treatment T102-b
Soapy water and wax 5-2-46, 5-2-50

Cherries
fumigation chamber standards for exports 6-3-5
treatment schedule 5-2-15
treatment T101-r-1
MB at NAP—tarpaulin or chamber 5-2-15

Cherry
T107-a cold treatment schedule 5-2-67
T107-b cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T108-a fumigation plus cold treatment 5-2-70

cherry 5-2-56

Chervil 5-2-27, 5-2-28

chestnut 5-2-56

Chestnut dioon
treatment T201-h-2
MB (“Q” label only) in 26" vacuum 5-3-8

Chestnuts
treatment T101-u-1
MB in 26" vacuum—chamber 5-2-16
treatment T203-e (mandatory treatment)
MB (“Q” label only) at
26" vacuum 5-3-27

Chicory 5-2-56

Chicory and chicory root
treatment T101-v-1
MB at NAP—tarpaulin or chamber 5-2-16 to 5-2-17

Chile
cherimoya treatment schedule 5-2-46, 5-2-50
grapes treatment schedule 5-2-24
lemons treatment schedule 5-2-31
limes treatment schedule 5-2-32, 5-2-47
mountain papaya treatment schedule 5-2-53 to 5-2-54
tomato treatment schedule 5-2-43

Chilean false spider mite
methyl bromide fumigation treatment schedule 5-2-31
water treatment schedule 5-2-46 to 5-2-47, 5-2-50, ?? to 5-2-50

Chinese 5-2-27

Chinese Cabbage
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-10

Chinese mustard
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-11

Chinese parsley 5-2-27, 5-2-28

Chive 5-2-27, 5-2-28

Chive, Chinese 5-2-28

Christmas trees
treatment schedules 5-4-26
treatment T501-5
Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray. 5-6-3

Chrysanthemum balsamita 5-2-27, 5-2-28

Chrysanthemum spp.
treatment T201-g-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-5
treatment T501-4
Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray. 5-6-3
treatment T557-1
Dip in hot water at 118°F for 25 minutes. 5-6-16

Chrysomyxa spp.
treatment T501-1
Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray. 5-6-3
treatment T501-6
Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray. 5-6-4

Cigarette beetle
treatment T308-d
Kabat® (active ingredient—methoprene) is an insect growth regulator applied at the rate of 0.2 pounds (3.9 fluid ounces) per 1,000 pounds of tobacco. 5-4-20

cilantro 5-2-27, 5-2-28

Cimicifuga
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T564-1
Presoak in water at 68°F for 1 hour followed by hot water soak at 110°F for 1 hour. Next, dip in a cold solution of 0.25 percent Thiram 5-6-18

Cinnamomum aromaticum 5-2-27, 5-2-28

Cinnamomum verum 5-2-27, 5-2-28

Cinnamon 5-2-27, 5-2-28

Cipollini 5-2-56
treatment T101-w-1
MB in 15" vacuum—chamber 5-2-17

Circulation and exhaust systems

atmospheric fumigation chambers 6-3-3
vacuum fumigation chambers 6-2-2

Cissus
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Citron
T107-b cold treatment schedule 5-2-67

citron (ethrog) 5-2-56

Citrus
countries prohibited from exporting to the United States 5-2-75
high temperature forced air treatment schedule 5-2-50
methyl bromide fumigation treatment schedule 5-2-18
T107-a cold treatment schedule 5-2-67
T107-e cold treatment schedule 5-2-68

Citrus blackfly
fruit treatment schedule 5-2-25
plant treatment schedule 5-3-12

Citrus canker
treatment T511-1
Wash seeds if any mucilaginous material is adhering. 5-6-10

Citrus whitefly
treatment T201-k-1
MB (“Q” label only) at NAP 5-3-10

Clary 5-2-27, 5-2-28

Clearance Action by Officer 3-7-15

Clematis
treatment T553-2
Hot water at 118°F for 30 minutes. 5-6-15

Clementine
T107-a cold treatment schedule 5-2-67
T107-b cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68

Clementines
methyl bromide fumigation treatment 5-2-18
vapor heat treatment schedules 5-2-60

Clove buds 5-2-27, 5-2-28

CO
See Certifying officers

CO2 fire extinguishers
for application of micronized dusts 2-11-2
safety precautions 2-11-4

Coast Guard Regulations B-1-1 to B-1-8

cocoa bean 5-2-56

Coconuts 5-2-56
treatment T101-x-1
MB ("Q" label only) at NAP—tarpaulin or chamber 5-2-19

Codling moth
treratment T101-s-1
MB at NAP—chamber only 5-2-15

Coffee beans
treatment schedule for bagging 5-4-17

Cold treatment
fumigation followed by cold treatment schedules 5-2-70
fumigation plus refrigeration treatment schedules for fruits 5-2-70
integral containers used for cold treatment 6-4-7 to 6-4-8
approval requirements 6-4-7
list of approved F-1-1
temperature recording instruments standards 6-4-7
intransit cold treatment of ships
approval for 3-7-2
clearance of shipments 3-7-10 to 3-7-16
initiating treatments 3-7-6 to 3-7-10
performance survey of vessels 3-7-2 to 3-7-5
progressive clearance 3-7-16
self-refrigerated containers 3-7-16 to 3-7-20
warehouses 3-7-21 to 3-7-22
schedules for 5-2-66 to 5-2-69
vessels used for intransit cold treatment 6-4-2 to 6-4-7
approval requirements 6-4-2 to 6-4-3
list of approved G-1-1
temperature recording systems standards 6-4-4
warehouses used for 6-4-8 to 6-4-9

Coles
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-7, 5-2-18

Collard greens
treatment schedule T101-n-2, 5-2-19

Colorimetric tubes 2-3-4

Commercial line conditioner
requirements for hot water immersion treatment 3-3-5

Compressed air
See CO2 fire extinguishers

Compressed air specifications 8-1-22

Compressed Gas Association 8-1-22

Computers

requirements for hot water immersion treatment 3-3-5

Concentration readings
chamber fumigation 2-5-5, 2-5-6, 2-5-7
phosphine 2-10-9
ship fumigation 2-6-13 to 2-6-14
structure fumigation 2-7-16
tarpaulin fumigation
methyl bromide 2-4-19 to 2-4-22

Concrete surfaces
treatment T404-b-5-1
Chlorpyrifos spray 5-5-13 to 5-5-14

Conifer Christmas trees
treatment T313-a
MB (“Q” label only) at NAP—tarpaulin or chamber 5-4-26

Conifer seeds
treatment T203-i-1
MB (“Q” label only) at NAP 5-3-27

Conogethes punctiferalis
treatment T109-a-1
(apples in plastic field bins at maximum load factor 50 percent or less) Cold treatment followed by MB at NAP—tarpaulin or chamber 5-2-74

Conopomorpha sinensis
treatment T107-h
Cold treatment 5-2-69

Construction
T406-d steam at NAP — tarpaulin, or tent 5-5-19

Construction equipment
treatment schedule for golden nematode contamination 5-5-18

Container fumigation
phosphine 2-10-8

Container vessels
clearing shipments cold treated in transit 3-7-10 to 3-7-16
temperature recorders 3-7-9
temperature sensors 3-7-3 to 3-7-5, 3-7-7 to 3-7-9

Containerized cargo
aeration of 2-4-31, 2-5-6
arrangement for fumigation 2-4-7 to 2-4-8
fan arrangement 2-4-10
gas introduction line placement 2-4-11
gas sampling tube placement 2-4-11

Containers
golden nematode treatment schedule 5-5-18
potato cyst nematode treatment schedule 5-6-7
T406-d steam at NAP — tarpaulin, or tent 5-5-19
wood containers treatment schedules 5-5-14 to 5-5-16

Continuous flow system 3-3-4

Convallaria (pips)
treatment T551-1
Keep pips frozen until time for treatment, then thaw enough to separate bundles one from another just before treatment begins. 5-6-14

Conventions 1-1-4

Conversion factors 2-2-3

Conversion Tables D-1-1 to D-1-2

Convolvulus japonicus
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Cooperative agreements 3-7-6

Copitarsia spp.
asparagus treatment schedule 5-2-3
banana treatment schedule 5-2-4
blackberry treatment schedules 5-2-6
melons treatment schedules 5-2-33
plantain treatment schedules 5-2-38
raspberry treatment schedules 5-2-41

Copra
treatment T101-x-1
MB ("Q" label only) at NAP—tarpaulin or chamber 5-2-19

Coriander 5-2-27, 5-2-28

Coriandor 5-2-27

Coriandor (cilantro) (seed) 5-2-28

Coriandrum sativum 5-2-27, 5-2-28

Corms
treatment T202-a-1
MB (“Q” label only) at NAP—Chamber 5-3-20 to 5-3-21

Corn
treatment schedules 5-4-7, 5-6-10

Corn-on-the-Cob 5-2-56

Corn-on-the-cob
countries prohibited from exporting to the United States 5-2-75
methyl bromide fumigation treatment schedule 5-2-20

Corrective lenses and respiratory protection 8-1-17, 8-1-19

Corrugated cartons
fumigation and 2-3-5

Corytholoma
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Costmary 5-2-27, 5-2-28

Cotton and cotton products
treatment schedules 5-4-2 to 5-4-5

Cotton pickers
treatment schedule 5-5-21

Cottonseed
treatment T203-f-1
MB ("Q" label only) at NAP—chamber 5-3-28 to 5-3-29
treatment T301-a-1-1
MB (“Q” label only) at NAP—chamber 5-4-5 to 5-4-6

Covers
treatment schedules 5-4-16 to 5-4-17
treatment T503-2-1
Soak in formaldehyde for 1 hour, 1 pint of commercial formaldehyde to 10 gallons of water. 5-6-5

Crocus
treatment T565-2
Hot water at 110°F for 4 hours. (Should be done immediately after digging.) 5-6-18

Crocus sativus 5-2-27, 5-2-28

Cryptophlebia illepida
treatment T203-k
MB (“Q” label only) at NAP 5-3-31

Cryptophlebia leucotreta
treatment T107-e
Cold treatment 5-2-68

Cucumbers 5-2-56
treatment schedule 5-2-20

Culantro 5-2-27

Culantro (leaf) 5-2-28

Cumin 5-2-27, 5-2-28

Cuminum cyminum 5-2-27, 5-2-28

Cupressus
treatment T201-b-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-9

Curaway 5-2-27

Curaway, black 5-2-28

Curculio caryae
treatment T107-g
Cold treatment 5-2-69

Curculio spp.
treatment T101-t-1
MB at NAP—tarpaulin or chamber 5-2-16
treatment T302-g-1
MB at NAP—tarpaulin, chamber, or van container 5-4-8

Curcuma
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Curry 5-2-27

Curry (leaf) 5-2-28

Cuscuta spp.
treatment T412-b-1
Dry heat—commodity heated to 212oF (100oC) for 15 minutes 5-5-39

Cut Flowers
See Flowers

Cuttings
plants
treatment T201-d-1
MB (“Q” label only) at NAP tarpaulin or chamber, see T201-a-1 5-3-13 to 5-3-15
treatment T201-m-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-16 to 5-3-18

Cycads
treatment T201-h-1
MB (“Q” label only) in 15" vacuum 5-3-6

Cyclamen
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Cydia fabivora
treatment T101-k-2
MB in 15" vacuum—chamber 5-2-25
treatment T101-k-2-1
MB at NAP—tarpaulin or chamber 5-2-26

Cydia pomonella
treatment T101-s-1
MB at NAP—chamber only 5-2-15

Cydia splendana
treatment T101-t-1
MB at NAP—tarpaulin or chamber 5-2-16
treatment T302-g-1
MB at NAP—tarpaulin, chamber, or van containe 5-4-8

Cylindrosporium camalliae
treatment T509-1-1
Light infection
Remove infected leaves and dip or spray plant with 4-4-50 Bordeaux. Dry quickly and thoroughly before release. 5-6-9

Cymbopogon citratus 5-2-27, 5-2-28

Cyst nematodes
treatment T553-5
Hot water at 118°F for 30 minutes. 5-6-15

Cytisus
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

D

Dahlia
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Dasheen
treatment T102-a-2
MB chamber, 15" vacuum-chamber 5-2-20 to 5-2-21

Data logger
checking operations 3-7-6
clearing shipments cold treated in transit 3-7-10 to 3-7-16
for intransit cold treatment of ships 3-7-3

Data logger recorders
APHIS approved models 3-3-10

Deciduous woody plants
treatment T201-a-1 MB
(“Q” label only) at NAP 5-3-6

Decks
treatment T402-b-3-1
Malathion spray at 2 gal/1,000 ft2 or to the point of runoff 5-5-3

Decontamination
of respiratory protection 8-1-19 to 8-1-21

Delinting 5-4-3

Desiccants 8-1-4, 8-1-5, 8-1-6

Detector kits or gas samples
costs 8-1-31
operations 8-1-23 to 8-1-24
use for fumigants 8-1-23

Detia 2-10-1

Devitalization Treatment
noxious weed seeds 5-5-38

Dialeurodes citri
treatment T201-k-1
MB (“Q” label only) at NAP 5-3-10

Dicentra
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Dieffenbachia spp.
treatment T201-i-1
MB (“Q” label only) at NAP 5-3-8 to 5-3-9

Dill 5-2-27, 5-2-28

Dill (seed) 5-2-28

dillweed 5-2-27, 5-2-28

Dinoderus
treatment T404-b-1-1
MB at NAP—tarpaulin or chamber 5-5-14
treatment T404-b-5-1
Chlorpyrifos spray 5-5-13

Dioon edule
treatment T201-h-2
MB (“Q” label only) in 26" vacuum 5-3-8

Dioscorea spp.
treatment T101-f-3
MB at NAP—tarpaulin or chamber 5-2-44
treatment T202-d
MB (“Q” label only) at NAP 5-3-26

Dips 5-3-13 to 5-3-19

Diptera
treatment T203-o-5
MB (“Q” label only) at NAP 5-3-34

Directory of commercial suppliers H-1-1 to H-1-58

Ditylenchus destructor
treatment T552-1
Presoak bulbs in water at 75°F for 2 hours, then at
110°F–111°F for 4 hours. 5-6-14
treatment T554-1-1
Presoak in water at 70°F–80°F for 2.5 hours, followed by hot water immersion at 110°F–111°F for 1 hour. 5-6-16
treatment T565-1
Hot water at 110°F for 4 hours. (Should be done immediately after digging.) 5-6-18

Ditylenchus dipsaci
treatment T552-1
Presoak bulbs in water at 75°F for 2 hours, then at
110°F–111°F for 4 hours. 5-6-14

treatment T554-1-2
Hot water immersion at 110°F–111°F for 3 hours with no presoaking. 5-6-16
treatment T565-4
Hot water at 110°F for 4 hours. (Should be done immediately after digging.) 5-6-19

Documentation 1-1-3

Dosage rates
methyl bromide
chamber fumigation 2-5-3
determining temperature for 2-4-14
guidelines 2-2-3
ship fumigation 2-6-1
structure fumigation 2-7-1
tarpaulin fumigation 2-4-1
phosphine 2-10-1
using commodity or air temperature 2-5-3

DOT
See U.S. Department of Transportation

Downy mildews
treatment schedules 5-6-5

Dracaena spp.
treatment T201-i-1
MB (“Q” label only) at NAP 5-3-8 to 5-3-9
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

dried 5-2-27

Drierite 2-4-21, 2-6-11, 2-7-14
use in T/C units 8-1-3, 8-1-6

Dry ice
safety precautions 4-2-1

Durian
water treatment schedule 5-2-46

Dust Masks 8-1-13
See also Respiratory protection

Dusts 2-13-1

Dyspessa ulula
treatment T101-e-2
MB in 15" vacuum—chamber 5-2-22
treatment T202-j
MB (“Q” label only) at 15" vacuum 5-3-21

E

Ear corn
treatment T302-a-1-1
MB at NAP—chamber only 5-4-8

Eggplant 5-2-56
treatment T106-b-2
Vapor heat 5-2-60

Electrical wiring
requirements for hot water immersion treatment 3-3-5

Electronic manometer 6-3-6, 8-1-30

Elettaria cardamomum 5-2-27, 5-2-28

Emergency Exemptions
See Section 18 Exemptions

Endive 5-2-56
treatment T101-b-2
MB at NAP—tarpaulin or chamber 5-2-21

Environmental Protection Agency 4-1-1

EPA
See Environmental Protection Agency

Epimendium pinnatum
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T564-1
Presoak in water at 68°F for 1 hour followed by hot water soak at 110°F for 1 hour. Next, dip in a cold solution of 0.25 percent Thiram 5-6-18

Epinotia aporema
treatment T101-k-2
MB in 15" vacuum—chamber 5-2-25 to 5-2-26

Equipment 8-1-1 to 8-1-32
air velocity measuring instruments 8-1-26
auxiliary pump 8-1-27 to 8-1-28
detector kits or gas samples 8-1-23 to 8-1-24
halide detector 8-1-9 to 8-1-11
opem arm manometer 8-1-28 to 8-1-30
phosphine detector 8-1-31 to 8-1-32
reference guide to commercial suppliers H-1-1 to H-1-58
respiratory protection 8-1-12 to 8-1-23
See also specific pieces of equipment
thermal conductivity gas analyzers 8-1-2 to 8-1-8
vacuum pump 8-1-30 to 8-1-31
volatilizer 8-1-24 to 8-1-26

Eryngium foetidum 5-2-27, 5-2-28

Ethrog
T107-a cold treatment schedule 5-2-67
T107-b cold treatment schedule 5-2-67

Eugenia caryophyllata 5-2-27, 5-2-28

Euonymus alata
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Eupatorium
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Euphorbia
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Europe
treatment schedule for alfalfa 5-6-14

European cherry fruit fly
treatment T203-o-5
MB ("Q" label only) at NAP 5-3-34

European corn borer
treatment T101-v-2
MB at NAP—tarpaulin or chamber 5-2-39
treatment T101-x-1-1
MB at NAP—tarpaulin or chamber 5-2-20

European fruit fly
See also Fruit flies

European pine shoot moth
treatment T201-j
MB ("Q" label only) at NAP 5-3-16

Eurytoma spp.
treatment T201-d-5
Hot water—118°F for 0.5 hour followed by a cool water bath 5-3-14

Eutetranychus orientalis
treatment T107-a
Cold treatment 5-2-67

Exhaust system
installation of 2-4-31 to 2-4-36

Exosoma lusitanica
treatment T101-w-1
MB in 15" vacuum—chamber 5-2-17

Exotic legume pod borers
treatment T101-k-2
MB in 15" vacuum—chamber 5-2-25 to 5-2-26

Exposure periods
adjusting
for miscellaneous products 5-5-1
for plant products 5-4-1
ship fumigation 2-6-11
tarpaulin fumigation 2-4-33 to 2-4-40

External feeders
See specific pest by name

F

False codling moth
treatment T107-e
Cold treatment 5-2-68

False red mite
treatment T108-a
Three alternative schedules based upon the fumigation exposure time 5-2-70

Fans
arranging and operating
guidelines 2-2-3 to 2-2-4
ship fumigation 2-6-5 to 2-6-6
structure fumigation 2-7-8
tarpaulin fumigation 2-4-10
determining number of 2-4-33

Farm equipment
T406-d steam at NAP — tarpaulin, or tent 5-5-19
treatment schedule for golden nematode contamination 5-5-18

Fava bean (dried) 5-2-56

Fava beans (dried)
treatment schedule 5-2-21 to 5-2-22

FDA
See Food and Drug Administration

Federal Insecticide, Fungicide, and Rodenticide Act 1-1-1
See also Section 18 Exemptions

Feeds
treatment schedules for Khapra beetles 5-4-16

Fennel 5-2-27, 5-2-28

Fennel (common) 5-2-28

Fenugreek 5-2-27

FIFRA
See Federal Insecticide, Fungicide, and Rodenticide Act

Financing 6-5-10

Fire Extinguishers
See CO2 fire extinguishers

Flag smut
treatment T504-1-1
Dry heat at 212°F for 1 hour. Treat small bales only. 5-6-5

Florida
treatment schedule for orchids shipped to 5-6-9

Florence 5-2-27

Florence (seed) 5-2-28

Flour
treatment schedules for ships 5-5-6

Flowers
aerating 2-4-33
treatment schedules for cut flowers 5-4-15 to 5-4-16

Foeniculum vulgare 5-2-27, 5-2-28

Foeniculum vulgare Azoricum Group 5-2-27, 5-2-28

Foliar nematodes
treatment T553-4
Hot water at 118°F for 30 minutes. 5-6-15
treatment T559-1
Dip in hot water at 118°F for 5 minutes. 5-6-17
treatment T564-1
Presoak in water at 68°F for 1 hour followed by hot water soak at 110°F for 1 hour. Next, dip in a cold solution of 0.25 percent Thiram 5-6-18

Food and Drug Administration 2-7-8

Foreign treatment facilities protocols 6-5-5 to 6-5-10

Forms A-1-1 to A-1-30
APHIS Form 2061 (Residue Sample for Food or Feed Product) A-1-2 to ??
Calibration of Temperature Probes (Cold Treatment) A-1-28
Certificate of Loading and Calibration for Cold Treatment in Self Refrigerated Containers (Cold Treatment) A-1-34
Container Specifications for the Approval of Self-refrigerated Containers for Use in Conducting In-transit Cold Treatment Under USDA Regulations (Cold Treatment) A-1-35
Instructions to Captain (Cold Treatment) A-1-32
Location of Temperature Sensors in Containerized Cargo (Cold Treatment) A-1-33
PPQ Form 203 (Foreign Site Certificate of Inspection and/or Treatment) A-1-25
PPQ Form 429 (Fumigation Record) A-1-11 to A-1-15
PPQ Form 449 3-7-5
PPQ Form 449-R (Temperature Recording Installation Report) A-1-24
PPQ Form 519 (Compliance Agreement) A-1-16
PPQ Form 523 (Emergency Action Notification) 2-4-4, 2-7-7, A-1-19 to A-1-22
PPQ Form 556 (In Transit Cold Treatment Clearance Report) 3-7-11, 3-7-16, 3-7-20, A-1-26
See also specific forms by title

Fragaria
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T558-1
Dip in hot water at 127°F for 2 minutes. 5-6-17
treatment T569-1
Hot water at 121°F for 7 minutes. (National Plant Board Conference, Tennessee, 1968) 5-6-20

fresh herbs 5-2-56

Fruit
adjusting exposure period 2-4-23 to 2-4-25
aerating 2-4-33 to 2-4-35
cold treatment schedules 5-2-66 to 5-2-69
determining temperature for proper dosage rate 2-4-14
fumigation plus refrigeration treatment schedules 5-2-70
high temperature forced air treatment schedules 5-2-50 to 5-2-55
hot water immersion treatment
air curtain 3-3-12
flow pattern 3-3-12
garbage disposal 3-3-12
loading treated fruit 3-3-13
post-treatment cooling options 3-3-14 to ??
pre-warming options 3-3-13
quarantine area 3-3-12
screening material 3-3-12
in shipboard-cooled containers 3-7-9 to 3-7-10
methyl bromide fumigation 5-2-3 to 5-2-45
pest specific/host variable treatment schedules 5-2-55 to 5-2-57
precooling 3-7-9
quick freeze treatment schedules 5-2-74
reporting commodity injury 5-2-1
See also specific fruit by name
vapor heat treatment schedules 5-2-60
water treatment schedules 5-2-46 to 5-2-49

Fruit flies
aircraft treatment schedule 5-5-25
cold treatment for 6-4-1
cold treatment schedule 5-2-66 to 5-2-69
fumigation followed by cold treatment schedule 5-2-70 to 5-2-74
high temperature forced air treatment schedule 5-2-50 to 5-2-55
hot water immersion treatment for 6-5-1
methyl bromide fumigation treatment schedule 5-2-4, 5-2-7, 5-2-29, 5-2-43
railroad cars treatment schedules 5-5-2
See also specific types of fruit flies
seeds treatment schedule 5-3-35
vapor heat treatment schedules 5-2-60 to 5-2-65
water treatment schedule 5-2-43

Fruit sensors
placement of 3-7-18

Fruit tree spider mite
apples treament schedule 5-2-74

Fruit, exported
fumigation chamber standards 6-3-5

Fruit, imported
cold treatment for ?? to 6-4-7
foreign treatment facilities protocols 6-5-5 to 6-5-10
hot water immersion treatment 6-5-1 to 6-5-5

Fuji apples
treatment T109-a-1
(apples in plastic field bins at maximum load factor 50 percent or less) Cold treatment followed by MB at NAP—tarpaulin or chamber 5-2-74

Fumi-Cel 2-10-1

Fumigants
authorized fumigants 2-2-2
characteristics of ideal fumigant 2-2-1
methyl bromide 2-3-1 to 2-3-8, 2-4-1 to 2-4-40, 2-5-1 to 2-5-7, 2-6-1 to 2-6-14, 2-7-1 to 2-7-16
modes of action 2-2-2
phosphine 2-10-1 to 2-10-9
physical properties 2-2-4
respiratory protection for 8-1-13
See also specific fumigants
supervision of quarantine treatments 2-2-2 to 2-2-4
threshold limit values 8-1-12
toxicity of 2-2-1

Fumigation
atmospheric fumigation chambers ?? to 6-3-9
Coast Guard regulations B-1-1 to B-1-8
conducting the fumigation 2-4-19 to 2-4-29
container arrangement 2-4-7
definition of 2-2-1
followed by cold treatment schedules 5-2-70 to 5-2-74
guidelines for safe use 2-2-3 to 2-2-4
items not to fumigate 2-3-7, 2-3-8
preparing to fumigate 2-4-3 to 2-4-19
site selection 2-4-4 to 2-4-7
vacuum fumigation chambers ?? to 6-2-4

Fumigation time 2-4-21

Fumiscope
description 8-1-2 to 8-1-4
limitations 8-1-23
maintenance 8-1-7
operational procedures 8-1-5 to 8-1-7
reading of 10 ounces per1,000 ft 8-1-8
repair and calibration 8-1-7
standardizing the instrument 8-1-4 to 8-1-5

Fungous diseases
treatment T303-d-2-1
Steam sterilization, use T303-b 5-4-12 to 5-4-13

G

G. pallida
Armoracea treatment schedule 5-6-15
Solanum treatment schedule 5-6-19

Galium odorata 5-2-27, 5-2-28

Gardenia
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Garlic 5-2-56
treatment T101-e-2
MB in 15" vacuum—chamber 5-2-22
treatment T202-j
MB (“Q” label only) at 15" vacuum 5-3-21

Garlic beetles
treatment T101-e-2
MB in 15" vacuum—chamber 5-2-22
treatment T202-j
MB (“Q” label only) at 15" vacuum 5-3-21

Garlic carpenterworm
treatment T101-e-2
MB in 15" vacuum—chamber 5-2-22

Gas analysis
methyl bromide 2-3-4
phosphine 2-10-2

Gas and vapor removing respirators 8-1-14 to 8-1-15
See also Respiratory Protection

Gas introduction lines
hot gas method 2-7-11
inside release option 2-7-11
methyl bromide
ship fumigation 2-6-6
structure fumigation 2-7-11
tarpaulin fumigation 2-4-19

Gas sampling tubes
determining number of 2-7-9
methyl bromide
ship fumigation 2-6-6
structure fumigation 2-7-9
tarpaulin fumigation 2-4-11 to 2-4-13
placement of 2-4-11 to 2-4-13

Gaultheria procumbens 5-2-27, 5-2-28

Generators
requirements for hot water immersion treatment 3-3-5

Gentiana
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Gentinae
treatment T507-2
Remove infected leaves and treat all plants of same species in shipment with Ferbam or Captan following label directions. 5-6-8

Gerbera
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Gesneria
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Geum
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Gin trash
treatment T301-a-1-1
MB (“Q” label only) at NAP—chamber 5-4-5
treatment T301-a-6
Phosphine at NAP ?? to 5-4-2, 5-4-6 to ??

Ginger 5-2-56
treatment T101-f-2
MB in 15" vacuum—chamber 5-2-22

Gladiolus spp.
treatment T202-e-1
MB (“Q” label only) at NAP 5-3-22
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T565-3
Hot water at 110°F for 4 hours. (Should be done immediately after digging.) 5-6-18

Gladiolus thrips
treatment T202-e-2
MB (“Q” label only) in 26" vacuum 5-3-22

Globodera campestris, pv. citri
treatment T511-1
Wash seeds if any mucilaginous material is adhering. Immerse in a 0.525 percent sodium hypochlorite (Clorox) solution for 2 minutes. 5-6-10

Globodera rostochiensis
Armoracea treatment schedule 5-6-15
bags treatment schedule 5-4-16
cargo treatment schedules 5-5-11
contamination treatment schedule 5-5-18
Convallaria (pips) treatment schedule 5-6-14
cotton treatment schedules 5-4-4
infestation treatment schedule 5-6-15
soil treatment schedule 5-5-22, 5-5-23
Solanum treatment schedule 5-6-19
wood products treatment schedules 5-5-14

Glossary 9-1-1 to 9-1-3

Golden nematode
bags treatment schedule 5-4-16
cargo treatment schedules 5-5-11
contamination treatment schedule 5-5-18
cotton treatment schedules 5-4-4
plants treatment schedule 5-6-15
soil treatment schedule 5-5-23
wood products treatment schedules 5-5-14

Gow-Mac
description 8-1-2
limitations 8-1-23
maintenance 8-1-7
operational procedures 8-1-5 to 8-1-6
repair and calibration 8-1-7
standardizing the instrument 8-1-4 to 8-1-5

Grains
treatment schedules 5-4-7 to 5-4-12, 5-6-5 to 5-6-6

Grains of paradise 5-2-27, 5-2-28

Grape
T107-a cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T108-a fumigation plus cold treatment 5-2-70
T108-b MB at NAP — tarpaulin or chamber followed by cold treatment 5-2-72

grape 5-2-56

Grapefruit 5-2-56
methyl bromide fumigation treatment schedule 5-2-25
T107-a cold treatment schedule 5-2-67
T107-b cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T107-d cold treatment schedule 5-2-68
vapor heat treatment schedules 5-2-61

Grapes
methyl bromide fumigation treatment schedule 5-2-23 to 5-2-24

GrapeT107-f cold treatment schedule 5-2-69

Grapevine moth
cold treatment T108-a
Three alternative schedules based upon the fumigation exposure time 5-2-70

Graphognathus spp.
treatment T101-u-2
MB at NAP—tarpaulin or chamber 5-2-39

Great Lakes Chemical Company 2-3-2

Green pod vegetables
treatment T101-k-2
MB in 15" vacuum—chamber 5-2-25

green pod vegetables 5-2-56

Greenery
treatment schedules 5-4-15 to 5-4-16

Greenhouse-grown plants
treatment T201-c-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-10 to 5-3-11

Greenwood cuttings
treatment T201-m-2
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-17

Gypsy moth
treatment T313-a
MB (“Q” label only) at NAP—tarpaulin or chamber 5-4-26
treatment T414
MB at NAP—tarpaulin or chamber 5-5-41

H

H. pallida
Convallaria (pips) treatment schedule 5-6-14

Haiti
supervision of hot water immersion treatments 6-5-9

Halide detector
description 8-1-9
illustration of halide detector using dispensable propane tank 8-1-11
principles of operation 8-1-9
usage 8-1-10 to 8-1-11

Halide detectors 2-3-4
demonstration 8-1-10

Halotydeus destructor
treatment T101-b-1-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-2-4

Hand removal of pests 5-3-19

Handicrafts
treatment T303-a
MB at NAP—chamber only 5-4-14

Harmolita spp.
treatment T303-a
MB at NAP—chamber only 5-4-14

Hawaii
avacado treatment schedule 5-2-4
carambola treatment schedules 5-2-58
citrus treatment schedule 5-2-52 to 5-2-53
lychee fruit treatment schedules 5-2-47, 5-2-58
papaya treatment schedules 5-2-54, 5-2-58
tomato treatment schedule 5-2-43

Hawaiian SalsaT107-i cold treatment schedule 5-2-69

Hay, baled
treatment T311
Phosphine at NAP 5-4-25

Heat
hot water immersion treatment 3-3-2 to 3-3-17
steam treatments 3-4-1 to 3-4-3
vapor heat treatment 3-5-1 to 3-5-3

Helicella spp.
treatment T203-h
MB (“Q” label only) at 26" vacuum 5-3-31

Heliopsis
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Helleborus
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Herbaceous plants
treatment T201-c-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-10
treatment T201-c-2
MB (“Q” label only) in 15" vacuum 5-3-11
treatment T201-m-2
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-17

Hessian fly
treatment T311
Phosphine at NAP 5-4-25

Hevea brasiliensis
treatment T203-j
MB (“Q” label only) at NAP 5-3-33

Hibiscus
treatment T203-g-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-30
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

High temperature forced air treatment schedules 5-2-50 to 5-2-55

honeydew melon 5-2-56

Horehound 5-2-27, 5-2-28

Horseradish 5-2-56
treatment T101-l-2
MB in 15" vacuum—chamber 5-2-28

Horseradish roots

treatment T202-f
MB in 15" vacuum 5-3-22
treatment T553-3
Hot water at 118°F for 30 minutes. 5-6-15

Host variable/pest specific treatment schedules 5-2-55 to 5-2-57

Hosta
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T564-1
Presoak in water at 68°F for 1 hour followed by hot water soak at 110°F for 1 hour. Next, dip in a cold solution of 0.25 percent Thiram 5-6-18

Hot water immersion facilities
address for technical contact 6-5-5
annual APHIS performance test procedures 6-5-2 to 6-5-4
description 6-5-1
foreign treatment facilities protocols 6-5-5 to 6-5-10
list of ideas if tank fails performance test 6-5-4
location 6-5-7
preliminary performance testing 6-5-1

Hot water immersion treatment
alarm system 3-3-12
boilers 3-3-6
changes 3-3-15
electrical and electronic components 3-3-5
general requirements 3-3-3 to 3-3-4
post-treatment cooling 3-3-14
pre-treatment warming 3-3-13
principle 3-3-2
procedures 3-3-2
resources 3-3-16
safeguarding treated fruit 3-3-12
safety precautions 3-3-15
schedules 3-3-2
start-up costs 3-3-16
temperature recorder 3-3-8 to 3-3-11
temperature sensors 3-3-7 to 3-3-8
water circulation 3-3-7
Work Plans 3-3-16

Hot water treatment
schedules for 5-3-3, 5-3-20, 5-6-14 to 5-6-20

Hoya
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Humidity
effect on methyl bromide 2-3-4

Humulus
treatment T553-5
Hot water at 118°F for 30 minutes. 5-6-15

Hyacinthus
treatment T554-1-1
Presoak in water at 70°F–80°F for 2.5 hours, followed by hot water immersion at 110°F–111°F for 1 hour. 5-6-16

Hydrocooling fruit 3-3-14 to ??

Hyssop 5-2-27, 5-2-28

Hyssopus officinalis 5-2-27, 5-2-28

I

Ilex
treatment T201-b-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-9

Illicium verum 5-2-27, 5-2-28

Illinois Testing Laboratories 8-1-27

Imported crucifer weevil
treatment T101-l-2
MB in 15" vacuum—chamber 5-2-28

India
treatment schedules for brassware 5-5-40

Indoor fumigation 2-4-32 to 2-4-40

Inspections on-site 3-3-3

Inspectors
bribery 6-5-9
foreign treatment facilities protocols 6-5-5 to 6-5-10
withdrawl from foreign facilities 6-5-9

Instructions to Captain document 3-7-8, 3-7-19

Interior Fumigation
methyl bromide 2-7-5, 2-7-10

Internal feeders
See specific pest by name

Interstate Commerce Commission
compressed air specifications 8-1-22

Ipomoea spp.
treatment T101-b-3-1
MB at NAP—tarpaulin or chamber 5-2-42
treatment T202-d
MB (“Q” label only) at NAP 5-3-26

Iris
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T554-1-1

Presoak in water at 70°F–80°F for 2.5 hours, followed by hot water immersion at 110°F–111°F for 1 hour. 5-6-16

Israel
avacado treatment schedule 5-2-4

Italy
exemption from treatment for garlic 5-2-22

J

Jacuzzi system 3-3-4

Japan
apples treatment schedule 5-2-74

Jasminum
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Jerusalem artichoke 5-2-56

Juniper berry 5-2-27, 5-2-28

Juniperus
treatment T201-b-1
MB ("Q" label only) at NAP—tarpaulin or chamber 5-3-9

Juniperus communis 5-2-27, 5-2-28

K

Kabat
treatment T308-d
Kabat® (active ingredient—methoprene) is an insect growth regulator applied at the rate of 0.2 pounds (3.9 fluid ounces) per 1,000 pounds of tobacco. 5-4-20

Kaempferia
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Kale
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-29

Kanzawa mite
apples treatment schedule 5-2-74

Kenaf
treatment T203-g-1
MB ("Q" label only) at NAP—tarpaulin or chamber 5-3-30

Khapra beetle
aircraft treatment schedule 5-5-24
bags treatment schedule 5-4-16
brassware treatment schedules 5-5-40
cargo treatment schedules 5-5-11
cotton treatment schedules 5-4-2 to 5-4-4
Emergency Action Notification 2-7-7
fumigating cargo 2-4-12
infested material treatment schedule 5-4-19
railroad cars treatment schedules 5-5-2
seeds treatment schedule 5-3-31
ships treatment schedule ?? to 5-5-3, 5-5-5 to ??
wood products treatment schedule 5-5-17

Kiln Drying
treatment schedules for wood products 5-5-16

Kiwi 5-2-56
T107-a cold treatment schedule 5-2-67
T107-d cold treatment schedule 5-2-68
T108-a fumigation plus cold treatment 5-2-70
treatment T101-m-2
MB at NAP—tarpaulin or chamber 5-2-29

Kniphofia
treatment T553-2
Hot water at 118°F for 30 minutes. 5-6-15

Koa seedworm
treatment T203-k
MB ("Q" label only) at NAP 5-3-31

Kohleria
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Kohlrabi
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-30

Korea
apples treatment schedule 5-2-74

Kraft paper
fumigation and 2-3-5

kumquat 5-2-56

L

Laurus nobilis 5-2-27, 5-2-28

Lavender 5-2-27, 5-2-28

Lavendula offinalis 5-2-27, 5-2-28

leaf 5-2-27

Leaf miners

methyl bromide fumigation treatment
schedule 5-2-7, 5-2-8, 5-2-9, 5-2-10, 5-2-11, 5-2-13, 5-2-18, 5-2-19, 5-2-25, 5-2-29, 5-2-30, 5-2-33, 5-2-34, 5-2-40, 5-2-41
plants treatment schedule 5-3-5, 5-3-14

Leaf tobacco
treatment T308-c
Vacuum-steam flow process followed by reconditioning 5-4-20

Leafy vegetables 5-2-56
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-30, 5-2-32

Leak detection
methyl bromide
sealing stores 2-6-7
ship fumigation 2-6-11
structure fumigation 2-7-14
tarpaulin fumigation 2-4-20
phosphine 2-10-2

Leeks
treatment T101-q-2
MB at NAP—tarpaulin or chamber 5-2-31

Leguminosae = Fabaceae
treatment T203-c
MB ("Q" label only) at NAP 5-3-33
treatment T203-o-3
MB (“Q” label only) in 26" vacuum 5-3-33

lemon 5-2-56

lemon baalm 5-2-27, 5-2-28

Lemongrass 5-2-27, 5-2-28

Lemons
treatment T101-n-2-1
MB at NAP—tarpaulin or chamber 5-2-31

Lentils
treatment T101-e-1
MB at NAP—tarpaulin or chamber 5-2-32

Lepidoptera
treatment schedules for miscellaneous cargo 5-5-13

Lesion nematodes
treatment T553-2
Hot water at 118°F for 30 minutes. 5-6-15

Levisticum officinale 5-2-27, 5-2-28

Libium
treatment schedule 5-6-19

Lily bulbs
treatment T202-g
MB (“Q” label only) at NAP 5-3-23

Limacidae
treatment T201-l
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-6

Limes 5-2-56
methyl bromide fumigation
treatment schedule 5-2-32
water treatment schedule 5-2-47

Limnaeidae
treatment T201-q
Hot water treatment 112°F for 10 minutes. 5-3-3

Lingularis
treatment T568-1
Treat with hot water at 110°F for 1 hour. 5-6-19

Lint and linters
treatment T301-a-6
Phosphine at NAP ?? to 5-4-2, 5-4-6 to ??

Liquid measure conversion 2-2-3

Litchi
- See Lychee 5-2-32
T107-b cold treatment schedule 5-2-67

Liverworts
treatment schedule for soil 5-5-22

Lobesia botrana
fumigation followed by cold treatment schedule 5-2-70
methyl bromide fumigation treatment schedule 5-2-23 to 5-2-24

Location of Temperature Sensors document 3-7-7, 3-7-19

Logs and lumber
adjusting exposure period 2-4-28
determining temperature for proper dosage rate 2-4-15
treatment schedules 5-4-25

Longan
T107-b cold treatment schedule 5-2-67

LongansT107-h cold treatment schedule 5-2-69

Lonicera spp.
treatment T203-o-5
MB (“Q” label only) at NAP 5-3-34

Loquat
T107-a cold treatment schedule 5-2-67

Lovage 5-2-27

Lovage (leaf) 5-2-28

Lovage (seed) 5-2-28

Lumber
See Logs and lumber

Lychee
T107-a cold treatment schedule 5-2-67

Lychee (Litchi) fruit
irradiation treatment schedules 5-2-58

Lychee (Litchi) fruit borer
treatment T107-h
Cold treatment 5-2-69

Lychee fruit
treatment T102-d
Hot water immersion 5-2-47

LycheeT107-h cold treatment schedule 5-2-69

Lycoris
treatment T202-h
MB in 26" vacuum 5-3-23

Lymantria dispar
treatment T313-a
MB ("Q" label only) at NAP—tarpaulin or chamber 5-4-26, 5-5-41

M

Macadamia nuts
treatment T203-k
MB ("Q" label only) at NA 5-3-31

Mace 5-2-27, 5-2-28

Magnesium phosphide
See Phosphine

Maintaining
the manual C-1-1 to C-1-5

Maintenance
respiratory protection 8-1-19 to 8-1-22
Supporting and Updating the Export Certification Manual (ECM) and Its Summaries
Appendix 10 C-1-1 to C-1-5
T/C units 8-1-7

Maize
treatment schedules 5-6-5

Malathion spray
effect asphalt surfaces 2-6-5
treatment schedule for ships and surrounding areas 5-5-3

Malathion-carbaryl chemical dip
treatment T201-o-2
Chemical Dip—Dip plants with a 5-3-13
treatment T201-p-2
Hand removal plus chemical dip—Hand removal of pests of infested parts plus a malathion-carbaryl chemical dip. 5-3-19

Mango seed weevils 6-5-6

Mangoes
cooling hot water-treated fruit 3-3-14
countries prohibited from exporting to the United States 5-2-75
high temperature forced air treatment schedule 5-2-53
hot water immersion standards 6-5-4
vapor heat treatment schedules 5-2-61
water treatment schedule 5-2-48 to 5-2-49

Manihot
treatment T101-n-1
MB at NAP—tarpaulin or chamber 5-2-12

Manometer
electronic 6-3-6, 8-1-28
open arm 6-3-5, 8-1-28 to 8-1-30
use in pressure-leakage testing 6-3-4 to 6-3-5, 8-1-29

Manuals
distributing C-1-9
ordering additional copies C-1-7, C-1-7

Marigold 5-2-27, 5-2-28

Marjoram 5-2-27, 5-2-28

Marrubium vulgare 5-2-27, 5-2-28

Maruca testulalis
treatment T101-k-2
MB in 15" vacuum—chamber 5-2-25 to 5-2-26

Mayetiola destructor
treatment schedules 5-4-25

MB
See Methyl bromide

Mealybugs
treatment T305-c
MB ("Q" label only) at NAP—tarpaulin or chamber 5-4-16

Mechanical Cotton Pickers
treatment T407
MB ("Q" label only) at NAP—tarpaulin, chamber, railroad car, or van 5-5-21

Medicago
treatment T520-1-1
Dust with 75 percent Thiram at the rate of 166

grams per 50 kilograms of seed (3.3g/kg). 5-6-14

Mediterranean fruit fly
cold treatment for 5-2-60, 6-4-1
cold treatment plus fumigation treatment schedule 5-2-67, 5-2-68
fumigation followed by cold treatment schedule 5-2-70 to 5-2-71
high temperature forced air treatment schedule 5-2-52 to 5-2-55
irradiation treatment schedules 5-2-58
methyl bromide fumigation treatment schedule 5-2-4, 5-2-7, 5-2-18, 5-2-24, 5-2-29, 5-2-43
See also Fruit flies
vapor heat treatment schedules 5-2-60 to 5-2-65
water treatment schedule 5-2-47 to 5-2-49

Melissa officinalis 5-2-27, 5-2-28

Meloidogyne spp.
treatment schedules 5-6-16 to 5-6-17

Melon fly
cold treatment schedule 5-2-69
fumigation followed by cold treatment schedule 5-2-70
high temperature forced air treatment schedule 5-2-52 to 5-2-55
irradiation treatment schedules 5-2-58
methyl bromide fumigation treatment schedule 5-2-4
vapor heat treatment schedules 5-2-60 to 5-2-65

Melons
treatment T101-o-2
MB at NAP—tarpaulin or chamber 5-2-33

Memory loggers 3-3-9

Mentha pulegium 5-2-27, 5-2-28

Metal surfaces
treatment schedules 5-5-13 to 5-5-14
treatment T402-b-3-1
Malathion spray at 2 gal/1,000 ft2 or to the point of runoff. 5-5-3

Meth-O-Gas Q 2-3-2 to 2-3-4

Methyl bromide
acceptable air concentration level 2-4-19
calibration of T/C units for 8-1-5
chamber fumigation
aerating the chamber 2-5-4 to 2-5-5
conducting the fumigation 2-5-2 to 2-5-4
materials needed 2-5-2
gas analysis 2-3-4
halide detector flame colors according to MB concentration 8-1-10
humidity and 2-3-4
items not to fumigate 2-3-7 to 2-3-8
leak detection 2-3-4
Meth-O-Gas Q 2-3-2 to 2-3-4
packaging and 2-3-5
properties of 2-3-1 to 2-3-2
residual effect 2-3-6 to 2-3-8
residue monitoring 4-1-1, 4-2-1
Section 18 Exemptions 2-3-2 to 2-3-4, 5-2-1 to 5-2-2
See also Treatment schedules
ship fumigation
aeration 2-6-13 to 2-6-14
conducting the fumigation 2-6-10 to 2-6-12
materials needed 2-6-2 to 2-6-3
preparing to fumigate 2-6-4 to 2-6-10
safety measures 2-6-3
sorption 2-3-5 to 2-3-6
structure fumigation
aerating the enclosure 2-7-15 to 2-7-16
conducting the fumigation 2-7-13
materials needed 2-7-2 to 2-7-3
preparing to fumigate 2-7-4 to 2-7-12
safety precautions 2-7-3
tarpaulin fumigation
aerating the enclosure 2-4-29 to 2-4-40
conducting the fumigation 2-4-19 to 2-4-29
materials needed 2-4-2 to 2-4-3
perparing to fumigate 2-4-3 to 2-4-19
temperature and 2-3-4
threshold limit value 8-1-12
use in atmospheric fumigation chambers 6-3-2, 6-3-4
use of 2-3-1 to 2-3-2
use of halide detectors with 8-1-9

Mexican fruit fly
treatment T107-b
Cold treatment 5-2-67

Mexico
clementines
methyl bromide treatment schedule 5-2-18
vapor heat treatment schedules 5-2-60
grapefruit
methyl bromide treatment schedule 5-2-25
vapor heat treatment schedules 5-2-61
mangoes
high temperature forced air treatment schedule 5-2-53
vapor heat treatment schedules 5-2-61
oranges
methyl bromide treatment schedule 5-2-36
vapor heat treatment schedules 5-2-63
supervision of hot water immersion treatments 6-5-9

Micronized dusts
application of 2-11-2 to 2-11-3
cartriges 2-11-2
equipment 2-11-2
safety precautions 2-11-4

Microprocessors

requirements for hot water immersion
treatment 3-3-5

Milacidae
treatment T201-l
MB ("Q" label only) at NAP—tarpaulin or chamber 5-3-6

Mites
treatment T201-g-3
Hot water at 110-111°F for 20 minutes 5-3-5

Mityvac Hand-Held Vacuum Pump 8-1-30

Monitoring leads
blocked or crimped 2-4-19

Mordellistena spp.
treatment T201-d-3
MB ("Q" label only) in 15" vacuum 5-3-14

Mosses
treatment schedule for soil 5-5-22

Mountain Papaya
T107-a cold treatment schedule 5-2-67

Mountain papaya
high temperature forced air treatment schedule 5-2-53 to 5-2-55
vapor heat treatment schedules 5-2-62

Murrya koenigii 5-2-27, 5-2-28

Muscari
treatment T567-1
Dip in hot water at 113°F for 4 hours. 5-6-19

Muskmelon 5-2-56

Mustard 5-2-27

Mustard (seed) 5-2-28

Mustard greens
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-34

Myristica fragrans 5-2-27, 5-2-28

N

Naegelia
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

NAP's
See Normal atmospheric pressure chamber

Narcissus
treatment T202-i-1
MB ("Q" label only) at NAP 5-3-24
treatment T555-1
Presoak in water at 70°F–80°F for 2 hours, then at 110°F–111°F until all bulbs reach that temperature and hold for 4 hours. (If importer desires, 1 pint of formalin per 35 gallons water may be added to prevent basal rot.) 5-6-16

Nasturtium 5-2-27, 5-2-28

Natal fruit fly
treatment T107-e
Cold treatment 5-2-68

National Institute for Occupational Safety and Health
certification of respiratory protective equipment 8-1-14

National Monitoring and Residue Monitoring Analysis Laboratory 4-2-3

Nectarine
T107-a cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T107-e cold treatment schedule 5-2-68
T108-a fumigation plus cold treatment 5-2-70

Nectarines 5-2-56
treatment T101-a-3
MB at NAP—tarpaulin or chamber 5-2-35

Nematode cysts
treatment schedules for railroad cars 5-5-2

Nematodes
treatment schedules 5-6-15, 5-6-18

Nepeta cataria 5-2-27, 5-2-28

New Zealand
asparagus treatment schedule 5-2-4

Nigelia sativa 5-2-27, 5-2-28

NIOSH
See National Institute for Occupational Safety and Health

NMRAL
See National Monitoring and Residue Monitoring Analysis Laboratory

Noctuidae spp.
asparagus treatment schedules 5-2-3
banana treatment schedules 5-2-4
blackberry treatment schedules 5-2-6
melons treatment schedules 5-2-33
plantain treatment schedules 5-2-38
raspberry treatment schedules 5-2-41

Nonchemical treatments

cold treatment
intransit cold treatment of ships 3-7-1 to 3-7-16
self-refrigerated containers 3-7-16 to 3-7-20
warehouses 3-7-21 to 3-7-22
heat
Cold Treatment (CT) 3-7-1 to 3-7-22
Forces Hot Air 3-6-1 to 3-6-9
Hot Water Immersion Treatment 3-3-1 to 3-3-16
hot water immersion treatment 3-3-2 to 3-3-17
Irradiation 3-8-1 to 3-8-15
overview 3-2-1
Steam Treatments 3-4-1 to 3-4-3
steam treatments 3-4-1 to 3-4-3
Vapor Heat Treatment 3-5-1 to 3-5-3
vapor heat treatment 3-5-1 to 3-5-3
irradiation 3-8-1
overview 3-1-1, 6-1-1

Nonperishable commodities
supervision of quarantine treatments 2-2-2

Normal atmospheric pressure chamber
aeration of 2-5-5 to 2-5-6

Noxious weed seeds
treatment schedules 5-5-38 to 5-5-39

Nut fruit tortrix
treatment schedules 5-2-16, 5-4-8

Nutmeg 5-2-27, 5-2-28

Nuts
methyl bromide fumigation treatment schedules 5-2-16
pest specific/host variable treatment schedules 5-2-55 to 5-2-57
reporting commodity injury 5-2-1

Nysius huttoni
treatment T101-m-2
MB at NAP—tarpaulin or chamber 5-2-29

O

Oak logs and lumber
treatment schedules 5-4-25

Oak Wilt Disease
treatment T312-a
MB (“Q” label only) at NAP 5-4-25

Occupational Safety and Health Administration
respiratory protection requirements 8-1-13, 8-1-17

Ocimum basilicum 5-2-27, 5-2-28

Officer-in-Charge
responsibility for respiratory protection 8-1-12

Off-odors
effect of methyl bromide 2-3-7 to 2-3-8

Okra 5-2-56
treatment schedules 5-3-30
treatment T101-p-2
MB at NAP—chamber only 5-2-35

Omalomyx unguis
treatment T201-o-1
Water Spray—Use a high-pressure water spray on the foliage to flush snails from the plants. Care should be taken not to spray the root systems of conifers since they will be damaged. 5-3-12

Onion/garlic carpenterworm
treatment T202-j
MB (“Q” label only) at 15" vacuum 5-3-21

Onions 5-2-56
treatment T101-q-2
MB at NAP—tarpaulin or chamber 5-2-35

On-site inspections 3-3-3

Open arm manometer
illustrations 6-3-6, 8-1-30
use in pressure-leakage testing 6-3-4, 8-1-28

OPPC
See Oxford Plant Protection Center

Opuntia
treatment T101-d-3
MB at NAP—tarpaulin or chamber 5-2-43

Orange
T107-a cold treatment schedule 5-2-67
T107-b cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T107-d cold treatment schedule 5-2-68

Oranges 5-2-56
methyl bromide fumigation treatment schedule 5-2-36
vapor heat treatment schedules 5-2-63

Orchids
bordeaux spray treatment schedules 5-6-3, 5-6-9
defoliation treatment schedules 5-6-11
hot-water treatment schedules 5-3-14, 5-6-15
methyl bromide treatment schedules 5-3-14
rusts treatment schedules 5-6-9

Ordering additional manuals, summaries or revisions C-1-7 to C-1-9

oregano 5-2-27, 5-2-28

Oriental citrus mite
treatment T107-a
Cold treatment 5-2-67

Oriental fruit fly
cold treatment schedule 5-2-69
fumigation followed by cold treatment schedule 5-2-70
high temperature forced air treatment schedule 5-2-52 to 5-2-55
irradiation treatment schedules 5-2-58
methyl bromide fumigation treatment schedule 5-2-4
See also Fruit flies
vapor heat treatment schedules 5-2-60 to 5-2-65
water treatment schedule 5-2-47

Origanum spp. 5-2-27, 5-2-28

Ornithogalum
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T567-1
Dip in hot water at 113°F for 4 hours. 5-6-19

Oryza
treatment schedules 5-6-17

Ostrinia nubilalis
treatment T101-v-2
MB at NAP—tarpaulin or chamber 5-2-39
treatment T101-x-1-1
MB at NAP—tarpaulin or chamber 5-2-20

Outdoor fumigation 2-4-36 to 2-4-40

Oxford Plant Protection Center 1-1-1
address for technical contact 6-5-5
approval of facilities 6-3-2, 6-4-2, 6-4-7, 6-5-5, 6-5-7
calibration of equipment 8-1-5, 8-1-7, 8-1-30
polarized plugs for T/C units 8-1-5
procedures to detect blocked monitoring leads with use of Mitivac vacuum pump 8-1-31

P

Paddy rice
See also Rice straw and hulls treatment schedule
treatment schedule 5-6-17

Paeonia
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T564-1
Presoak in water at 68°F for 1 hour followed by hot water soak at 110°F for 1 hour. Next, dip in a cold solution of 0.25 percent Thiram 5-6-18

Paints
for atmospheric fumigation chambers 6-3-3

Papaver somniferum 5-2-27, 5-2-28

Papaya
high temperature forced air treatment schedule 5-2-53 to 5-2-55
irradiation treatment schedules 5-2-58
vapor heat treatment schedules 5-2-62 to 5-2-63

Parsley 5-2-27

Parsley (dried) 5-2-28

Parsnip 5-2-56
treatment T101-g-1
MB chamber, 15" vacuum—chamber 5-2-36

Particulate removing respirators 8-1-15
See also Respiratory protection

Passiflora
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Peach
T107-a cold treatment schedule 5-2-67
T107-b cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T107-e cold treatment schedule 5-2-68
T108-a fumigation plus cold treatment 5-2-70

peach 5-2-56

Peach fruit moth
apples treatment schedule 5-2-74

Peaches
treatment T101-a-3
MB at NAP—tarpaulin or chamber 5-2-36

Pear
T107-a cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T107-d cold treatment schedule 5-2-68
T108-a fumigation plus cold treatment 5-2-70
T108-b MB at NAP — tarpaulin or chamber followed by cold treatment 5-2-72

Pears
maximum loading temperature 3-7-9

Peas 5-2-56
treatment schedules 5-2-25 to 5-2-26
treatment T101-e-1
MB at NAP—tarpaulin or chamber 5-2-37

Pecan weevil
treatment T107-g
Cold treatment 5-2-69

Pectinophora gossypiella
cotton equipment treatment schedule 5-5-21
okra treatment schedule 5-2-35
railroad cars treatment schedules 5-5-2

Pectinophora spp.

treatment schedules ?? to 5-4-3, 5-4-5 to 5-4-10, 5-4-12 to ??

Pen recorders
APHIS approved models 3-3-10

Pennyroyal 5-2-27, 5-2-28

Pentatomidae spp.
methyl bromide fumigation treatment schedule 5-2-41
treatment schedule 5-2-6

Pepper 5-2-27, 5-2-56

Pepper White 5-2-27

Pepper, black 5-2-28

Pepper, white 5-2-28

Perishable commodities
supervision of quarantine treatments 2-2-2

Persimmon
T107-a cold treatment schedule 5-2-67
T107-b cold treatment schedule 5-2-67

Pest risk analysis 6-5-6

Petroselinum crispum 5-2-27, 5-2-28

PH
See Phosphine

Philippines
treatment T101-c-1
MB at NAP—tarpaulin or chamber 5-2-4

Philodendron spp.
treatment T201-i-1
MB (“Q” label only) at NAP 5-3-8

Philomycidae
treatment T201-l
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-6

Phoma chrysanthemi
treatment T501-4
Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray. 5-6-3

Phosphine
aeration 2-10-7
amount liberated by various products 2-10-3, 5-4-25, 5-5-45
bulk fumigations 2-10-6 to 2-10-7
concentration readings 2-10-9
container fumigation 2-10-8 to 2-10-9
disposal of residue 2-10-6
dosage rates 2-10-2 to 2-10-3
leak detection 2-10-2
measurement of 8-1-23
properties of 2-10-1 to 2-10-2
safety precautions 2-10-3 to 2-10-4
threshold limit value 8-1-12
treatment schedule for seeds 5-3-29, 5-3-30
use in atmospheric fumigation chambers 6-3-2
use of 2-10-1 to 2-10-2

Phosphine detector
PortaSens phosphine detector
alarm function 8-1-32
battery power supply 8-1-32
description 8-1-31
flow verification 8-1-32
operation 8-1-31
power down 8-1-32
response time 8-1-32

Phostoxin 2-10-4

Photinia
treatment T201-b-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-9

Phthorimaea operculela
treatment T101-v-2
MB at NAP—tarpaulin or chamber 5-2-39

Phyllosticia bromeliae Uredo
treatment schedules 5-6-8

Physoderma diseases
treatment schedules 5-6-5

Picea spp.
treatment T203-i-1
MB (“Q” label only) at NAP 5-3-27

Pieris spp.
treatment T403-f
MB at NAP 5-5-13

Piers
treatment T402-b-3-1
Malathion spray at 2 gal/1,000 ft2 or to the point of runoff. 5-5-3
treatment T406-c
Steam Cleaning 5-5-18

Pimenta dioica 5-2-27, 5-2-28

Pimento 5-2-56

Pimpinella anisum 5-2-27, 5-2-28

Pine Christmas trees
treatment T313-b
MB (“Q” label only) at NAP—chamber or tarpaulin 5-4-27

Pine shoot beetle

treatment T313-b
MB (“Q” label only) at NAP—chamber or tarpaulin 5-4-27

Pineapple 5-2-56
methyl bromide fumigation treatment schedule 5-2-38
vapor heat treatment schedules 5-2-64

Pineapple slips
treatment T201-e-3-1
MB (“Q” label only) at NAP 5-3-15

Pines
treatment T201-j
MB (“Q” label only) at NAP 5-3-16

Pink bollworm
treatment T401-a
MB (“Q” label only) at NAP 5-5-2
treatment T407
MB (“Q” label only) at NAP—tarpaulin, chamber, railroad car, or van 5-5-21

Pinus mugo spp.
treatment T203-i-2
MB ("Q" label only) in 26" vacuum 5-3-28

Pinus spp.
treatment T201-j
MB (“Q” label only) at NAP 5-3-16

Pinus sylvestris spp.
treatment T203-i-1
MB (“Q” label only) at NAP 5-3-27

Piper nigrum 5-2-27, 5-2-28

Pitahaya
treatment T101-d-3
MB at NAP—tarpaulin or chamber 5-2-43

Planorbidae
treatment T201-q
Hot water treatment 112°F for 10 minutes. Elodea densa and Cabomba caroliniana plants not tolerant to this treatment. 5-3-3

Plant pests and pathogens
treatment schedules 5-6-1 to 5-6-20

Plant Protection and Quarantine 1-1-1

Plantain 5-2-56, 5-2-57
treatment T101-t-2
MB at NAP—tarpaulin or chamber 5-2-38

Plants
treatment schedules 5-3-3, 5-4-1 to 5-4-28

Plastic wrappings
perforating for fumigation 2-3-5

Plum
T107-a cold treatment schedule 5-2-67
T107-b cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T107-e cold treatment schedule 5-2-68
T108-a fumigation plus cold treatment 5-2-70

Plumcot
T107-a cold treatment schedule 5-2-67
T108-a fumigation plus cold treatment 5-2-70

Plums 5-2-56
treatment schedule 5-2-39

Podocarpus
treatment T201-b-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-9

Poisoning
See Emergency aid and safety

Polyanthes
treatment schedules 5-6-15, 5-6-19

Pomagranate
T107-b cold treatment schedule 5-2-67

Pomegranate
T107-a cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68

Poppy 5-2-27

Poppy (seed) 5-2-28

PortaSens phosphine detector 2-10-2
alarm function 8-1-32
battery power supply 8-1-32
description 8-1-31
flow verification 8-1-32
operation 8-1-31
power down 8-1-32
response time 8-1-32

Post-treatment cooling 3-3-14 to ??

pot marjoram 5-2-27, 5-2-28

Potato cyst nematode
treatment schedules 5-6-4, 5-6-7 to 5-6-8

Potato tubers
treatment T565-5
Hot water at 110°F for 4 hours. (Should be done immediately after digging.) 5-6-19

Potato tuberworm
treatment T101-v-2
MB at NAP—tarpaulin or chamber 5-2-39

Potatoes 5-2-56
treatment T101-u-2

MB at NAP—tarpaulin or chamber 5-2-39

PPQ
See Plant Protection and Quarantine

Pratylenchus spp.
treatment schedules 5-6-15, 5-6-16, 5-6-20

Preclearance Program Office 3-7-6

Preclearance programs
See Certifying facilities

Precooling treatment 3-7-10

Prefumigation conferences 2-7-7 to 2-7-8

Pre-fumigation procedures 2-6-6

Pre-warming treatment 3-3-13

Prickly pear
treatment T101-d-3
MB at NAP—tarpaulin or chamber 5-2-43

Primula
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Probing
phosphine 2-10-6 to 2-10-7

Professional Development Center 1-1-4

Program Support 5-2-1

Progressive clearance 3-7-16

Propagative plant material
fan operation 2-2-3
treatment schedules 5-3-1 to 5-3-34

Property fumigation
methyl bromide 2-7-5

Pterandrus rosa
treatment T107-e
Cold treatment 5-2-68

Puerto Rico
supervision of hot water immersion
treatments 6-5-9

Pulp
fruit
treatment schedules 5-2-66 to 5-2-69

Pulpy vegetables
See Vegetables

Pulses
treatment T101-e-1
MB at NAP—tarpaulin or chamber 5-2-39

Pummelo
T107-a cold treatment schedule 5-2-67

Pumpkin 5-2-56

Pumpkins
treatment schedule 5-2-40

Purpose of manual 1-1-1

Q

Q labels 2-3-2 to 2-3-4

Quarantine 56 3-7-2, 6-4-3, 6-4-8

Quarantine Exemptions
See Section 18 Exemptions

Quarantine fumigants
supervision of 2-2-2 to 2-2-4

Quarantine requirements
samples for residue monitoring 4-2-3

Queensland fruit fly
cold treatment schedule 5-2-68
fumigation followed by cold treatment
schedule 5-2-70 to 5-2-71
See also Fruit flies

Quick freeze treatment schedules 5-2-74

Quince
T107-a cold treatment schedule 5-2-67
T107-c cold treatment schedule 5-2-68
T108-a fumigation plus cold treatment 5-2-70

R

Radishes 5-2-56
treatment T101-g-1
MB chamber, 15" vacuum—chamber 5-2-40

Railroad cars
treatment schedules 5-5-2, 5-5-18

Rape greens
treatment T101-n-2
MB at NAP—tarpaulin or chamber 5-2-40

Raspberries 5-2-56
treatment T101-x-2
MB at NAP—tarpaulin or chamber 5-2-41

Recorder sensors
See also Temperature sensors

testing 3-7-8

Recorders
See Temperature recorders

Reference documents 1-1-3

Refrigerated transport
See also Cold treatment
vessels used for intransit cold treatments 6-4-2 to 6-4-7, G-1-1

Refrigerated warehouses
used for cold treatment 6-4-8 to 6-4-9

refuse entry if pseudo-bulbs infected. 5-6-11

Reichsteineria
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Reporting problems 1-1-4

Residual effect
of methyl bromide 2-3-6 to 2-3-8

Residue monitoring
collecting samples 4-2-2
labeling samples 4-2-2
overview 4-1-1
safety precautions 4-2-1
shipping samples 4-2-3
storing samples 4-2-3

Resistive thermal detectors 3-3-7

Resmethrin
treatment schedule for aircraft 5-5-25

Respirators 2-4-19, 2-4-31, 2-10-4

Respiratory protection
capabilities and limitations 8-1-14 to 8-1-15
communication and 8-1-19
corrective lenses and 8-1-18
employee acceptance 8-1-13
facepiece fit and testing 8-1-17 to 8-1-18
for fumigants 8-1-13
for pesticides other than fumigants 8-1-13
low temperatures and 8-1-19
maintenance and care 8-1-19 to 8-1-22
NIOSH certification 8-1-14
OSHA requirements 8-1-12
physical condition and 8-1-16
responsibility for 8-1-12
See also specific types or respiratory protection
selection of 8-1-15
use of 8-1-16 to 8-1-19

Restrictions of manual 1-1-1

Resurrection plants
treatment T202-a-2
MB (“Q” label only) at NAP—Tarpaulin 5-3-25

Rhagoletis cerasi spp.
treatment T203-o-5
MB (“Q” label only) at NAP 5-3-34

Rhagoletis indifferens
treatment T101-s-1
MB at NAP—chamber only 5-2-15

Rhagoletis tomatis
treatment T101-c-3-1
MB at NAP—tarpaulin or chamber 5-2-43

Rhizomes
treatment schedules 5-3-20 to 5-3-21

Rhododendron
treatment T501-6
Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray. 5-6-4

Rhyacionia buoliana
treatment T201-j
MB (“Q” label only) at NAP 5-3-16

Rhynchostylis spp.
treatment T201-d-5
Hot water—118°F for 0.5 hour followed by a cool water bath 5-3-14

Rice straw and hulls
methyl bromide treatment schedules 5-4-12 to ??
See also Paddy rice
steam treatment schedules 5-6-13

Root cuttings
treatment schedule 5-3-17 to 5-3-18

Root-knot nematodes
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T556-1
Dip in hot water at 122°F for 30 minutes. 5-6-16

Roots
treatment schedule 5-3-20 to 5-3-21

Rosa spp.
treatment T560-1
Dip in hot water at 123°F for 10 minutes. 5-6-17

Rosemarinus officinalis 5-2-27, 5-2-28

Rosemary 5-2-27, 5-2-28

Rosmarinus seeds
treatment T203-h
MB (“Q” label only) at 26" vacuum 5-3-31

RTD sensors
See Resistive thermal detectors

Rubber trees
treatment T203-j
MB (“Q” label only) at NAP 5-3-33

Rue 5-2-27, 5-2-28

Rusts
treatment T508-1
For rust-infected shipments to Florida
Refuse entry to all infected plants and all other plants of the same species or variety in the shipment. 5-6-9

Ruta graveolens 5-2-27, 5-2-28

rutabaga 5-2-56

S

Saccharum
treatment T514-1
Presoak in water at room temperature for 24 hours then immerse in water at 122°F for 3 hours. 5-6-11

Safety precautions
aerosols 2-11-4
CO2 fire extinguishers 2-11-4
hot water immersion treatment 3-3-15
micronized dusts 2-11-4
phosphine 2-10-5 to 2-10-6
residue monitoring 4-2-1
See also Emergency aid and safety
ship fumigation 2-6-3
structure fumigation 2-7-3

Saffron 5-2-27, 5-2-28

Sage 5-2-27, 5-2-28

salsify 5-2-56

Salvia officinalis 5-2-27, 5-2-28

Salvia sciarea 5-2-27, 5-2-28

Sanguisorba minor 5-2-27, 5-2-28

Sansevieria
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Satureja spp. 5-2-27, 5-2-28

Savory summer 5-2-27, 5-2-28

Savory winter 5-2-28

Scabiosa
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

SCBA
See Self-contained breathing apparatus

Schedules
See Treatment schedules

Scilla
treatment T565-4
Hot water at 110°F for 4 hours. (Should be done immediately after digging.) 5-6-19

Scion wood cuttings
treatment T201-m-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-16

Scirtothrips dorsalis
treatment T101-b-1-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-2-4

Scope of manual 1-1-2

Scrobopalpula absoluta
treatment T101-c-3-1
MB at NAP—tarpaulin or chamber 5-2-43

Section 18 Exemptions
determination of 2-5-2, 2-6-5
for fruits nuts and vegetables 5-2-1 to 5-2-2
methyl bromide fumigants 2-3-2 to 2-3-4
residue monitoring 4-1-1
treatment recommendations 1-1-1

Sedum
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Seed beetles
seeds treatment schedule 5-3-31
vegetables treatment schedule 5-2-5, 5-2-21 to 5-2-22, 5-2-32, 5-2-37, 5-2-39

Seeds 5-2-27
treatment schedules 5-3-26 to 5-3-34, 5-4-7 to 5-4-8

Selaginella spp.
treatment T202-a-1
MB (“Q” label only) at NAP—Chamber 5-3-25

Self-contained breathing apparatus 2-10-4, 8-1-14, 8-1-15, 8-1-22
See also Respiratory protection

Self-refrigerated containers
clearance of intransit cold treatments 3-7-20 to 3-7-21
initiating intransit cold treatments 3-7-17 to 3-7-20

Senecio
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15
treatment T568-1
Treat with hot water at 110°F for 1 hour. 5-6-19

Sensors
See Temperature sensors

Septoria gentinae
treatment T507-2
Remove infected leaves and treat all plants of same species in shipment with Ferbam or Captan following label directions. 5-6-8

Set points
requirements for hot water immersion treatment 3-3-6

Shallots
treatment T101-q-2
MB at NAP—tarpaulin or chamber 5-2-41

Shelf life
effect of methyl bromide 2-3-6 to 2-3-8

Shelled corn
treatment T302-b-1-1
Reserved 5-4-12

Ship fumigation
aeration 2-6-13 to 2-6-14
conducting the fumigation 2-6-10 to 2-6-12
materials needed 2-6-2 to 2-6-3
methyl bromide 2-6-1 to 2-6-14
preparing to fumigate 2-6-4 to 2-6-10
safety measures 2-6-3

Ship holds
treatment schedules ?? to 5-5-3, 5-5-4 to ??

Ships
intransit cold treatment 3-7-1 to 3-7-16
treatment schedules 5-5-3 to 5-5-6

Short term exposure limits 2-10-4

Slack Associates, Inc. 6-2-4

Slugs
treatment T201-l
MB ("Q" label only) at NAP—tarpaulin or chamber 5-3-6
treatment T403-a-3
MB at NAP 5-5-8

Snails
cargo treatment schedules 5-5-6 to 5-5-10
grains and seeds treatment schedules 5-4-11
plants treatment schedules 5-3-12 to 5-3-13
seeds treatment schedule 5-3-31
ships treatment schedules 5-5-4

Soft scales
cacti treatment schedule 5-3-4
flowers and greenery treatment schedule 5-4-15
orchids treatment schedule 5-3-14

Soil
pests and pathogens treatment schedule 5-5-22 to 5-5-24
potato cyst nematode treatment schedule 5-6-4
steam pressure sterilization 3-4-1

Solanum
treatment T565-5
Hot water at 110°F for 4 hours. (Should be done immediately after digging.) 5-6-19

Sorption
of methyl bromide 2-3-5 to 2-3-6

Spain
exemption from treatment for garlic 5-2-22

Sprays 2-14-1

Squash 5-2-56
methyl bromide fumigation treatment schedule 5-2-41
vapor heat treatment schedules 5-2-64

Steam treatments
principle 3-4-1
steam jet method 3-4-2
steam pressure sterilization 3-4-1 to 3-4-2

STEL
See Short term exposure limits

Steneotarsonemus laticeps
treatment T202-i-1
MB ("Q" label only) at NAP 5-3-24

Stipa tenacissima
treatment schedules 5-4-14

stone fruit 5-2-56

Storerooms
treatment schedules 5-5-5

Strawberries 5-2-56
hot water treatment schedule 5-6-17, 5-6-20
methyl bromide fumigation treatment schedule 5-2-42

Striga spp.
treatment T408-g-1
MB ("Q" label only) (chamber) 5-5-24

Strip chart recorders
APHIS approved models 3-3-9
calculating chart speed 3-7-12
checking operation 3-7-6

clearing shipments cold treated in transit 3-7-10 to 3-7-16
for intransit cold treatment of ships 3-7-3
obtaining chart length 3-7-13

Structure fumigation
aerating the enclosure 2-7-15 to 2-7-16
conducting the fumigation 2-7-13 to 2-7-15
materials needed 2-7-2 to 2-7-3
methyl bromide 2-7-1 to 2-7-16
preparing to fumigate 2-7-4 to 2-7-12
safety precautions 2-7-3

Succinea horticola
treatment schedule 5-3-12

Succulents
treatment T201-f-1
MB (“Q” label only) at NAP—tarpaulin or chamber) 5-3-4 to 5-3-5

sugar beet 5-2-56

Sugarcane
treatment schedules 5-6-11 to 5-6-12

Sulfuryl Fluoride
threshold limit value 8-1-12

Suppliers
reference guide to commercial suppliers H-1-1 to H-1-58

Surge protectors
requirements for hot water immersion treatment 3-3-5

sweet 5-2-27, 5-2-28

Sweet bay 5-2-27, 5-2-28

sweet corn 5-2-56

Sweet potatoes 5-2-56
treatment T101-b-3-1
MB at NAP—tarpaulin or chamber 5-2-42
treatment T202-d
MB (“Q” label only) at NAP 5-3-26

Systole spp.
treatment T203-o-2
MB (“Q” label only) in 26" vacuum 5-3-34

T

T/C units
See Thermal conductivity units
*See*Thermanl conductivity gas analyzers

Taeniothrips eucharii
treatment T202-h
MB in 26" vacuum 5-3-23

Taeniothrips simplex
treatment T202-e-1
MB (“Q” label only) at NAP 5-3-22

Taiwan
mango treatment schedules 5-2-62

Tanacetum vulagre 5-2-27, 5-2-28

tangelo 5-2-56

Tangerine
T107-b cold treatment schedule 5-2-67
T107-d cold treatment schedule 5-2-68

tangerine 5-2-56

Tansy 5-2-27, 5-2-28

Tarpaulin fumigation
arranging the stack 2-4-7 to 2-4-10
covering the stack 2-4-16
fan operation 2-4-10
methyl bromide
aerating the enclosure 2-4-29 to 2-4-40
conducting the fumigation 2-4-19 to 2-4-29
materials needed 2-4-2 to 2-4-3
preparing to fumigate 2-4-3 to 2-4-19
of structures 2-7-10
padding corners 2-4-13
phosphine 2-10-6 to 2-10-7
rate of sorption 2-3-5
sealing 2-4-16, 2-10-6

Tarragan 5-2-27, 5-2-28

Tarsonemus spp.
treatment T101-h-1
MB at NAP—tarpaulin or chamber 5-2-6

Taxus
treatment T201-b-1
MB (“Q” label only) at NAP—tarpaulin or chamber 5-3-9

Teflon tubing 2-5-5

Temperature
effect on methyl bromide 2-3-4
measurement of
chamber fumigation 2-5-3
ship fumigation 2-6-7
structure fumigation 2-7-9
tarpaulin fumigation 2-4-14
using commodity or air temperature 2-5-3

Temperature recorders
calibrating 3-7-7, 3-7-17
for hot water immersion treatment 3-3-8 to 3-3-11

for intransit cold treatment of ships 3-7-3
on container vessels 3-7-8
testing 3-7-9

Temperature recording systems
standards for integral containers used for cold treatment 6-4-7 to 6-4-8
standards for vessels used for intransit cold treatment 6-4-4 to 6-4-7

Temperature sensors
calibrating 3-7-17
document preparation 3-7-7
for hot water immersion treatment 3-3-7 to 3-3-8
for intransit cold treatment of ships 3-7-3 to 3-7-5
placement of 3-7-7, 3-7-18

Temperature set points
requirements for hot water immersion treatment 3-3-7

Tephritidae
treatment schedule for seeds 5-3-34

Termites
cargo treatment schedules 5-5-11
wood products treatment schedules 5-5-17

Terms and conventions 1-1-4

Tetranychus kanzawai
apples treatment schedule 5-2-74

Tetranychus viennensis
apples treatment schedule 5-2-74

Thailand
asparagus treatment schedule 5-2-4

then let dry. 5-6-18

Thermal conductivity gas analyzers
Fumiscope and Grow-Mac
description 8-1-2 to 8-1-4
Fumiscope reading of 10 ounces per 1000 ft 8-1-8
limitations 8-1-7
maintenance 8-1-7
operational procedures 8-1-5 to 8-1-7
repair and calibration 8-1-7
standardizing the instrument 8-1-4 to 8-1-5

Thermal conductivity units 2-3-4, 2-4-21
See also Concentration readings

Thermistors 3-3-8

Thermocouple sensors 3-3-7, 3-3-8, 3-7-8, 3-7-15, 3-7-19

Thermometers
certified glass-mercury 3-3-8

Thermostatic controls
requirements for hot water immersion treatment 3-3-6

Thompsonia nepalensis
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Threshold limit values 2-10-4

Thrips spp.
asparagus treatment schedule 5-2-3
banana treatment schedule 5-2-4
blackberry treatment schedule 5-2-6
melons treatment schedule 5-2-33
plantain treatment schedule 5-2-38
raspberry treatment schedule 5-2-41

Thuja
treatment T201-b-1
MB ("Q" label only) at NAP—tarpaulin or chamber 5-3-9

Thyme 5-2-27, 5-2-28

Thymus spp. 5-2-27, 5-2-28

Tick-infested materials
non-food treatment schedules 5-4-24 to 5-4-25
nonplant articles treatment 5-5-38

Tigridia
treatment T554-1-1
Presoak in water at 70°F–80°F for 2.5 hours, followed by hot water immersion at 110°F–111°F for 1 hour. 5-6-16

TLV's
See Threshold limit values

Tobacco moth
treatment T308-d
Kabat® (active ingredient—methoprene) is an insect growth regulator applied at the rate of 0.2 pounds (3.9 fluid ounces) per 1,000 pounds of tobacco. 5-4-20

Tobacco, for export
treatment schedules 5-4-19 to 5-4-20

Tomatoes 5-2-56
methyl bromide fumigation treatment schedule 5-2-43
vapor heat treatment schedules 5-2-65

Tomicus piniperda
treatment T313-b
MB ("Q" label only) at NAP—chamber or tarpaulin 5-4-27

Toxicity of fumigant 2-2-1

Treatment facilities

certifying 6-2-1 to ??, 6-3-1 to ??, 6-4-1 to ??, 6-5-1 to ??, 6-6-1 to ??, 6-7-1 to ??, 6-8-1 to 6-8-4

Treatment schedules
adjusting exposure period 2-4-23 to 2-4-25
cold treatment 5-2-66 to 5-2-69
determining label for fumigation 5-2-2
for miscellaneous plant products 5-4-1 to 5-4-28, 5-5-1 to 5-5-45
for miscellaneous products 5-5-1 to 5-5-45
for plant pests or pathogens 5-6-1 to 5-6-20
for propogative plant material 5-3-1 to 5-3-34
fruits, nuts and vegetables 2-4-25 to 2-4-28, 5-2-1 to 5-2-75
fumigation plus refrigeration of fruits 5-2-70
high temperature forced air 5-2-50 to 5-2-55
hot water treatments 5-6-14 to 5-6-20
irradiation 5-2-58
methyl bromide fumigation 5-2-3 to 5-2-45
pest specific/host variable 5-2-55 to 5-2-57
quick freeze 5-2-74
reporting commodity injury 5-2-1
Section 18 Exemptions 5-2-1 to 5-2-2
T100 5-2-1 to 5-2-75
T200 5-3-1 to 5-3-34
T300 5-4-1 to 5-4-28
T400 5-5-1 to 5-5-45
T500 5-6-1 to 5-6-20
tarpaulin fumigation with methyl bromide 2-4-3
vapor heat 5-2-60 to 5-2-64
water treatment schedules 5-2-46 to 5-2-49

Trees, Christmas
treatment schedules 5-4-26
treatment T501-5
Remove infected parts and treat all plants of same species in shipment with 4-4-50 Bordeaux dip or spray. 5-6-3

Trigonella foenumgraecum 5-2-27

Trogoderma granarium
aircraft treatment schedules 5-5-24
bags treatment schedule 5-4-16
brassware treatment schedules 5-5-40
cargo treatment schedules 5-5-11
cottonseed treatment schedules 5-4-2 to 5-4-4
grains and seeds treatment schedules 5-4-9
railroad cars treatment schedules 5-5-2
seeds treatment schedule 5-3-31
ships treatment schedules ?? to 5-5-3, 5-5-5 to ??
wood products treatment schedules 5-5-17

Tropaeolum majus 5-2-27, 5-2-28

Tuberose
treatment T565-5
Hot water at 110°F for 4 hours. (Should be done immediately after digging.) 5-6-19

Tubers
treatment schedules 5-3-20 to 5-3-21

Tuna 5-2-56

Tuna (Opuntia)
treatment T101-e-3
MB at NAP—tarpaulin or chamber 5-2-44

Turnips 5-2-56
treatment T101-g-1
MB chamber, 15" vacuum—chamber 5-2-44

Tydaea
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Type T thermocouple sensors 3-7-8, 3-7-15, 3-7-19

U

U.S. Department of Agriculture 3-3-2 to 3-3-4

U.S. Department of Transportation
compressed air specifications 8-1-22

Umbelliferae
treatment T203-o-2
MB (“Q” label only) in 26" vacuum 5-3-34

United States
citrus treatment schedule 5-2-18

Updating the manual
Appendix 10 C-1-1 to C-1-5

USDA
See U.S. Department of Agriculture

Use of manual 1-1-3

U-tube manometer
See Open arm manometer

V

Vacuum fumigation
of plants 5-3-14

Vacuum Fumigation chambers
accessories 6-2-3
aeration of 2-5-4
chamber 6-2-1
circulation and exhaust system 6-2-2
fumigant introduction systems 6-2-2
manufacturers 6-2-4
performance standards 6-2-3
vacuum pump 6-2-2

Vacuum Pump 8-1-30

Vanilla 5-2-27, 5-2-28

Vanillia planifolia 5-2-27, 5-2-28

Vapor heat treatment
principle 3-5-1
procedures 3-5-2 to 3-5-3
safeguards 3-5-3
schedules 3-5-1, 5-2-60 to 5-2-64

Vegetables
adjusting exposure period 2-4-25 to 2-4-28
aerating 2-4-29 to 2-4-30
determining temperature for proper dosage rate 2-4-15
methyl bromide fumigation treatment schedules 5-2-3 to 5-2-45
pest specific/host variable treatment schedules 5-2-55 to 5-2-57
quick freeze treatment schedules 5-2-74
reporting commodity injury 5-2-1
See also specific vegetables by name
vapor heat treatment schedules 5-2-60 to 5-2-64
water treatment schedules 5-2-46 to 5-2-49

Velometer 8-1-27

Verbena
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Veronicellidae
treatment T201-l
MB ("Q" label only) at NAP—tarpaulin or chamber 5-3-6

Verticillium albo-atrum
treatment T520-1-1
Dust with 75 percent Thiram at the rate of 166 grams per 50 kilograms of seed (3.3g/kg). 5-6-14

Vessels
used for intransit cold treatment 6-4-2 to 6-4-7

Vetch seeds
treatment T203-d-1
MB ("Q" label only) at NAP 5-3-35

Vicia spp.
treatment T203-d-1
MB ("Q" label only) at NAP 5-3-35

Vine moth
treatment schedule 5-2-23 to 5-2-24

Vinsonia spp.
treatment T201-d-3
MB ("Q" label only) in 15" vacuum 5-3-14

Vitis
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Viviparidae
treatment T201-q
Hot water treatment 112°F for 10 minutes. Elodea densa and Cabomba caroliniana plants not tolerant to this treatment. 5-3-3

Volatilizer
description and use 8-1-24
liquid fumigant vaporizer 8-1-26
methyl bromide volatilizer coil 8-1-25

Volume measurement
ship fumigation 2-6-9
structure fumigation 2-7-10
tarpaulin fumigation 2-4-17

W

Warehouses
clearance of the cold treated fruit 3-7-21
initiating the cold treatment 3-7-17 to 3-7-20
used for cold treatment 6-4-8 to 6-4-9

Waste
treatment schedules 5-4-5

Water circulation system
requirements for hot water immersion treatment 3-3-7

Water heating capacity
requirements for hot water immersion treatment 3-3-6

Water Spray
treatment schedule for plants 5-3-12

Water treatment schedules 5-2-46 to 5-2-49

watermelon 5-2-56

Weed seeds
treatment schedules 5-5-38 to 5-5-39

Weevils
treatment T302-g-1
MB at NAP—tarpaulin, chamber, or van container 5-4-8

Weigela
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Western cherry fruit fly
See also Fruit flies
treatment schedule 5-2-15

Wheat
treatment schedules for flag smut 5-6-6

Wheat bug
treatment T101-m-2
MB at NAP—tarpaulin or chamber 5-2-29

White Zapote
T107-b cold treatment schedule 5-2-67

wild marjoram 5-2-27, 5-2-28

winter 5-2-27

Wintergreen 5-2-27, 5-2-28

Wire sensors 3-7-8, 3-7-19

Wiring
requirements for hot water immersion
treatment 3-3-5

Witchweed
treatment T408-g-1
MB (“Q” label only) (chamber) 5-5-24

Wood borers
treatment T403-d
see T404 schedules 5-5-11

Wood products
treratment schedules 5-5-13 to 5-5-17

Wood surfaces
treatment schedules 5-5-13 to 5-5-14
treatment T402-b-3-1
Malathion spray at 2 gal/1,000 ft2 or to the point of runoff. 5-5-3

Wood wasps
treatment schedules for wood 5-5-13, 5-5-14

Wooden boxes
aeration for fumigation 2-3-5

Woodruff 5-2-27, 5-2-28

Work plans
hot water immersion treatment 3-3-16

Wormwood 5-2-27, 5-2-28

X

Xanthomonas albilineans
treatment schedules 5-6-11

Xanthomonas vasculorum
treatment schedules 5-6-11

Y

Ya pearT107-f cold treatment schedule 5-2-69

Yams 5-2-56
treatment schedules 5-2-44, 5-3-26

Yellow peach moth
apples treatment schedule 5-2-74

Yucca
treatment T101-n-1
MB at NAP—tarpaulin or chamber 5-2-12

Z

Zantedeschia
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Zingiberaceae
treatment T553-1
Hot water at 118°F for 30 minutes. 5-6-15

Zoecon Corporation 5-4-20

Zucchini 5-2-56
methyl bromide fumigation 5-2-45
vapor heat treatment schedules 5-2-65

Treatment Manual

Comment Sheet

Directions: Use this sheet to suggest an improvement or to identify a problem in the content of the manual. **Do not use this sheet to order manuals and manual parts—see Appendix C for ordering manuals and manual parts, or for changing the number of manuals you receive.** To mail, please follow the directions on the next page.

Description of problem (error, inconsistency, missing or insufficient information, etc.)

Description of improvement or recommended change (add attachments if necessary)

Reason for improvement or change

After completion:

1. Fold on the dotted lines with the address side outward.
2. Staple or tape to close.
3. Affix postage.
4. Drop in the mail.

Professional Development Center

USDA-APHIS-PPQ
69 Thomas Johnson Drive
Frederick, MD 21702-4301

Attn: Phil Grove