

A Publication of the
National Wildfire
Coordinating Group

Interagency Ground Ignition Guide



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National Wildfire
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Prepared by
Ground Ignition Subcommittee of the
Equipment Technology Committee
National Wildfire Coordinating Group

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- Acknowledgments ii
- Chapter 1—Introduction 1
 - Objectives 1
 - Scope 1
 - Authority 1
 - Participating Agencies 1
 - Minimum Equipment Standards/Specifications 1
 - Guidelines for Contracted Ground Ignition Services 1
 - Organization of This Guide 2
 - Review and Revision 2
- Chapter 2—ATV/UTV Torches 3
 - Equipment Description 3
 - Sources of Equipment That Meet Standards 4
 - Situations Favorable for ATV/UTV Torch Use 4
 - Safety Requirements 4
 - Required Personal Protective Equipment (PPE) 4
 - Required ATV/UTV Equipment 4
 - Recommended Additional ATV/UTV Equipment 4
 - Transporting ATV/UTV Torch Fuel 5
 - Qualifications 5
 - Prerequisites 5
 - Minimum Training 5
 - Position Responsibilities 5
 - Inspecting ATV/UTV Torches and Mixing Fuel 6
 - Torch Inspections 6
 - ATV/UTV Inspections 7
 - Mixing ATV/UTV Torch Fuel 7
 - Normal Operating Procedures for ATV/UTV Torches 8
 - Preparing the Torch for Use 8
 - Transporting the ATV/UTV 8
 - Transporting the Torch 8
 - Fueling or Refueling the Torch 8
 - Using the Torch 8
 - Emergency Operating Procedures for ATV/UTV Torches 9
 - Maintenance and Storage 10
 - Cleaning and Repair 10
 - Storing the Torch 10
 - Storing ATV/UTV Torch Fuel 10
 - ATV/UTV Torch Resources 11
 - Hazard Analysis 12
 - List of Required Material Safety Data Sheets 13



Recommended Spare Parts 14

Equipment Standards for ATV/UTV Torches 14

Contract Equipment Inspection Checklist 15

ATV/UTV Torch References..... 15

Chapter 3—Drip Torches 17

 Equipment Description 17

 Sources of Equipment That Meet Specifications 18

 Situations Favorable for Drip Torch Use 18

 Safety Requirements 18

 Required Personal Protective Equipment (PPE)..... 18

 Transporting Drip Torch Fuel 19

 Qualifications 19

 Prerequisites 19

 Minimum Training 19

 Inspecting Drip Torches and Mixing Fuel 20

 Inspections..... 20

 Mixing Fuel..... 21

 Normal Operating Procedures for Standard and Panama Drip Torches 22

 Standard Drip Torch..... 22

 Panama Drip Torch..... 26

 Emergency Operating Procedures for Standard and Panama Drip Torches..... 28

 Maintenance and Storage 28

 Cleaning and Repair 28

 Storing the Torch and Fuel 28

 Drip Torch Resources 29

 Hazard Analysis 30

 List of Required Material Safety Data Sheets 31

 Recommended Spare Parts 32

 Cache Refurbishment Standards..... 33

 Equipment Specifications for Drip Torches..... 36

 Contract Equipment Inspection Checklist 52

 Drip Torch References..... 52

Chapter 4—Flares and Flare Launchers..... 53

 Equipment Description 53

 Sources of Equipment That Meet Standards..... 54

 Situations Favorable for Flare Launcher Use 54

 Safety Requirements 54

 Required Personal Protective Equipment (PPE)..... 54

 Transporting Flare Launchers 54

 Transporting Cartridges 54

 Transporting FireQuick Flares 55



Transporting Orion Flare Cartridges	55
Qualifications	56
Prerequisites	56
Minimum Training	56
Inspecting Flares and Flare Launchers	56
Normal Operating Procedures for FireQuick Flare Systems	57
Preparing the Flare Launcher	57
Using the Flare Launcher	57
Emergency Operating Procedures for FireQuick Flare Systems	60
Normal Operating Procedures for Orion Flare Systems	61
Preparing the Flare Launcher for Use	61
Using the Flare Launcher	61
Emergency Operating Procedures for Orion Flare Systems	62
Maintenance and Storage	63
Cleaning and Repair	63
Launcher Replacement	63
Storing the Launcher	64
Storing Flares	64
Disposing of Damaged or Dud Flares	64
Flare and Flare Launcher Resources	65
Hazard Analysis	66
List of Required Material Safety Data Sheets	67
Recommended Spare Parts	68
Cache Refurbishment Standards	68
Equipment Standards for Flares and Flare Launchers	68
Contract Equipment Inspection Checklist	69
Flare and Flare Launcher References	69
Chapter 5—Fusees	71
Equipment Description	71
Sources of Equipment That Meet Specifications	71
Situations Favorable for Fusee Use	72
Safety Requirements	72
Required Personal Protective Equipment (PPE)	72
Transporting Fusees	72
Qualifications	73
Prerequisites	73
Minimum Training	73
Safety Precautions	73
Normal Operating Procedures for Fusees	74
Storage	75
Disposal of Fusees	75
Fusee Resources	75



- Hazard Analysis 76
- List of Required Material Safety Data Sheets 77
- Equipment Specifications for Fusees 78
- Fusee References 86

- Chapter 6—Gelled Fuel Blivets 87
 - Equipment Description 87
 - Sources of Equipment That Meet Standards 87
 - Situations Favorable for Gelled Fuel Blivet Use 88
 - Safety Requirements 88
 - Required Personal Protective Equipment (PPE) 88
 - Transporting Gelled Fuel Blivets 88
 - Qualifications 89
 - Prerequisites 89
 - Minimum Training 89
 - Inspecting Gelled Fuel Blivets 89
 - Normal Operating Procedures for Gelled Fuel Blivets 90
 - Preparing Blivets for Use 90
 - Using Blivets 90
 - Preparing Blivets for Transportation and Storage 90
 - Maintenance and Storage 90
 - Gelled Fuel Blivet Resources 91
 - Hazard Analysis 92
 - List of Required Material Safety Data Sheets 93
 - Equipment Standards for Gelled Fuel Blivets 94
 - Contract Equipment Inspection Checklist 94
 - Gelled Fuel Blivet References 94

- Chapter 7—Plastic Spheres and Launchers 95
 - Equipment Description 95
 - Sources of Equipment That Meet Standards 98
 - Plastic Spheres 98
 - Ethylene Glycol Antifreeze 98
 - PyroShot Plastic Sphere Launcher 98
 - Situations Favorable for Plastic Sphere Use 98
 - Safety Requirements 99
 - Required Personal Protective Equipment (PPE) 99
 - Transporting Plastic Spheres and Ethylene Glycol Antifreeze 99
 - Qualifications 100
 - Prerequisites 100
 - Minimum Training 100
 - Inspecting Plastic Spheres and Launchers 100
 - Plastic Sphere Inspections 100



Slingshot (Launcher) Inspections 100

PyroShot Launcher Inspections 100

Normal Operating Procedures for Slingshots 101

Emergency Operating Procedures for Slingshots 101

Normal Operating Procedures for PyroShot Launchers 102

Normal Operating Procedures for PyroShot HS Launchers 102

Emergency Operating Procedures for PyroShot and PyroShot HS Launchers 102

Maintenance and Storage 103

Plastic Sphere Resources 103

 Hazard Analysis 104

 List of Required Material Safety Data Sheets 105

 Recommended Spare Parts 106

 Equipment Standards for Plastic Spheres and Launchers 106

 Contract Equipment Inspection Checklist 107

 Plastic Sphere and Launcher References 107

Chapter 8—Power Torches 109

 Equipment Description 109

 Situations Favorable for Power Torch Use 109

 Sources of Equipment That Meet Standards 109

 Safety Requirements 110

 Required Personal Protective Equipment (PPE) 110

 Transporting Power Torch Fuel 112

 Qualifications 113

 Prerequisites 113

 Minimum Training 113

 System Organization and Position Responsibilities 113

 Inspecting Power Torches 114

 Inspections 114

 Firing Vehicle Inspections 114

 Preventative Maintenance 114

 Installation Procedures 114

 Mixing Power Torch Fuel 114

 Normal Operating Procedures for Power Torches 115

 Project Briefing 115

 Communications 115

 Fueling the Torch 115

 Using the Torch 115

 Emergency Operating Procedures for Power Torches 116

 Maintenance and Storage 116

 Cleaning and Repair 116

 Storing the Torch 116

 Storing Power Torch Fuel 116



Power Torch Resources 117

Hazard Analysis 118

 List of Required Material Safety Data Sheets 119

 Recommended Spare Parts 120

 Equipment Standards for Power Torches 120

 Contract Equipment Inspection Checklist 121

 Power Torch References 121

Chapter 9—Propane Torches 123

 Equipment Description 123

 Sources of Equipment That Meet Standards 123

 Situations Favorable for Propane Torch Use 123

 Safety Requirements 124

 Required Personal Protective Equipment (PPE). 124

 Transporting Propane Cylinders 124

 Qualifications 124

 Prerequisites 124

 Minimum Training 124

 Inspecting Propane Torches 125

 Inspections. 125

 Normal Operating Procedures for Propane Torches 126

 Preparing the Torch for Use 126

 Igniting the Torch 126

 Using the Torch 127

 Extinguishing the Torch 127

 Preparing the Torch for Transportation and Storage 127

 Emergency Operating Procedures for Propane Torches 128

 Maintenance and Storage 128

 Cleaning and Repair 128

 Storing Propane Cylinders 128

 Propane Torch Resources 129

 Hazard Analysis 130

 List of Required Material Safety Data Sheets 131

 Equipment Standards for Propane Torches 132

 Propane Torch References 132

Chapter 10—Terra Torches 133

 Equipment Description 133

 Sources of Equipment That Meet Standards 134

 Terra Torches 134

 Gelling Agents 134

 Situations Favorable for Terra Torch Operations 134

 Safety Requirements 135



Required Personal Protective Equipment (PPE) 135

Minimum Safety Equipment Required 135

Transporting the Gelling Agent and Fuel 135

Qualifications 136

 Prerequisites 136

 Minimum Training 136

 System Organization and Position Responsibilities 136

Inspecting Terra Torches and Mixing Fuel 137

 Inspections 137

 Mixing Terra Torch Fuel 137

 Precautions 137

 Fuels 138

 Fueling From Bulk Fuel Supply 138

 Gelling Agents 139

 Safety Preparations 140

Normal Operating Procedures for Terra Torches 142

 Preparing the Torch for Use 142

 Igniting the Torch 142

 Using the Torch 142

 Shutting Down the Torch 142

Emergency Operating Procedures for Terra Torches 143

Maintenance and Storage 148

 Cleaning and Repair 148

 Storing Equipment and Fuel 148

Terra Torch Resources 149

 Hazard Analysis 150

 List of Required Material Safety Data Sheets 151

 Using a Dust Mask 152

 Recommended Spare Parts 153

 Equipment Standards for Terra Torches 153

 Contract Equipment Inspection Checklist 155

 Terra Torch References 157

Appendix A—Material Safety Data Sheets 159

 Flares and Cartridges 160

 FireQuick Flares 160

 Orion Flares 162

 Cartridges (Industrial Loads) for FireQuick Flare Systems 164

 Fuels 170

 Diesel 170

 Gasoline 175

 Fuseses 181

 Orion Fuseses 181



Gases	183
Nitrogen	183
Propane	189
Gelling Agents	191
Fire-Trol Firegel/SureFire	191
Fire-Trol Flash 21A	194
Fire-Trol Flash 21B	196
Fire-Trol Petrol Jel	198
Gelled Fuel Blivets	203
FireSnakes/Heat Source Slash Burners	203
Plastic Spheres	208
Ethylene Glycol Antifreeze	208
Potassium Permanganate	220
Appendix B—Ground Ignition References	227
Drip Torches	227
Flares and Flare Launchers	227
Fusees	227
Hazardous Materials	227
Plastic Spheres and Sphere Launchers	227
Terra Torches	227
Transporting Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel	228
Additional Useful References	228

Objectives

The Interagency Ground Ignition Guide has been developed to:

- Define and standardize procedures and equipment for approved ground ignition operations by all cooperating natural resource agencies.
- Ensure that all ground ignition operations are performed in a safe and efficient manner.
- Provide a framework within which areas, regions, States, and local units can provide their own supplemental, site-specific guidance.
- Provide the minimum standards/specifications for ground ignition equipment.

Scope

The National Wildfire Coordinating Group (NWCG), through its Equipment Technology Committee, recognized a need for guidance on ground ignition operations. The procedures and equipment outlined in this guide address both incident and project ground ignition operations.

Authority

The Ground Ignition Subcommittee was chartered by the Equipment Technology Committee to develop guidance for interagency ground ignition operations. The administrative manuals of participating agencies contain the authority for implementing this guide.

Participating Agencies

The Interagency Ground Ignition Guide is published by NWCG with the cooperation of the U.S. Department of Agriculture, Forest Service; the U.S. Department of the Interior, Bureau of Indian Affairs, BLM, Fish and Wildlife Service, and National Park Service; and various State and local agencies.

Minimum Equipment Standards/Specifications

A list of the minimum requirements for each type of equipment will be found in the corresponding chapter of this guide.

Guidelines for Contracted Ground Ignition Services

Private vendors own and operate ground ignition systems in some areas of the country. When an agency contracts for ground ignition personnel or equipment, the following guidelines shall be observed:

The requesting agency unit must ensure that the contractor has been awarded a contract or a modification has been made to an existing procurement document that includes provisions for contracted ground ignition services and that the equipment and personnel have been approved. The line officer will ensure that contracted ground ignition services will be conducted in accordance with the procurement document.

The requesting agency unit will provide information including the location of the burn and the burn objectives to help the contractor plan for the equipment, personnel, and supplies. This information will include the approximate acreage to be burned (overall acreage and acres per day), times and dates of the proposed burn, location and directions to the burn area, time and location of equipment inspection, supplies and equipment to be provided by the agency, agency contact names and phone numbers, and local support sources (bulk fuel providers, motels, etc.) and their phone numbers.

The contractor shall have a written operating plan outlining the equipment that will be used, the duties and responsibilities for the contractor's personnel, and the procedures for mixing fuel and for operations. The standard operating procedures, a copy of the qualifications of the contractor's employees, and training documentation shall be available for review when the Government representative arrives at the jobsite—before the start of contract work.

The contractor's equipment shall meet the minimum requirements listed in the resources section in each applicable chapter of this guide.



Any residual waste product, such as gelled fuel or drip torch fuel, shall be disposed of at an approved hazardous waste disposal site or, with the Government representative's approval, by incineration within the burn area.

Any deviation from established standard operating procedures or policy requires authorization by the contracting officer's technical representative (COTR) or designee.

Organization of This Guide

This guide is divided into chapters. Each chapter covers a specific type of ground ignition system, including an equipment description, operational advantages and disadvantages, sources of equipment, situations favorable for use, safety requirements, qualifications, equipment inspections and fuel mixing methods, operating (normal and emergency) procedures, maintenance and storage, and resources.

Review and Revision

The National Wildfire Coordinating Group (NWCG) sponsored publication of this guide. Users are encouraged to send recommended changes to their agency representatives. This guide will be reviewed by the Ground Ignition Subcommittee of the NWCG Equipment Technology Committee every 3 years and will be revised as warranted. The most current version of the guide can be found at <<http://www.nwcg.gov/>>.

Chapter 2—ATV/UTV Torches

Equipment Description

The all-terrain vehicle/utility-terrain vehicle (ATV/UTV) torch is a ground ignition device designed for mounting on the rear cargo platform of an ATV/UTV. It has a fuel tank, a system to dispense fuel, and an ignition source.

The tank may be fabricated from carbon steel, stainless steel, or aluminum. Fuel may be dispensed by gravity, electric pump, or pressurized gas. The ignition source may be a lighted wick, propane torch, or electric spark (figures 2–1 through 2–3).



Figure 2–1—A UTV torch with a lighted wick ignition source. This UTV has a water tank and pump for fire suppression.



Figure 2–3—A UTV torch with an electrical spark ignition source.

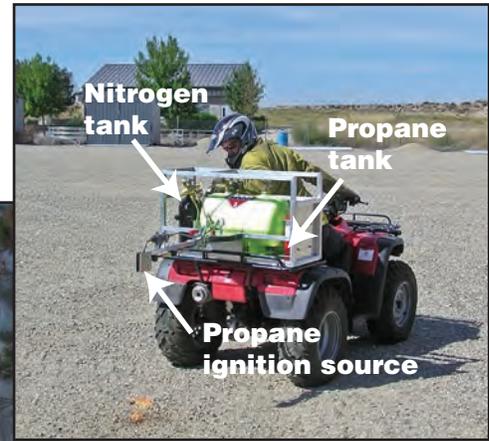


Figure 2–2—An ATV/UTV torch with a propane ignition source. The torch on this UTV uses pressurized nitrogen gas to dispense fuel from the tank.

ATV/UTV Torches

Advantages

Advantages and Disadvantages of Using ATV/UTV Torches

Advantages of using ATV/UTV torches	Disadvantages of using ATV/UTV torches
Greatly increase safety by reducing firefighter exposure and the number of people required for burning	Increase risk of vehicle rollover
Reduce the number of employees exposed to fireline hazards, such as tripping, stump holes, bee stings, and so forth	May create fire near the ignition vehicle that could burn the vehicle or entrap the operator if the ATV/UTV quits or becomes stuck
Reduce employee fatigue by decreasing the amount of walking, compared to hand lighting	Can make communication difficult because of the noise of the ATV/UTV
Develop a convective column more quickly, increasing control over the fire and reducing smoke management issues	Require additional PPE, training, and certification
More acres may be burned in less time than with hand lighting	Can distract the ATV/UTV operator from driving while the operator is using the torch
Provide a rapid escape platform	
Can be operated at different speeds	



Sources of Equipment That Meet Standards

ATV/UTV torches must conform to the requirements in the “Equipment Standards” section at the end of this chapter.

Hayes Manufacturing Co., Inc
106 Pelican Dr.
P.O. Box 3309
Pineville, LA 71361-3309
Phone: 318-487-0100

Bill’s Machine
5687 Beale Ford Rd.
Pace, FL 32571
Phone: 850-994-9820

Forestry Suppliers, Inc.
205 West Rankin St.
P.O. Box 8397
Jackson, MS 39284-8397
Phone: 800-647-5368

For copies of designs that meet specifications, contact:

Fire Equipment Specialist
U.S. Department of the Interior
Bureau of Land Management
National Fire Equipment Program
3833 South Development Ave.
Boise, ID 83705
Phone: 208-387-5445

Ignition Specialist
Forest Service-MTDC
5785 Highway 10 West
Missoula, MT 59808-9361
Phone: 406-329-3900

Situations Favorable for ATV/UTV Torch Use

An ATV/UTV torch may work well when:

- The terrain is safe for operating an ATV/UTV
- Sites have open timber stands or grasslands
- Burn units are large
- Areas need to be ignited quickly
- Protecting point sources of remote resources

Safety Requirements

Hazard analysis information for ATV/UTV torch operations, including use of ATVs/UTVs and flammable liquids, is provided in the “ATV/UTV Torch Resources” section at the end of this chapter. Prepare and review your hazard analysis document before beginning work.

Required Personal Protective Equipment (PPE)

- Head protection following agency policy
- Flame-resistant pants
- Flame-resistant shirt
- Leather gloves
- Approved boots
- Eye protection
- Hearing protection
- Fire shelter

Required ATV/UTV Equipment

- Fire extinguisher
 - » Mount the fire extinguisher so it is easily accessible; recommended minimum rating is 10-B:C.
 - » Do not mount the fire extinguisher on the torch.
- Handtool, such as a combi or shovel
- Handheld radio (minimum method of communication)

Recommended Additional ATV/UTV Equipment

- Winch
- Water tank or bladder bag
- Skid plates (figure 2-4)
- Brush guards
- Floor plates
- Puncture-resistant tires/Fix-A-Flat tire inflator

ATV/UTV Torches

Use of ATV-mounted torches may be prohibited or restricted by some agencies. Refer to your agency ATV-use policy for more information.



Figure 2-4—A UTV with brush guards, skid plate, and puncture-resistant tires. Fire extinguishers are mounted within the torch operator's reach.

Transporting ATV/UTV Torch Fuel

- Use approved containers—safety cans, jerricans, and fuel tanks that meet DOT specifications.
- Avoid transporting fuel on public highways in containers that do not meet DOT specifications.
- Make sure that all fuel containers are properly secured during transportation.
- Avoid transporting more than 440 pounds of hazardous materials, including torch fuel, in one vehicle—all containers must be smaller than 8 gallons.
- If you are transporting more than 440 pounds of torch fuel (or other hazardous materials) or if any fuel container is larger than 8 gallons, DOT hazardous materials training is required. In addition, you must carry shipping papers and a copy of the “Emergency Response Guidebook” in the vehicle.
- If you are transporting 1,001 pounds or more of torch fuel or if any container is larger than 119 gallons, the driver must have a commercial driver’s license (CDL) and DOT hazardous materials training. In addition, the vehicle must be placarded. You must carry shipping papers and a copy of the “Emergency Response Guidebook” in the vehicle.

For more information on transporting fuel, see the “Interagency Transportation Guide for Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel.”

Qualifications

To be qualified to use ATV/UTV torches for incident or project work, individuals must meet prerequisites and training requirements.

Prerequisites

Operators shall:

- Hold the position of Type 2 firefighter (FFT2) or prescribed fire crewmember (RXCM).
- Hold ATV/UTV operator certification following agency requirements.

Instructors shall:

- Hold the position of single resource boss.
- Hold ATV/UTV operator certification following agency requirements.
- Demonstrate proficiency with an ATV/UTV torch.

Minimum Training

Operators shall:

- Read and understand the information in this chapter.
- Read the ATV/UTV torch manufacturer’s operating instructions.
- Receive operational training from an instructor.
- Receive agency specific ATV/UTV torch training.
- Receive other training that supports development of knowledge and skills, including S-290 (intermediate wildland fire behavior) and S-234 (ignition operations).

Instructors shall:

- Demonstrate proficiency with an ATV/UTV torch.

Position Responsibilities

Torch operators shall:

- Prepare, install, operate, maintain, and clean the torch and ATV/UTV.
- Coordinate ignition actions closely with other fire personnel.
- In coordination with the supervisor, verify that desired ignition tactics are being used and are effective, adjusting ignition patterns as required.
- Recognize malfunctions and act accordingly.
- Make sure the torch is correctly installed, the vehicle’s weight limit is not exceeded, and the vehicle remains properly balanced.



Inspecting ATV/UTV Torches and Mixing Fuel

Before torches are used, the equipment must be inspected and readied for the field.

Torch Inspections

Inspect the following (figures 2-5 through 2-9):

- Valves for leaks and damage.
- Filters for damage from dirt and debris.
- Hose and fitting connections for leaks.
- Fuel lines for cracking, cuts, leaks, and other damage.
- Switches for damage.
- Straps, buckles, or other fasteners, making sure the torch is securely fastened to the ATV/UTV.
- Fuel tank for leaks.
- Pump for leaks, clogs, or damage (see figure 2-6).

- Nozzle for damage, clogs, or missing parts.
- Igniter system for shorts or wiring damage.
- Tank cap for cross threading or damaged seals (see figure 2-7).
- Tank vent for damage (see figure 2-8).
- Wick snuffer (if equipped) for breakage.
- Electrical fuses for proper size.
- Pump wiring and connections (if equipped) for damage.
- The quick release mechanism on the torch's base plate, making sure that it is installed properly and not damaged (see figure 2-9).

Replace or repair any damaged parts of the torch before using it.

ATV/UTV Torches

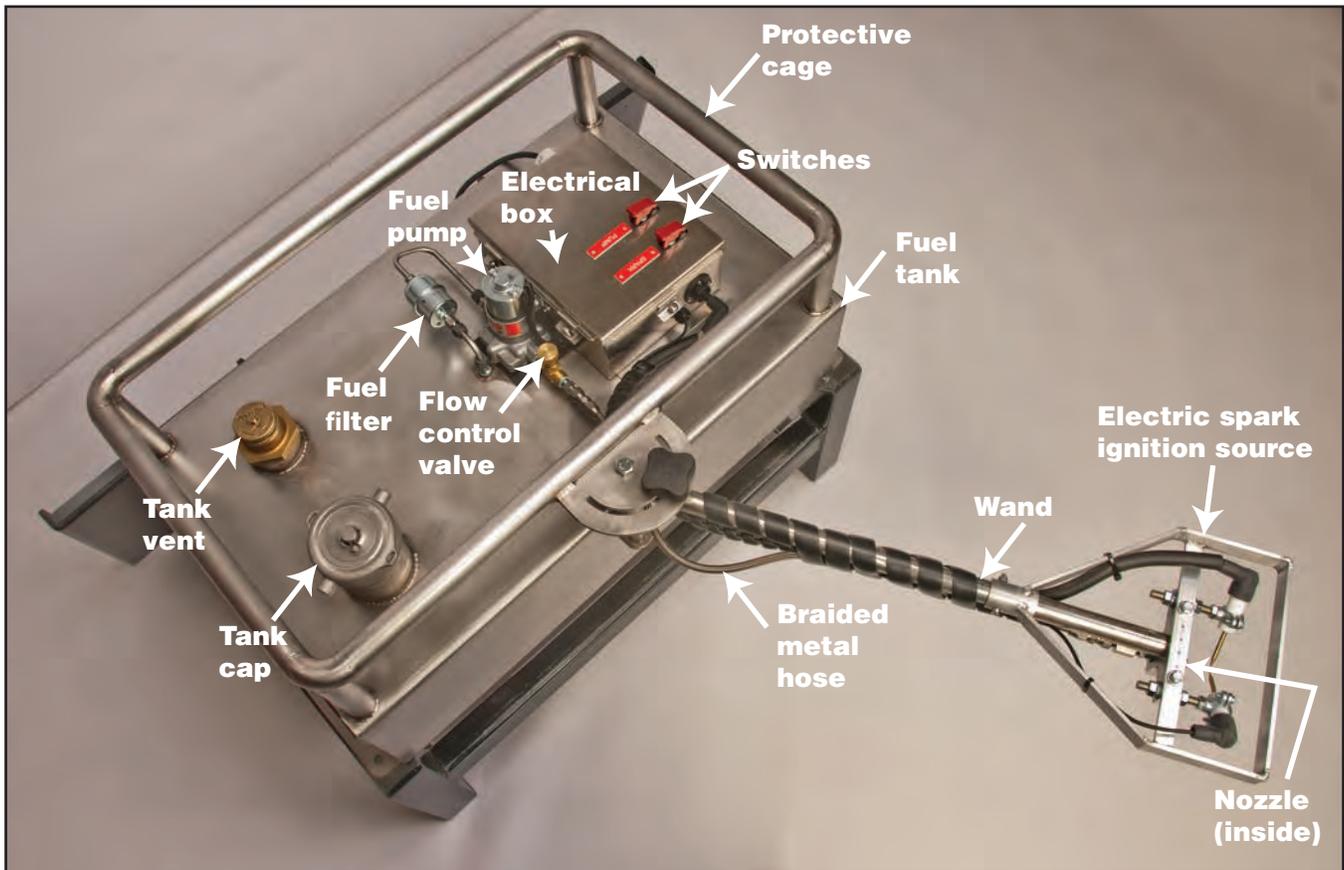


Figure 2-5—An example of ATV/UTV torch parts that must be inspected before use. Specific components may vary by model.



Figure 2-6—Inspect the fuel pump for obvious damage and listen for correct operation.

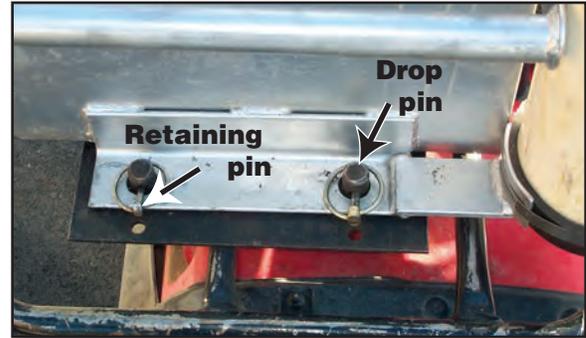


Figure 2-9—Many torches have a pinned quick release mechanism. Pull the retaining pin to allow the drop pin to fall, releasing the torch from the ATV/UTV.



Figure 2-7—A fusible cap for a fuel tank. If the tank catches fire, the cap will melt to prevent excessive pressure from building. Inspect the cap for cross-threading or damaged seals.



Figure 2-8—This two-way tank vent prevents pressure or vacuum from building up inside the tank. The vent has a flame arrester. Inspect the vent for external damage. Remove the vent to check for internal damage and clogging.

ATV/UTV Inspections

Inspect the ATV/UTV following agency policy. Before using the ATV, make sure that it is free of all combustible debris, such as needles, leaves, and grass.

Mixing ATV/UTV Torch Fuel

When mixing fuel:

- Wear proper PPE.
- Use only approved containers (safety cans, jerricans, and fuel tanks that meet DOT specifications).
- Ensure that the fuel containers are properly labeled.
- Select the proper fuel mixture ratio for the job. Refer to your agency's policy for authorized fuel mixtures. Mixtures other than those authorized by the agency require an additional hazard analysis (JHA) before use.
- Make sure that fuel containers are properly bonded while they are being filled to prevent static electricity from building up. Keeping the fuel nozzle in contact with the container provides electrical bonding.
- Do not fill fuel containers or mix fuel in the bed of a vehicle.
- Mix fuel only in well-ventilated areas.
- Make sure that fuel is thoroughly mixed before using it in an ATV/UTV torch.



Normal Operating Procedures for ATV/UTV Torches

Rollovers are serious risks for ATV and UTV operators. Mounting a torch raises the vehicle's center of gravity and increases its overall weight, making the vehicle less responsive to the operator. Exposure to flammable liquids and their fumes are also hazards.

Follow these procedures when using ATV/UTV torches.

Preparing the Torch for Use

- Properly install the torch on the rear cargo rack of the ATV/UTV following the manufacturer's recommendations (if available).
- Verify that the weight of the torch and other accessories do not exceed the capacity of the ATV/UTV or make it unbalanced.
- Make sure the torch is securely fastened to the ATV/UTV.
- Connect electrical power to the torch if applicable.

Transporting the ATV/UTV

- Transport the ATV/UTV following agency requirements.

Transporting the Torch

- Transport the empty torch to the staging area.
- Make sure that the wand is secured and not protruding beyond the edge of the vehicle that is carrying it. The wand may be removed while the torch is being transported.

Fueling or Refueling the Torch

- Turn off the ATV/UTV and allow the vehicle to cool. Otherwise, the vehicle's hot exhaust system could ignite the torch prematurely.
- Close all torch valves.
- Make sure that the wick is completely extinguished and cooled.
- Do not allow smoking or open flame within 25 feet of the torch.
- Do not completely fill the torch fuel tank. Instead, fill the tank to about 90 percent of capacity, and replace the tank cap.
- Wipe up any fuel that might have spilled on the tank or the ATV/UTV.
- Complete inspections.

Using the Torch

To operate the torch, consult the manufacturer's instructions; some models have an instruction placard and labels showing each of the torch's valves.

- Open all valves.
- Adjust the valves for the desired flow of fuel.
- Light the wick or initiate the ignition system when ready to begin active burning.
- Operate the ATV/UTV safely. Make adjustments to the torch valves as necessary.
- If the operator is not familiar with the area being burned, the operator should scout the area before firing.
- In thick fuels, the operator should ride into an area, and fire only on the way out.
- In hazardous situations, such as when burning thick fuels or swampy savannahs, two ATVs/UTVs should be used together; one to do the firing and the other to serve as a lookout.
- Be aware of burning fuel that may continue dripping from the torch when the ATV/UTV is stopped.



Emergency Operating Procedures for ATV/UTV Torches

ATV/UTV operators need to know what to do in the following situations:

- Stuck, stalled, or rolled ATV/UTV
 - » Stop igniting vegetation.
 - » Extinguish the wick.
 - » Extinguish any fires near the machine using the water tank or a handtool.
 - » Notify others of your situation.
 - » Request help.
- Torch catches fire
 - » Stop ignition:
 1. If practical, try to extinguish the burning torch.
 2. If 1 is not practical, jettison the torch and drive away.
 3. If 1 and 2 are not practical, abandon the burning ATV/UTV and torch. Move a safe distance away.
 - » Notify others of your situation.
 - » Request help.

Caution

If the torch catches fire, do not jeopardize your safety to save the torch or the vehicle!

ATV/UTV Torches

Troubleshooting

Torch Does Not Dispense Fuel

Make sure the electrical system is connected.
 Check for a broken wire or blown fuse.
 Check the pump for defects.
 Make sure the tank vent is not plugged.
 Check for obstructions in hoses, piping, or tubing.
 Check the nitrogen pressure (for pressurized systems)—the pressure may be too low.

Torch is Difficult to Keep Ignited

Make sure the wick, propane torch, and igniter electrodes are adjusted properly.
 Make sure the propane bottle is not empty (propane ignition systems only).
 Check the vibrator or coil for problems (electronic ignition systems only).
 Check the fuel mixture—it may have too much diesel.

Fuel Burns Up Before Reaching Vegetation

Check the fuel mixture—it may have too much gasoline.

9



Maintenance and Storage

Follow these procedures to make sure that ATV/UTV torches will be ready for their next use.

Cleaning and Repair

- Following an inspection checklist, repair or replace damaged or broken equipment. Equipment that can not be readily repaired should have a tag attached that identifies the problem.
- Remove any residual fuel from the tank. Store or dispose of residual fuel following agency policy.
- Close valves and remove lines from the pressure tanks of pressurized systems.
- To minimize the risk of mechanical failure when firing, have a certified ATV/UTV mechanic inspect the ATVs/UTVs used for torch operations every 6 months or more frequently if the ATV/UTV is used heavily.

Storing the Torch

- Store the torch in a secured facility out of the weather.
- Do not stack anything on top of the torch.

Storing ATV/UTV Torch Fuel

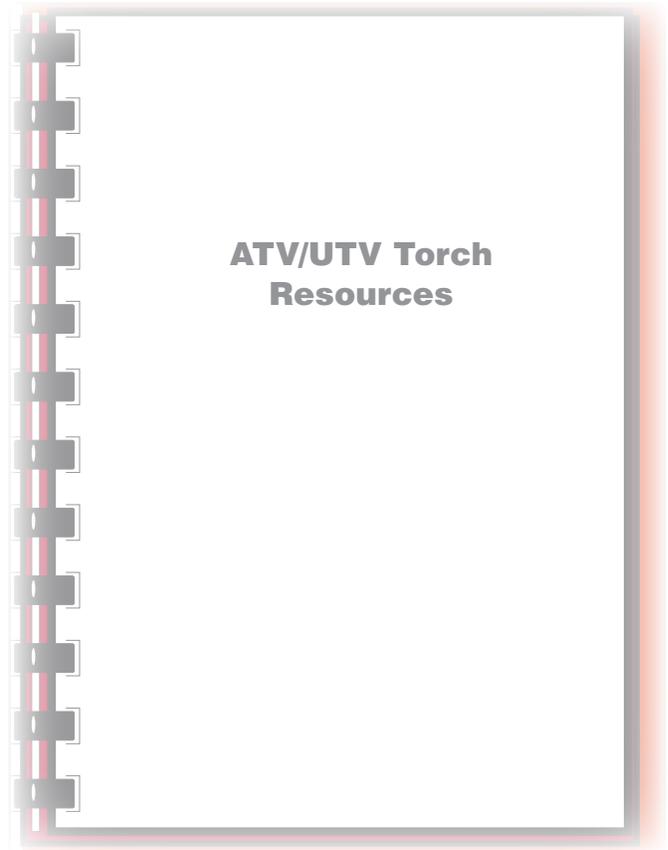
- Store torch fuel following agency policy.
- For further guidance on fuel storage, consult your agency policy, your local hazardous materials coordinator, and the “Everyday Hazmat User’s Training Guide.”



ATV/UTV Torch Resources

This section includes the following resources:

- Information for inclusion in a hazard analysis
- List of required material safety data sheets
- Recommended spare parts
- Equipment standards for ATV/UTV torches
- Contract equipment inspection checklist
- ATV/UTV torch references



ATV/UTV Torches



Hazard Analysis

This information can be used when preparing a job hazard analysis (used by the Forest Service) or similar hazard analysis.

ATV/UTV Torches

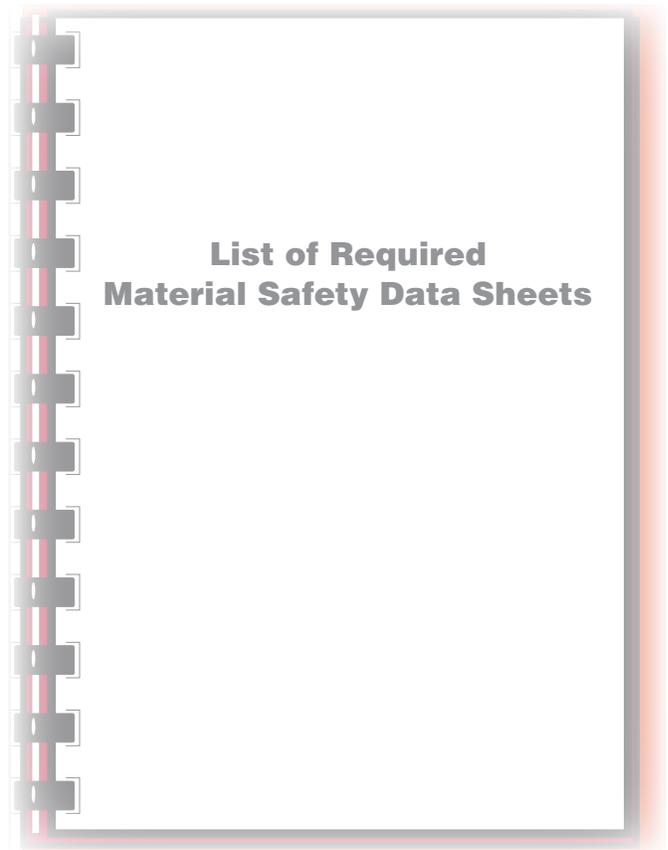
Information for ATV/UTV Torch Hazard Analyses		
Task	Hazards	Abatement actions
Fueling and servicing ATVs/UTVs	Burns from hot engine	Turn off the engine. Allow it to cool before servicing or refueling.
Traveling	Cuts and bruises from brush and limbs	Wear standard Nomex clothing and PPE during firing. Maintain all brush guards in working condition. Wear eye protection.
	Head injury from a fall or collision	Wear head protection following agency policy for ATV/UTV use.
	Collision or falling from ATVs/UTVs	Make sure all operators are trained and experienced. Provide an ATV/UTV Safety Institute standard rider course for all new riders. Maintain safe speeds. Use only low gears when operating ATVs/UTVs off established roads and trails.
	High noise levels	Provide hearing protection.
	Overturning	Follow manufacturers' recommendations for sidehill operations. If more than 40 pounds is carried on the back of a four-wheel ATV/UTV, a counterweight must be carried on the front cargo rack. The counterweight must be securely strapped down or permanently mounted.
	Speed	Limit cross-country speed to 5 mph.
	ATV/UTV knocked into gear when dismounting	Apply the parking brake and turn off the ATV/UTV engine before dismounting.
Firing Operations	Vehicle and operator exposed to fire during operations	Mount a fire extinguisher (minimum rating of 10-B:C) on each ATV/UTV. The fire extinguisher shall be readily accessible and not mounted to the torch. If required by unit policy, ATVs/UTVs used for firing must have at least a 5-gallon water tank with an electric pump mounted on the vehicle. The preferred location is the front cargo rack. Scout the area before firing. Identify escape routes and safety zones. Use two ATVs/UTVs together; one to do the firing and the other to serve as a lookout. Carry a handtool, such as a combi or shovel, on all ATVs/UTVs used for firing. PPE must be worn during firing.
	ATV/UTV stuck in the burn area	Contact your supervisor immediately on the radio. Shut off torch fuel and extinguish the torch. Identify which of your escape routes and safety zones is closest. Time permitting, try to free the ATV/UTV. Clear vegetation around the ATV/UTV if time permits. Use the water tank to put out fire near the ATV/UTV, if possible. Do not jeopardize your safety to save the torch or the ATV/UTV.
Transporting the ATV/UTV	Damage to the ATV/UTV	Transport ATVs/UTVs following agency policy.



List of Required Material Safety Data Sheets

Material safety data sheets for all ground ignition systems are in appendix A. The material safety data sheets for ATV/UTV torches include:

- Diesel
- Gasoline
- Nitrogen (BLM torch)
- Propane



ATV/UTV Torches



Recommended Spare Parts

- Fuel pump
- Fuel filters
- Fuel line assemblies
- Fuses
- Electrical tape
- Extra wiring
- Extra wicks
- Extra wand
- Fuel caps
- Pressure relief valve (if equipped)
- Spare gas cylinders (pressurized torches only)

Equipment Standards for ATV/UTV Torches

All components must be compatible with diesel and gasoline.

Fuel Tank

- The fuel tank must be made of metal.
- For ATVs, the fuel tank capacity shall not be more than 10 gallons unless approved by a line officer.
- The fuel tank must be vented to prevent pressure from building up and to allow the fuel pump to operate properly.

Hoses

- Must be compatible with gasoline and must have a braided metal cover.
- Must use swaged end fittings.

Fuel Pump

- The fuel pump and piping must be protected from damage in the event of a rollover.
- The fuel pump must be designed for use with gasoline and diesel.
- If the fuel pump or wand is gravity fed, a manually operated shutoff valve must be installed on the tank or the fuel line and the valve must be protected so it cannot be torn loose during operation. Pumps that draw fuel from the top of the tank do not require a tank shutoff valve.

Electrical System

- Wiring must be free of splices.
- An inline fuse must be installed as close to the ATV/UTV battery as possible.
- The minimum fuse size should be determined by multiplying the total electrical load required by all of the torch's electrical equipment by 1.5.
- All wiring shall be installed in an abrasion-resistant covering for protection.
- All electrical connections shall be sealed with silicone sealant or shrink tubing to prevent sparking except for the quick disconnect used to allow the torch to be removed from the ATV/UTV.
- Solenoids (if used) must be explosion-proof.
- The torch's electrical controls shall be located up front within easy sight and reach of the operator.
- The torch shall be equipped with a quick release mechanism to allow the torch to be quickly removed from the ATV/UTV in an emergency (see figure 2-9).

ATV/UTV

- Requirements
 - » Cargo capacity adequate to carry torch, water/foam unit, and other equipment (see manufacturer's specifications)
 - » Rack capacity adequate (see manufacturer's specifications)
 - » Liquid engine cooling system or auxiliary fan if engine is air cooled
 - » Roll protection on UTV
 - » Seat belts on UTV
- Recommendations
 - » All-wheel drive
 - » Engine size: 300 cubic centimeters or larger
 - » Heavy-duty or puncture-resistant tires
 - » Skid plates
 - » Brush guards
 - » Running boards



Contract Equipment Inspection Checklist

- The fuel tank is metal.
- For ATV only: the maximum tank capacity is 10 gallons unless approved by a line officer.
- The fuel tank is vented to prevent pressure buildup and to allow the fuel pump to operate properly.
- The fuel pump and piping are protected from rollover damage.
- If the fuel pump or burner is gravity fed, a manually-operated shutoff valve is installed on the tank or the fuel line is adequately guarded so it cannot be torn loose during operation. Pumps that obtain suction from the top of the tank do not require a tank shutoff valve.
- All components are compatible with diesel and gasoline.
- All hoses have a braided metal cover and swaged end fittings.
- The wiring is free of splices.
- An inline fuse is installed as close to ATV/UTV battery as possible.
- The fuse size is at least 1.5 times the total electrical load required by all the torch's equipment.
- All wiring has an abrasion-resistant cover for protection.
- All electrical connections except the quick disconnect used to allow removal of the torch from the ATV/UTV are sealed with silicone sealant or shrink tubing to prevent sparking.
- Solenoids (if used) must be explosion proof.
- The torch's electrical controls are located within easy sight and reach of the operator.
- The torch is equipped with a quick-release mechanism for emergencies.

ATV/UTV Torch References

See appendix B for additional ground ignition references.

Interagency Transportation Guide for Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel, PMS 442, available at <<http://www.nwccg.gov/>>.

Everyday Hazmat User's Training Guide, 0471-2810-MTDC, available at <http://www.fs.fed.us/eng/everyday_hazmat/users_guide.htm>.



Notes

ATV/UTV Torches



Equipment Description

A drip torch is a ground ignition device that has a fuel tank, a spout (also known as a burner), and an igniter with a wick. The drip torch tank is filled with a mixture of gasoline and diesel. The wick is ignited and drip torch fuel is poured out of the tank, through the spout, and past the burning wick. The burning wick ignites the drip torch fuel, which starts the fire (figure 3-1).



Figure 3-1—A firefighter using a drip torch.

The two most common types of drip torches—the standard drip torch and the Panama torch (figures 3-2 and 3-3)—will be discussed in this chapter. The standard drip torch, available from the General Services Administration (GSA), has an aluminum tank and a spout about 12 inches long that can be stored inside the tank for transport and storage. The Panama torch has a stainless steel tank and a spout that may be 12, 15, or 19 inches long (figure 3-4). The spout must be removed from a Panama torch before it can be transported with fuel.



Figure 3-2—A Panama drip torch with a 19-inch spout installed and a standard drip torch, both configured for use.



Figure 3-3—A Panama drip torch and a standard drip torch, both configured for transport and storage.

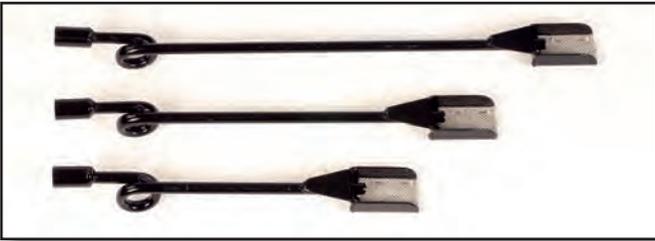


Figure 3-4—The spouts of Panama drip torches may be 12, 15, or 19 inches long.

Situations Favorable for Drip Torch Use

A drip torch may work well when:

- Burning in areas with limited access
- Broadcast burning small areas
- Burning out along control lines

Safety Requirements

Hazard analysis information for drip torch operations is provided in the “Drip Torch Resources” section at the end of this chapter. Prepare and review your hazard analysis document before beginning work.

Required Personal Protective Equipment (PPE)

- Hardhat
- Flame-resistant pants
- Flame-resistant shirt
- Leather gloves
- Approved boots
- Eye protection

Sources of Equipment That Meet Specifications

- Existing nonspecification torches may be used until 2019 or until they are unserviceable.
- New drip torches are available from GSA (NSN 4210-01-558-9951) and from the National Fire Equipment System (NFES 000241) catalog. Drip torches purchased elsewhere must meet Forest Service specification 5100-614 or 5100-616. These specifications are included in the “Drip Torch Resources” section at the end of this chapter.

Drip Torches

Advantages and Disadvantages of Using Drip Torches	
Advantages of using drip torches	Disadvantages of using drip torches
Inexpensive, easy-to-use, portable	Expose the operator to the flammable gasoline/diesel mixture
Suitable for terrain where other ground ignition equipment cannot be used	Require a larger crew working longer to complete a burn (increasing the exposure to hazards during burning) when compared to other forms of ground ignition
Require little setup time	Can become tiring to carry
Effective in most fuel types	



Transporting Drip Torch Fuel

- Use approved containers—safety cans, jerricans, drip torches, and fuel tanks that meet the U.S. Department of Transportation (DOT) specifications (figure 3–5).
- Avoid transporting fuel on public highways in drip torches that do not meet DOT specifications.
- Ensure that all fuel containers are properly secured during transportation.
- Avoid transporting more than 440 pounds of hazardous materials, including drip torch fuel, in one vehicle—all containers must be smaller than 8 gallons.



Figure 3–5—Drip torches that meet DOT specifications will be marked with the UN symbol followed by a number and letter combination such as 1B1 or 3B1.

If you are transporting more than 440 pounds of drip torch fuel, other hazardous materials, or if any fuel container is larger than 8 gallons, DOT hazardous materials training is required. In addition, you must carry shipping papers and a copy of the “Emergency Response Guidebook” in the vehicle.

If you are transporting 1,001 pounds or more of drip torch fuel or if any container is larger than 119 gallons, the driver must have a commercial driver’s license (CDL) with a hazardous materials endorsement in addition to DOT hazardous materials training. The vehicle must be placarded.

For more information on transporting fuel, see the “Interagency Transportation Guide for Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel.”

Qualifications

To be qualified to use a drip torch for incident or project work, individuals must meet prerequisites and training requirements.

Prerequisites

Operators shall:

- Hold the position of Type 2 firefighter (FFT2) or prescribed fire crewmember (RXCM).

Instructors shall:

- Hold the position of FFT2 or RXCM.
- Demonstrate proficiency with a drip torch.

Minimum Training

Operators shall:

- Read and understand the information in this chapter.
- Read the drip torch manufacturer’s operating instructions.
- Receive operational training from an instructor.

Instructors shall:

- Demonstrate proficiency with a drip torch.



Inspecting Drip Torches and Mixing Fuel

Before drip torches are used, the equipment must be inspected and readied for the field.

Inspections

Inspect the following:

- Tank and tank cover for damage and leaks.
- Handle for breakage.
- Tank cover seal for damage and leaks (figure 3-6).
- Breather valve and discharge plug O-rings for damage and leaks (figure 3-7).
- Breather valve tube for damage and proper installation (figure 3-8).
- Fuel spout and nozzle for damage.
- Lock ring for damage.
- Check valve and screen for damage or missing parts (figures 3-9 and 3-10).
- Wick assembly for proper installation and damage.

Repair or replace any damaged or missing parts before use. Do not use a drip torch that leaks. Do not interchange parts between drip torches that meet the DOT specification and those that do not.

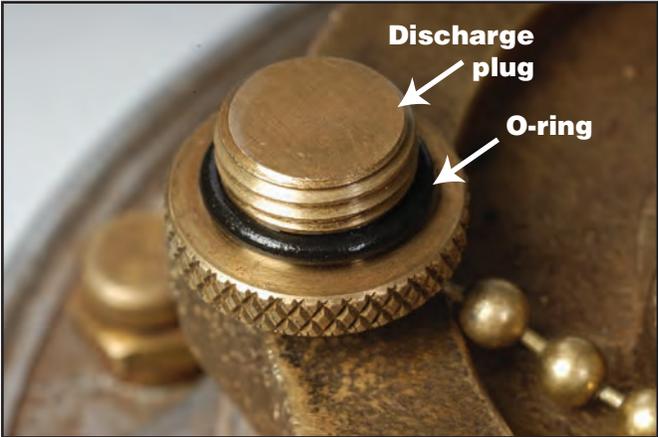


Figure 3-7—Inspect the discharge plug O-ring for damage.

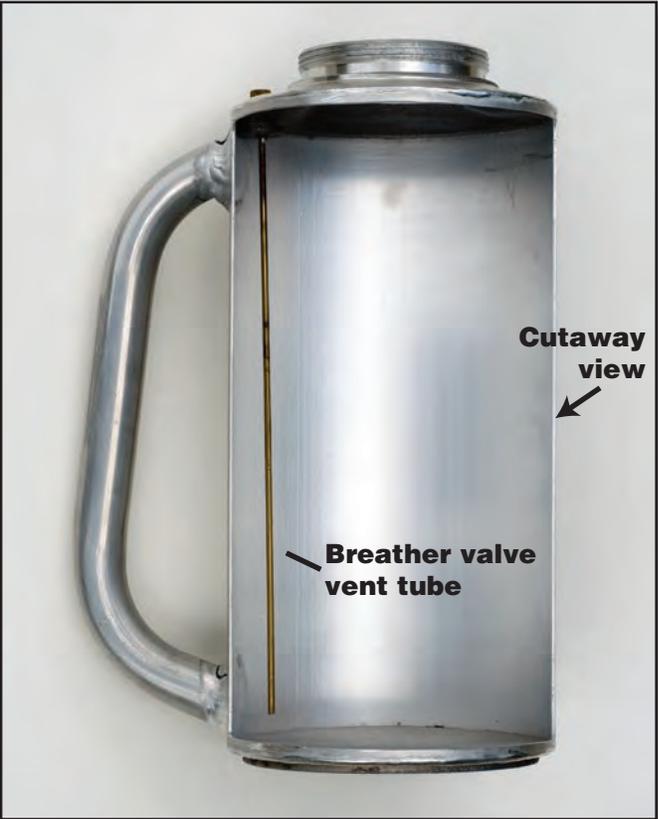


Figure 3-8—Remove the tank cover so you can look inside the tank to verify that the breather valve vent tube is installed and that it has not been damaged. If the vent tube is missing, fuel can pour out of the breather valve and catch fire when the torch is used.



Figure 3-6—Inspect the tank cover seal for damage.

Drip Torches



Figure 3-9 —Verify that the check valve is installed and undamaged.

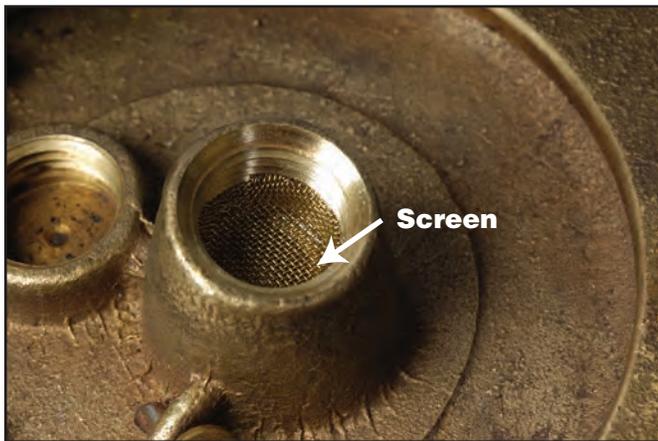


Figure 3-10—Make sure the check valve screen is installed and undamaged.

Mixing Fuel

When mixing fuel:

- Wear proper PPE.
- Use only approved containers (safety cans, jerricans, and drip torches and fuel tanks that meet DOT specifications).
- Ensure that the fuel containers are properly labeled.
- Select the proper fuel mixture for the job. See your agency's policy for authorized fuel mixtures. Mixtures other than those authorized by the agency require an additional hazard analysis, such as a job hazard analysis, before use.
- Ensure fuel containers are properly bonded while they are being filled (keep the fuel nozzle in contact with the container, figure 3-11).
- Do not fill fuel containers or mix fuel in the bed of a vehicle. Drip torches should be placed in a spill containment barrier before filling.
- Mix fuel only in well-ventilated areas.
- Ensure that the fuel is thoroughly mixed before using it in a drip torch.



Figure 3-11—Make sure that the pump or fuel container nozzle contacts the tank when filling a drip torch. Contact ensures electrical bonding, preventing static electricity from building up.



Normal Operating Procedures for Standard and Panama Drip Torches

Follow these procedures when using a standard or Panama drip torch.

Standard Drip Torch

The operator must wear proper PPE.

Preparing the Torch for Use

- Remove the plug from the tank cover and screw it into the threaded plug holder (figure 3-12).
- Unscrew the lock ring from the fuel tank (figure 3-13).
- Remove the tank cover from the tank (figure 3-14).
- If the fuel tank is empty, fill the tank with fuel. Leave at least 1 inch of the tank unfilled, so the fuel has room to expand. The torch should be filled on the ground at least 25 feet from any open flame. Clean spilled fuel from the outside of the tank.
- Install the tank cover with wick and fuel nozzle extended (figure 3-15).
- Install the lock ring on the fuel tank and hand tighten the lock ring to ensure that the tank does not leak; do not overtighten the lock ring (figure 3-16).
- Open the breather valve to allow fuel to flow (figure 3-17).



Figure 3-13—Remove the lock ring from the fuel tank.



Figure 3-14—Remove the tank cover from the tank.



Figure 3-12—Screw the discharge plug into the threaded plug holder.

Drip Torches



Figure 3-15—Install the tank cover with the spout ready for use.



Figure 3-16—Tighten the lock ring.

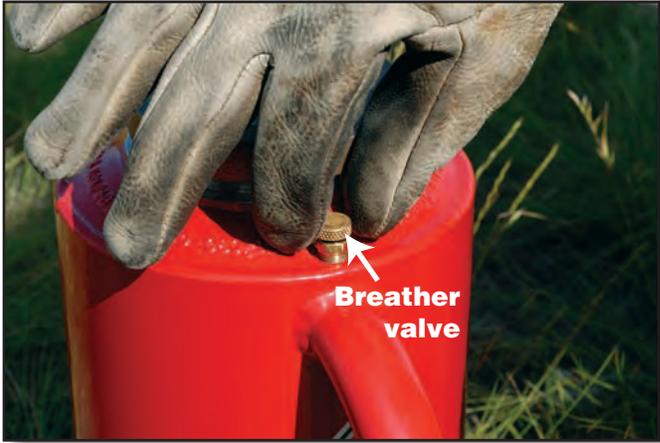


Figure 3-17—Open the breather valve.

Drip Torches



Igniting the Torch

- Hold the torch with the nozzle pointed down and allow a small amount of fuel to flow to the wick.
- Verify that fuel is not leaking from the tank cover seal.
- Tip the torch back so fuel stops flowing.
- Light the fuel on the wick with a match, lighter, another drip torch, or ground fire.

Using the Torch

- Carry the torch with the nozzle pointing up so fuel is not flowing from the nozzle when you are walking from one area that is being burned to another. If you are carrying a torch for long distances in areas that are not being burned, extinguish the wick.
- When igniting vegetation, make sure that the drip torch's nozzle is not pointed at you. Tilt the nozzle down so the burning wick ignites the fuel stream.
- Adjust the opening of the breather valve as necessary to control the flow of fuel from the nozzle.

Extinguishing the Wick

- Allow the wick to burn out on its own. For your own safety, do not blow out the wick or use a glove to extinguish it.

Refueling

- Before refueling the torch, extinguish the wick and allow it to cool.
- Ensure that the drip torch is at least 25 feet away from any open flame before removing the lock ring and tank cover.
- Place the drip torch on the ground; do not refuel the torch in the back of a vehicle.
- Refuel the torch from an approved fuel container. When dispensing fuel into the torch, ensure that the fuel container's spout is touching the torch to prevent static electricity from building up.
- Wipe spilled fuel from the outside of the torch.
- Use a spill containment barrier when fueling drip torches.

Preparing the Torch for Transportation and Storage

- Make sure the wick is extinguished and has cooled.
- Remove the lock ring and tank cover.
- Invert the tank cover and install the cover so the fuel spout and wick assembly is stowed inside the fuel tank (figure 3–18).
- Install the lock ring and hand tighten.
- Unscrew the discharge plug from the plug holder and screw it into the fuel spout opening (figure 3–19). Hand tighten the plug to prevent the plug from leaking.
- Close the breather valve (figure 3–20).
- Secure drip torches to keep them from moving while they are being transported in a vehicle.



Figure 3-18—Install the tank cover with the fuel spout and wick assembly stowed inside the tank.



Figure 3-19—The discharge plug installed in the fuel spout opening.



Figure 3-20—The breather valve in the closed position.

Drip Torches



Panama Drip Torch

The operator must wear proper PPE.

Preparing the Torch for Use

- Install the discharge spout on the regulating valve (figure 3–21).
- If the fuel tank is empty, remove the filler cap from the tank and fill the tank with fuel. Leave at least 1 inch of the tank unfilled so the fuel has room to expand. The torch should be filled on the ground at least 25 feet from any open flame. Clean any spilled fuel from the outside of the tank.
- Hand tighten the filler cap to ensure that it does not leak. Do not overtighten.
- Open the vent valve (figure 3–22).
- Open the regulating valve to allow fuel to flow (figure 3–23).



Figure 3–22—Open the vent valve of a Panama torch before use.



Figure 3–23—Adjust the regulating valve to control the flow of fuel.

Drip Torches

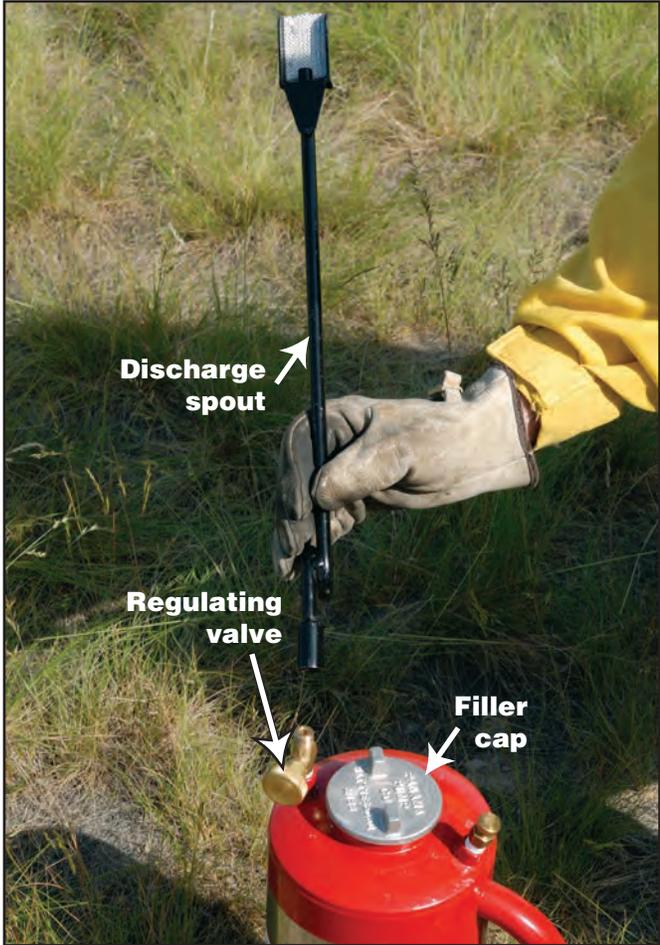


Figure 3–21—Install the spout on the regulating valve of a Panama torch.



Igniting the Torch

- Hold the torch with the burner pointed down and allow a small amount of fuel to flow to the wick.
- Verify that fuel is not leaking from the filler cap seal.
- Tip the torch back to stop the fuel from flowing.
- Light the fuel on the wick with a match, lighter, another drip torch, or ground fire.

Using the Torch

- Carry the torch with burner pointed up so fuel does not flow from the nozzle when you are walking from one area that is being burned to another. If you are carrying the torch for long distances in areas that are not being burned, extinguish the wick.
- When igniting vegetation, make sure that the burner is not pointed at you. Tilt the burner down so the burning wick ignites the fuel stream.
- Adjust the opening of the regulating valve to control the flow of fuel from the nozzle.

Extinguishing the Wick

- Allow the wick to burn out on its own. Do not blow the wick out or use a glove to extinguish the wick.

Refueling

- Before refueling the torch, let the wick burn out and allow it to cool. Ensure that the drip torch is at least 25 feet away from any open flame before removing the filler cap.
- Place the drip torch on the ground; do not refuel the torch in the back of a vehicle.
- Refuel the torch from an approved container. When dispensing fuel into the torch, ensure that the spout or nozzle of the fuel container is touching the torch to prevent static electricity from building up.
- Wipe spilled fuel from the outside of the torch.
- Use a spill containment barrier when fueling drip torches.

Preparing the Torch for Transportation and Storage

- Extinguish the wick and allow it to cool.
- Close the regulating and vent valves.
- Remove the discharge spout from the regulating valve.
- Ensure that the filler cap is tight and does not leak.
- Secure drip torches to keep them from moving when they are being transported.

Troubleshooting	Fuel Does Not Pour From Torch
	Make sure that you have removed the discharge closure plug. Check for an obstruction in the fuel spout. Make sure that the breather valve is open and unobstructed.
	Torch Is Difficult To Ignite
	Make sure that the wick is saturated with fuel. Check the wick. It may need replacing. Check the fuel mixture—it may have too much diesel.
	Fuel Burns Up Before Reaching the Vegetation
Check the fuel mixture—it may have too much gasoline.	
Tank Cover Leaks	
Make sure that the lock ring is tight. Make sure that the cover seal is not missing, damaged, or defective.	



Emergency Operating Procedures for Standard and Panama Drip Torches

Drip-torch operators need to know what to do in the following situations:

- Torch catches fire
 - » If a torch catches fire, toss the torch into the burn area, move a safe distance away, and let the torch burn itself out.
- Major fuel spill (more than 5 gallons)
 - » Report the spill to your local environmental coordinator and follow your agency’s procedures for containment and cleanup.

Maintenance and Storage

Follow these procedures to make sure that drip torches will be ready for their next use.

Cleaning and Repair

- Note any leakage
- Clean the drip torch as recommended by the manufacturer
- Tag damaged parts
- Replace any defective seals or other damaged parts

Storing the Torch and Fuel

- Fuel should be stored only in drip torches that meet DOT specifications.
- All standard drip torches, whether full or empty, should be stored with the:
 - » Fuel spout and wick assembly stowed inside the fuel tank (does not apply to the Panama torch)
 - » Lock ring hand tightened
 - » Closure plug installed and hand tightened (figure 3–24)
 - » Breather valve closed

Drip torch fuel shall be stored in metal containers that meet OSHA requirements.

For further guidance on fuel storage, consult your agency policy, your local hazardous materials coordinator, and the “Everyday Hazmat User’s Training Guide.”



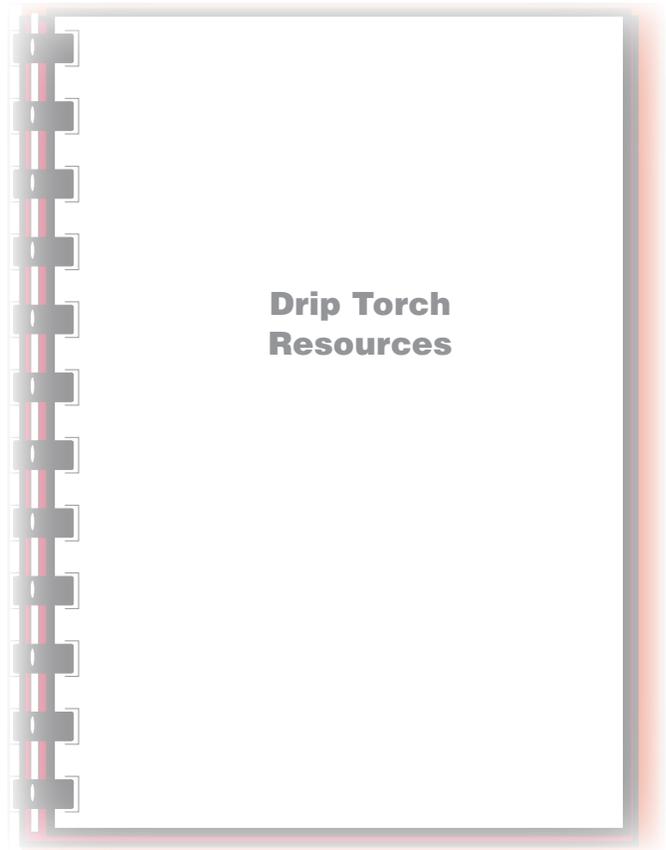
Figure 3–24—A standard drip torch ready for transport or storage with the fuel spout stowed inside the tank, the lock ring tightened, the closure plug installed in the fuel spout opening and the breather valve closed.



Drip Torch Resources

This section includes the following resources:

- Information for inclusion in a hazard analysis
- List of required material safety data sheets
- Recommended spare parts
- Cache refurbishment standards
- Equipment specifications for drip torches
- Contract equipment inspection checklist



Drip Torches



Hazard Analysis

This information can be used when preparing a job hazard analysis (used by the Forest Service) or similar hazard analysis.

Information for Drip-Torch Hazard Analyses		
Task	Hazards	Abatement actions
Mixing fuel	Harmful vapors	Mix in well-ventilated area. Use an organic vapor respirator in confined or unventilated locations.
	Fire/burns	Keep ignition sources at least 25 feet away from the mixing area. Use no more gasoline than necessary in the fuel mixture.
Filling the torch	Harmful vapors	Fill in well-ventilated area.
	Fire/burns	Keep ignition sources at least 25 feet away from the fueling area. Let the wick cool before removing the tank cover. Do not add fuel to the torch unless the torch is on the ground. Do not overfill the tank. Wipe any spilled fuel from the outside of the tank. Make sure the tank cover is tight.
Using the torch	Leg/ankle injuries	Watch out for holes, limbs, and other tripping hazards while walking.
	Fire/burns	Ensure that the fuel is thoroughly mixed to prevent flaring. Keep the spout and the burning wick away from your body. Be alert in case the torch flares, which is an indication that the fuel is not mixed properly.

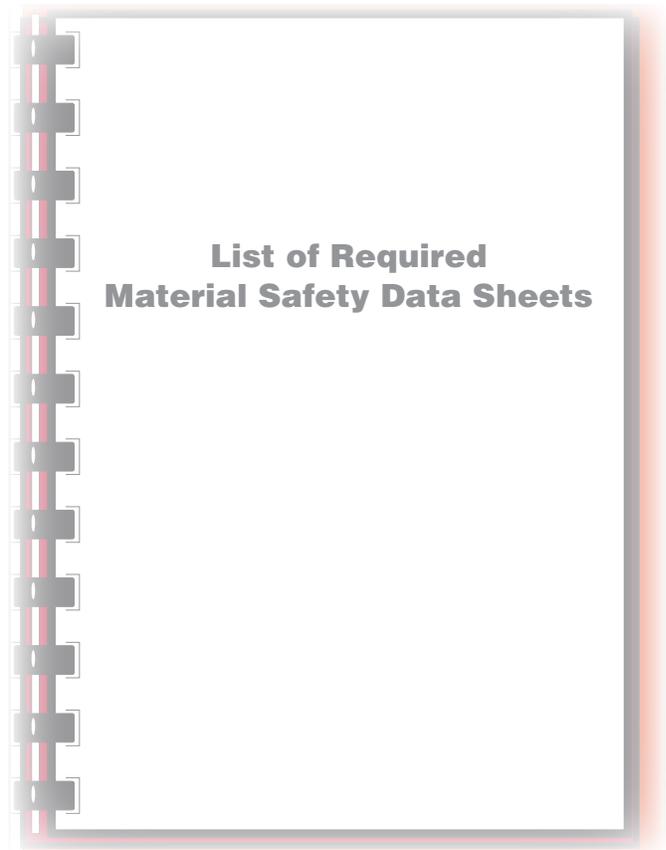
Drip Torches



List of Required Material Safety Data Sheets

Material safety data sheets for all ground ignition systems are in appendix A. The material safety data sheets for drip torches include:

- Diesel
- Gasoline

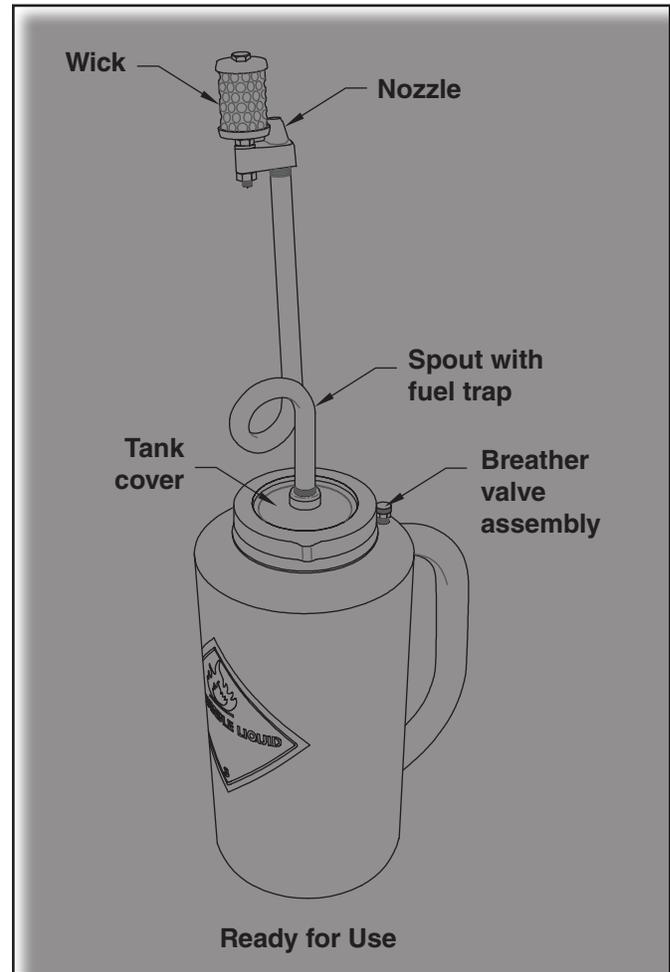


Drip Torches



Recommended Spare Parts

- Fuel tank cover gaskets
- Closure plug O-rings
- Wick assemblies
- Lock rings
- Check valve assemblies
- Check valve screens
- Breather valve assemblies
- Closure plugs
- Closure plug chain assemblies
- Spout with fuel trap
- Tank cover
- Nozzle
- Clamps for wick
- Wick clamp screws





Cache Refurbishment Standards

Fire Equipment Storage and Refurbishing Standards 1 49

ITEM: **TORCH**, drip, 1. GL (4.7L) capacity

NFES #000241

A. Initial Inspection/Disposal Criteria

1. Visually inspect tank for cracks, splits, and obvious damage that may cause tank to leak. Dispose of.
2. Lock ring will not seal due to thread damage, if so dispose of.
3. Air breather tube is not broken off or missing, if so replace.
4. Visually inspect for correct alignment of igniter, fuel trap, and fuel outlet.
5. Salvage usable component parts.

B. Tests

1. Fill drip torch with water inspect for leaks.
2. Place spout and ring on drip torch and remove discharge plug.
3. Turn drip torch with spout down, open vent, water should flow; close vent, water should stop.

✓ **CAUTION:** Remove any residual fuel before testing and dispose of according to local hazardous materials regulations.

C. Refurbishing Procedures

1. Steam clean or wash with mild degreaser soap, rinse with water, inspect for and remove any scab deposits inside tank.
2. Replace igniter if screen is ruptured, crushed, or tiller is burned out or carbonized. Some carbonization can be cleaned with wire brush.
3. Tighten screw that holds igniter and screen in place.
4. Ensure that alignment of igniter, fuel trap, and fuel outlet is correct (see figure 3).
5. Ensure that discharge plug and chain are attached to tank cover assembly.
6. Install discharge plug into the fuel outlet seat.
7. Thoroughly dry all components with clean rag and air hose.
8. There are several different manufacturers of drip torches. Do not mix the components as the drip torch will not function correctly or will leak.
9. Insert spout into tank and tighten lock ring.
10. Replace worn flammable liquid labels if damage.

D. Retesting Criteria—none

E. Cleaning Procedures

See C. Refurbishing Procedures.

F. Repackaging

Package 1 each in carton NFES 008189.

G. Storage and Shelf Life Checks—none



Cache Refurbishment Standards (continued)

H. Pictured (figures 1 & 2) are two DOT approved shipping containers.

1. Note the UN Markings and Flammable Liquid Label. Drip Torch cans without these markings and label may not be used to transport fuel.
2. The red can is the 'NEW' OSHA approved can for fuel dispensing.
3. Alignment of the igniter, fuel trap, and fuel outlet assembly.



Figure 1. UN Markings



Figure 2. Hazardous Material Label



Figure 3. Alignment of the igniter, fuel trap, and fuel outlet assembly

Discharge plug in transport position, fuel outlet is plugged.

Discharge plug in parked position, fuel outlet is open.

Drip Torches

—Adapted from PMS 448,
“Fire Equipment Storage and Refurbishing Standards,”
National Wildfire Coordinating Group, 2011.



Drip Torches

The drip torch on the right in each photo is a UN-approved shipping container. The drip torch on the left in each photo is a non-UN approved shipping container. —National Wildfire Coordinating Group, "Fire Equipment Storage and Refurbishing Standards" 2007.



Equipment Specifications for Drip Torches

Specification 5100–614A, DRIP TORCH (Diesel and Gasoline Mixture)

5100-614A
June 11, 2009

Supersedes
5100-614
January 10, 2008

**U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE**

SPECIFICATION

**DRIP TORCH
(Diesel and Gasoline Mixture)**

1. SCOPE

1.1 Scope. This document covers the minimum requirements for the design and construction of a drip torch used to ignite fires in vegetation with a mixture of diesel and gasoline.

2. APPLICABLE DOCUMENTS

2.1 Government documents. The following Government documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of solicitation.

U.S. DEPARTMENT OF TRANSPORTATION

49 CFR Parts 100-185

U.S. DEPARTMENT OF LABOR

29 CFR Part 1910

(The Code of Federal Regulations is for sale from the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20402-9325. Reprints of certain regulations may be obtained from the Federal agency responsible for issuing them. In addition to other sources for the Code of Federal Regulations (CFR), 49 CFR is available electronically at <http://hazmat.dot.gov> and 29 CFR is available electronically at <http://www.osha.gov>.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of the solicitation or request for proposals.

Beneficial comments (recommendations, additions, deletions) and any pertinent data that may be used in improving this document should be addressed to: USDA Forest Service, Missoula Technology and Development Center, 5785 Highway 10 West, Missoula, MT 59808, ddavis02@fs.fed.us.

FSC 4210



Equipment Specifications for Drip Torches (continued)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 1974 - Standard Practice for Methods of Closing, Sealing, and Reinforcing Fiberboard Shipping Containers
- D 3951 - Standard Practice for Commercial Packaging
- SI-10 - Standard For Use of the International System of Units (SI): The Modern Metric System (IEEE/ASTM Standard available from ASTM)

(Copies are available from ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.)

AMERICAN SOCIETY FOR QUALITY (ASQ)

- Z1.4 - Sampling Procedures and Tables for Inspection by Attributes

(Copies are available from the American Society for Quality, PO Box 3005, Milwaukee, WI 53201-3005, www.asq.org.)

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT

- National Motor Freight Classification

(Copies are available from the American Trucking Association, Inc., Traffic Department, 1616 P St. NW, Washington, DC 20036.)

(Non-Government standards and other publications normally are available from the organizations that prepare and distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. Unless otherwise specified the item shall be subjected to first article inspection (see 6.3) in accordance with 4.6. During the term of the contract the contractor shall be required to notify the contracting officer in writing when a component, or the component supplier, changes in any way; when a major manufacturing process changes in any way; and when a manufacturing location changes. The contracting officer may at any time require the contractor to submit a new first article sample when substantive changes occur during the term of the contract.

3.2 Design.

3.2.1 Diameter. The outside diameter of the drip torch tank, including the welds shall not be less than 5-³/₄" or exceed 6-¹/₄" to allow the drip torch to fit in drip torch holders designed for 6" diameter drip torches.



Equipment Specifications for Drip Torches (continued)

3.2.2 Capacity. The capacity of the drip torch shall be a minimum of 1-1/8 gallons and a maximum of 1-3/8 gallons.

3.2.3 Materials of construction. The drip torch shall be constructed of the following materials:

Tank and handle assembly:	Aluminum
Tank cover:	Aluminum, brass, or bronze
Tank lock ring:	Brass or bronze
Discharge plug:	Brass or bronze
Spout with fuel trap:	Steel
Breather valve assembly:	Brass or bronze
Nozzle:	Brass or bronze
Seals and o-rings:	Buna N or Viton

The materials for components not listed must be compatible with diesel/gasoline fuel mixtures.

3.2.4 Fuel spout/igniter assembly. The fuel spout/igniter assembly shall extend a minimum of 10 inches from the top of the tank to the end of nozzle, with the igniter extending beyond that in such a configuration that flame from the igniter will reliably ignite the fuel stream as it exits the nozzle. The maximum length of the spout/igniter assembly shall be such that the spout/igniter assembly can be stowed inside of the fuel tank when the torch is not in use.

3.2.5 Fuel mixture. The drip torch shall be capable of operating with diesel/gasoline fuel mixtures.

3.2.6 Stowage of fuel spout and igniter assembly. The torch shall be designed such that the fuel spout/igniter assembly can be stowed inside of the fuel tank when the torch is not in use.

3.2.7 Flashback protection. As a minimum each drip torch shall be equipped with a fuel trap in the spout and a check valve assembly and screen in the tank cover.

3.2.8 Breather valve assembly. Each drip torch shall be equipped with a breather valve assembly to provide smooth flow of fuel when the drip torch is in use. The breather valve assembly shall be capable of being closed to provide a leak-tight seal for storage or transportation. Each breather valve assembly shall be provided with an interior tube that extends from the valve to a location near the bottom of the tank. The tube shall be located so that it does not interfere with stowage of the fuel spout and igniter assembly. The head of the breather valve thumb screw shall be a minimum of 1/2 inch in diameter and located to allow easy opening and closing with a gloved hand.

Drip Torches





Equipment Specifications for Drip Torches (continued)

3.2.8.1 Interior tube attachment. The interior tube for the breather valve assembly shall be securely soldered into the valve assembly in such a manner that the soldered joint shall not leak air or fuel.

3.2.9 Handle. The handle shall be permanently attached to the tank and fabricated using tubing with a minimum diameter of $\frac{3}{4}$ inch and a maximum diameter of 1-1/8 inch. The handle shall be designed to provide a minimum of 2 inches clearance between the inside of the handle and the outside of the fuel tank to allow the torch to be used with a gloved hand. The length of the clearance space between the inside of the handle and the outside of the tank shall be at least 8 inches. The handle must have a straight section at least 5" in length. The straight section may be at an angle to the outside of the tank to aid in holding the drip torch in the spout down position during use. When the handle is manufactured from bended tubing, intrusion into the space between the inside of the handle and the outside of the tank by the radius of the bends is acceptable.

3.2.10 Leak Tightness. All closures such as the tank cover, discharge plug, and breather valve shall provide a leak-tight seal when hand tightened. Closures shall be designed such that the closure seal or o-ring cannot be displaced from its sealing surface during hand tightening of the closure.

3.2.11 Markings. The drip torch shall be legibly and permanently marked with the manufacturer's name, catalog or model number, and the month and year of manufacture. These markings may be applied by casting, engraving, stamping or any other method that cannot be rubbed off or affected by contact with drip torch fuel or other substances. In addition, the drip torch shall be marked with the specification markings required in 3.3.4.

3.3 Department of Transportation requirements.

3.3.1 Construction requirements. Construction of the drip torch shall comply with the applicable portions of 49 CFR Part 178 Subpart L - Non-bulk Performance-Oriented Packaging Standards.

3.3.2 Design qualification testing requirements. With the fuel spout and igniter in the stowed position, the drip torch assembly must meet the design testing requirements for Packing Group II liquids with a specific gravity of 1 listed in 49 CFR Part 178 Subpart M - Testing of Non-bulk Packaging and Packages.

3.3.3 Production testing requirements. Each drip torch must pass a leak test that at a minimum meets the requirements for Packing Group II liquids listed in 49 CFR Section 178.604.

3.3.4 Specification markings. Each drip torch shall be marked with UN standard or DOT specification markings per 49 CFR Sections 178.3 and 178.503. This marking shall be permanently cast or engraved in the drip torch fuel container.

3.3.5 Labeling. Each drip torch shall be labeled with a Flammable Liquid label that meets the requirements of 49 CFR Sections 172.407 and 172.419.

3.4 Color. The outside of the tank and the handle shall be powder coated red (see 3.4.1) to meet the OSHA requirements of 29 CFR 1910.144(a)(1)(ii). The powder coating shall not render the markings required in 3.2.11 and 3.3.4 unreadable. The powder coating shall not be applied to the tank threads.



Equipment Specifications for Drip Torches (continued)

3.4.1 Red. The color red as defined by RAL (German Institute for Quality Assurance, see 6.4) Color Numbers 3001 or 3002 are known to meet this requirement, however, other standards exist and conformance to RAL is not required.

3.5 Instructions. The manufacturer's instructions included with the drip torch shall specify the requirements to safely use the drip torch, and shall refer to agency or bureau policy regarding the types of fuel mixtures to be used. The instructions shall include a spare parts list and specify an ordering address where to obtain parts.

3.6 Delivery. Each drip torch shall be delivered in a completely assembled, tested, and ready to use condition with the spout in the stowed position. The drip torch shall be packaged in such a manner as to prevent damage during shipping.

3.7 Workmanship. All items shall conform to the quality of product established by this document. The occurrence of nonconformities shall not exceed the applicable acceptable quality levels. There shall be no nonconformities that affect use, appearance, or serviceability.

3.8 Metric products. Products manufactured to metric dimensions will be considered on an equal basis with those manufactured using inch/pound units, provided they fall within the tolerances specified using conversion tables contained in the latest revision of IEEE/ASTM SI-10, and all other requirements of this specification are met.

3.9 Recovered materials. The contractor/offeror is encouraged to use recovered materials to the maximum extent possible in accordance with paragraph 23.403 of the Federal Acquisition Regulation (FAR).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his/her own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.2 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known nonconforming material, either indicated or actual, nor does it commit the Government to accept nonconforming material.

4.3 Responsibility for dimensional requirements. Unless otherwise specified in the contract or purchase order, the contractor is responsible for ensuring that all specified dimensions have been met. When dimensions cannot be examined on the end item, inspection shall be made at any point or at all points in the manufacturing process necessary to ensure compliance with all dimensional requirements.



Equipment Specifications for Drip Torches (continued)

4.4 Certification of compliance. Unless otherwise specified, certificates of compliance supplied by the manufacturer of the item, component, or material, listing the specified test method and test results obtained, may be furnished in lieu of actual lot by lot testing performed by the contractor (see 4.7). When certificates of compliance are submitted, the Government reserves the right to check test such items to determine the validity of the certification.

4.5 Sampling for inspections and tests. Sampling for inspections and tests shall be made in accordance with ANSI/ASQ Z1.4. The inspection level and acceptable quality level (AQL) shall be as specified. All drip torches manufactured at one time shall be considered a lot for purposes of acceptance inspection and test. A sample unit shall be one complete drip torch.

4.6 Quality conformance inspection. Each end item lot shall be sampled and inspected as specified in 4.8. The packaging shall be sampled as specified in 4.9. Unless otherwise specified (see 6.2), first articles submitted in accordance with 3.1 shall be inspected as specified in 4.8. Packaging and packing is not part of the first article inspection. The presence of any nonconformity or failure to pass any test shall be cause for rejection of the first article.

4.7 Certification. Unless otherwise specified (see 6.2), as part of first article presentations and lot inspections, all test results and other documentation showing compliance with the requirements of this specification and Department of Transportation requirements (3.3) shall be provided.

4.8 End item visual examination. The end items shall be examined for compliance with the requirements and dimensions of this specification (3.2) in accordance with Table I. The lot size shall be expressed in units of complete drip torches. The inspection level shall be S-3, and the acceptable quality level (AQL), expressed in terms of nonconformities per hundred units, shall be 4.0. Unless otherwise specified, nonconformities shall be scored on an individual basis, i.e. each dimension, etc.

Table I - End Item Visual Examination

<u>Examine</u>	<u>Nonconformity</u>
Dimension	Tank less than 5- ³ / ₄ inches or more than 6 - ¹ / ₄ inches in diameter
Capacity	Tank less than 1- ¹ / ₈ gallons or greater than 1- ³ / ₈ gallons
Design	Not designed to utilize the diesel and gasoline mixtures as specified in 3.2.5
	Fuel spout and igniter assembly not stowable as specified in 3.2.6
	No fuel trap in the spout or check valve assembly in tank cover
	No breather valve provided, breather valve does not seal, thumb screw is not 1/2" in diameter and usable with gloved hand
	Breather valve interior tube not securely soldered to valve assembly or is not leaktight.
	Handle not as specified in 3.2.9
	Material not as specified in 3.2.3
Markings	Markings not per 3.2.11
	Markings not permanent or unreadable
Color	Tank and handle not powder coated red per 3.4
Instructions	Does not refer user to agency or bureau policy regarding fuel mixtures
	Does not include spare parts list



Equipment Specifications for Drip Torches (continued)

4.9 Packaging examination. The fully packaged end items shall be examined for the nonconformities in Table II. The sample unit shall be one shipping container fully prepared for delivery except that it need not be closed. Nonconformities of closure listed in Table II shall be examined on shipping containers fully prepared for delivery. The lot size shall be the number of shipping containers in the end item inspection lot. The inspection level shall be S-2 and the AQL, expressed in terms of nonconformities per hundred units, shall be 2.5.

Table II. Packaging Examination

<u>Examine</u>	<u>Nonconformity</u>
Markings	Omitted; incorrect; illegible; of improper size, location, sequence, or method of application.
Materials	Any component missing or not as specified. Any component damaged, affecting serviceability.
Workmanship	Inadequate application of components, such as: incomplete closure of container flaps, improper taping, loose strapping, inadequate stapling. Bulged or distorted container.
Contents	Number of items per container is more or less than required.

5. PREPARATION FOR DELIVERY

5.1 Preservation. Preservation shall be in accordance with ASTM D 3951 and as specified herein and in the contract or purchase order.

5.2 Packing. Each drip torch, with the spout in the stowed position (3.6) shall be packed in a close-fitting fiberboard box, minimum edge crush strength 32 lbs per inch, meeting the requirements of the latest version of ASTM D 5118. Boxes shall be in compliance with the National Motor Freight Classification. Each box shall be closed in accordance with the latest version of ASTM D 1974, except that the inspection shall be in accordance with 4.9.

5.3 Marking. In addition to any special marking required by the contract or purchase order, shipping and unit containers shall be marked in accordance with FED-STD-123 with the addition of the applicable National Fire Equipment System (NFES) number (which includes the nomenclature "NFES"), which shall appear on a separate line below the National Stock Number (NSN).

6. NOTES

6.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification
- b. Special packing requirements

6.2 Notice. When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility or any obligation whatsoever.





Equipment Specifications for Drip Torches (continued)

6.3 First article. When first articles are required, they shall be inspected and approved under the appropriate provisions of Federal Acquisition Regulation 52.209. The first article shall consist of three completely assembled items covered under this specification and shall be preproduction samples. The contracting officer should include specific instructions regarding arrangements for selection, inspection, and approval of the first articles.

6.4 RAL. German Institute for Quality Assurance and Certification e. V.
Siegburger Strasse 39
53757 Sankt Augustin
Germany
Phone: +49(0) 22 41 - 16 05 -0
Fax: +49(0) 22 41 - 16 05 -11
E-Mail: RAL-Institut@RAL.de
www.RAL.de

6.5 Preparing activity. USDA Forest Service, Missoula Technology and Development Center (MTDC), 5785 Highway 10 West, Missoula, Montana 59808.



Equipment Specifications for Drip Torches (continued)

Specification 5100–616, DRIP TORCH–EXTENDED SPOUT (Diesel and Gasoline Mixture)

5100-616

December 8, 2008

**U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE**

SPECIFICATION

**DRIP TORCH – EXTENDED SPOUT
(Diesel and Gasoline Mixture)**

1. SCOPE

1.1 Scope. This document covers the minimum requirements for the design and construction of a drip torch with an extended burner used to ignite fires in vegetation with a mixture of diesel and gasoline.

2. APPLICABLE DOCUMENTS

2.1 Government documents. The following Government documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of solicitation.

U.S. DEPARTMENT OF TRANSPORTATION

49 CFR Parts 100-185

U.S. DEPARTMENT OF LABOR

29 CFR Part 1910

(The Code of Federal Regulations is for sale from the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20402-9325. Reprints of certain regulations may be obtained from the Federal agency responsible for issuing them. 49 CFR is available electronically at <http://hazmat.dot.gov> and 29 CFR is available electronically at www.osha.gov)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of the solicitation or request for proposals.

Beneficial comments (recommendations, additions, deletions) and any pertinent data that may be used in improving this document should be addressed to: USDA Forest Service, Missoula Technology and Development Center, 5785 Highway 10 West, Missoula, MT 59808.

FSC 4210



Equipment Specifications for Drip Torches (continued)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

SI-10 - Standard For Use of the International System of Units (SI): The Modern Metric System (IEEE/ASTM Standard available from ASTM)

(Copies are available from ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.)

AMERICAN SOCIETY FOR QUALITY (ASQ)

Z1.4 - Sampling Procedures and Tables for Inspection by Attributes

(Copies are available from the American Society for Quality, PO Box 3005, Milwaukee, WI 53201-3005.)

(Non-Government standards and other publications normally are available from the organizations that prepare and distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. Unless otherwise specified (see 6.1), the item shall be subjected to first article inspection (see 6.3) in accordance with 4.5. During the term of the contract the contractor shall be required to notify the contracting officer in writing when a component, or the component supplier, changes in any way; when a major manufacturing process changes in any way; and when a manufacturing location changes. The contracting officer may at any time require the contractor to submit a new first article sample when substantive changes occur during the term of the contract.

3.2 Design.

3.2.1 Diameter. The outside diameter of the drip torch tank, including the welds shall not be less than 5-3/4" or exceed 6-1/4" to allow the drip torch to fit in drip torch holders designed for 6" diameter drip torches.

3.2.2 Capacity. The capacity of the drip torch shall be a minimum of 1-1/4 gallons and a maximum of 1-1/2 gallons.

3.2.3 Materials of construction. The drip torch shall be constructed of the following materials:

- Tank and handle assembly: Stainless steel or aluminum
- Filler cap: Aluminum
- Spout with fuel trap: Steel



Equipment Specifications for Drip Torches (continued)

Nozzle:	Brass or bronze
Regulating valve:	Brass or bronze
Breather valve assembly:	Brass or bronze
Seals and O-rings:	Neoprene, Buna N, or Viton

The materials for components not listed must be compatible with diesel/gasoline fuel mixtures.

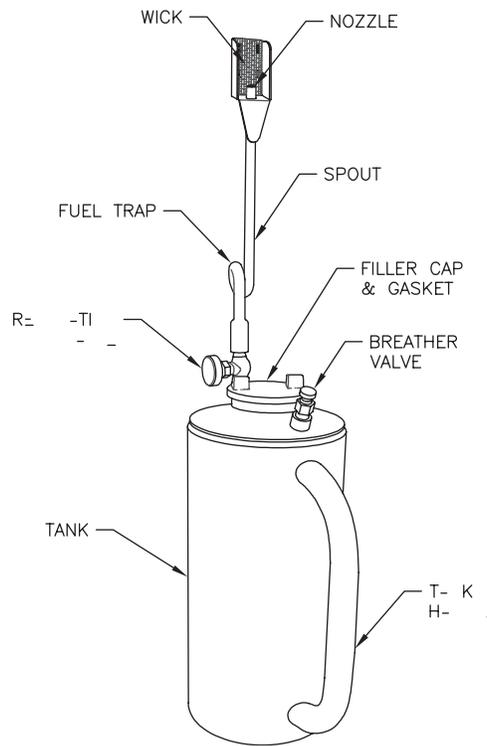


Figure 1. Drip Torch Components

Drip Torches





Equipment Specifications for Drip Torches (continued)

3.2.4 Spouts (Also referred to as “burners” by some manufacturers). Spouts shall be available in 12 inch, 15 inch, and 19 inch lengths. The length of the spout shall be measured from the inlet of the spout to the end of the wick. The wick shall be configured such that flame from the wick will reliably ignite the fuel stream as it exits the nozzle. Spouts shall be easily removable for transportation or replacement. All lengths of spouts shall be interchangeable with each other.

3.2.5 Fuel mixture. The drip torch shall be capable of operating with diesel/gasoline fuel mixtures.

3.2.6 Stowage of the spout. The torch shall be designed such that the 12 inch long spout can be stowed inside of the fuel tank when the torch is not in use. Longer spouts are not required to be stowed inside of the fuel tank.

3.2.7 Flashback protection. As a minimum each drip torch shall be equipped with a fuel trap in the spout.

3.2.8 Breather valve assembly (Also referred to as “vent valve” by some manufacturers). Each drip torch shall be equipped with a breather valve to provide smooth flow of fuel when the drip torch is in use. The breather valve shall be capable of being closed to provide a leak-tight seal for storage or transportation. The head of the breather valve thumb screw shall be a minimum of ½ inch in diameter and located to allow easy opening and closing with a gloved hand.

3.2.9 Vent tube. Each tank shall be provided with an interior tube that extends from the breather valve tank fitting to a location near the bottom of the tank. The tube shall be located so that it does not interfere with stowage of the 12 inch spout.

3.2.10 Regulating valve. Each drip torch shall be equipped with a regulating valve to control fuel flow. The regulating valve shall be capable of being closed to provide a leak tight seal for storage or transportation. The regulating valve handle shall be a minimum of 1 inch in diameter and located to allow easy adjustment of the fuel flow.

3.2.11 Tank opening and filler cap. The tank fill opening shall be no less than 2 inches in diameter and shall be sealed by a threaded filler cap. The filler cap shall provide a leak tight seal when it is hand tightened. The filler cap shall be designed to hold the 12 inch spout inside of the tank for transportation and storage.

3.2.12 Tank handle. The handle shall be permanently attached to the tank and fabricated using tubing with a minimum diameter of ¾ inch and a maximum diameter of 1-1/8 inch. The handle shall be designed to provide a minimum of 1-¾ inches clearance between the inside of the handle and the outside of the fuel tank to allow the torch to be used with a gloved hand. The length of the clearance space between the inside of the handle and the outside of the tank shall be at least 8 inches. The handle must have a straight section at least 5” in length. The straight section may be at an angle to the outside of the tank to aid in holding the drip torch in the spout down position during use. When the handle is manufactured from bended tubing, intrusion into the space between the inside of the handle and the outside of the tank by the radius of the bends is acceptable.

3.2.13 Holder. A holder shall be available that can securely hold the torch during transport and has a provision to store 15 inch and 19 inch spouts when not in use.

3.2.14 Leak tightness. All closures such as the filler cap, regulating valve, and breather valve shall provide a leak-tight seal when hand tightened. Closures shall be designed such that the closure seal cannot be displaced from its sealing surface during hand tightening of the closure.



Equipment Specifications for Drip Torches (continued)

3.2.15 Markings. The drip torch shall be legibly and permanently marked with the manufacturer's name, catalog or model number, and the month and year of manufacture. These markings may be applied by casting, engraving, stamping or any other method that cannot be rubbed off or affected by contact with drip torch fuel or other substances. In addition, the drip torch shall be marked with the specification markings required in 3.3.4.

3.3 Department of Transportation requirements.

3.3.1 Construction requirements. Construction of the drip torch shall comply with the applicable portions of 49 CFR Part 178 Subpart L - Non-bulk Performance-Oriented Packaging Standards.

3.3.2 Design qualification testing requirements. With the spout removed and the regulating and breather valves installed, the drip torch assembly must meet the design testing requirements for Packing Group II liquids with a specific gravity of 1 listed in 49 CFR Part 178 Subpart M - Testing of Non-bulk Packaging and Packages.

3.3.3 Production testing requirements. Each drip torch must pass a leak test that at a minimum meets the requirements for Packing Group II liquids listed in 49 CFR Section 178.604.

3.3.4 Specification markings. Each drip torch shall be marked with UN standard or DOT specification markings per 49 CFR Sections 178.3 and 178.503. This marking shall be permanently cast or engraved in the drip torch fuel container.

3.3.5 Labeling. Each drip torch shall be labeled with a Flammable Liquid label that meets the requirements of 49 CFR Sections 172.407 and 172.419.

3.4 Color. The outside of the tank and the handle shall be painted red to meet the OSHA requirements of 29 CFR 1910.144(a)(1)(ii). The color red as defined by RAL (German Institute for Quality Assurance, see 6.4) Color Numbers 3001 or 3002 is known to meet this requirement, however, other standards exist and conformance to RAL is not required. The paint shall not render the markings required in 3.2.15 and 3.3.4 unreadable. The paint is required only on the tank and handle, and shall not be applied to the tank threads, filler cap threads breather valve or threads, or regulating valve or threads.

3.5 Instructions. The manufacturer's instructions included with the drip torch shall specify the requirements to safely use the drip torch, and shall refer to agency or bureau policy regarding the types of fuel mixtures to be used. The instructions shall include a spare parts list and specify an ordering address where to obtain parts.

3.6 Delivery. Each drip torch shall be delivered in a completely assembled, tested, and ready to use condition except that the spout may be removed from the tank for shipment. The drip torch shall be packaged in such a manner as to prevent damage during shipping.

3.7 Workmanship. All items shall conform to the quality of product established by this document. The occurrence of nonconformities shall not exceed the applicable acceptable quality levels. There shall be no nonconformities that affect use, appearance, or serviceability.

3.8 Metric products. Products manufactured to metric dimensions will be considered on an equal basis with those manufactured using inch/pound units, provided they fall within the tolerances specified using conversion tables contained in the latest revision of IEEE/ASTM SI-10, and all other requirements of this specification are met.





Equipment Specifications for Drip Torches (continued)

3.9 Recovered materials. The contractor/offeror is encouraged to use recovered materials to the maximum extent possible in accordance with paragraph 23.403 of the Federal Acquisition Regulation (FAR).

3.10 Symmetry. All metal part sections shall be symmetrical and concentric to 0.060 inch.

3.11 Extruded components. Extruded sections shall be free from laps, sharp die marks, cracks, or other nonconformities.

3.12 Cast components. Cast parts shall be fine-grained, free from blowholes, pinholes, pits, porosity, hard spots, shrinkage, cracks, or other nonconformities.

3.13 Dimensional tolerance. Unless otherwise noted, the following tolerances apply: one place (x.x) +/-0.1 inch, two places (x.xx) +/-0.03 inch, and three places (x.xxx) +/-0.010 inch.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his/her own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.2 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known nonconforming material, either indicated or actual, nor does it commit the Government to accept nonconforming material.

4.3 Responsibility for dimensional requirements. Unless otherwise specified in the contract or purchase order, the contractor is responsible for ensuring that all specified dimensions have been met. When dimensions cannot be examined on the end item, inspection shall be made at any point or at all points in the manufacturing process necessary to ensure compliance with all dimensional requirements.

4.4 Sampling for inspections. Sampling for inspections and tests shall be made in accordance with ANSI/ASQ Z1.4. The inspection level and acceptable quality level (AQL) shall be as specified. All drip torches manufactured at one time shall be considered a lot for purposes of acceptance inspection and test. A sample unit shall be one complete drip torch.

4.5 Quality conformance inspection. Each end item lot shall be sampled and inspected as specified in 4.7. Unless otherwise specified (see 6.1), first articles submitted in accordance with 3.1 shall be inspected as specified in 4.8. The presence of any nonconformity shall be cause for rejection of the first article.



Equipment Specifications for Drip Torches (continued)

4.6 Certification. Unless otherwise specified (see 6.1), as part of first article presentations and lot inspections, all test results and other documentation showing compliance with the requirements of this specification and Department of Transportation requirements (3.3) shall be provided.

4.7 End item examination. The end items shall be examined for compliance with the requirements and dimensions of this specification (3.2) in accordance with Table I. The lot size shall be expressed in units of complete drip torches. The inspection level shall be S-3, and the acceptable quality level (AQL), expressed in terms of nonconformities per hundred units, shall be 4.0. Unless otherwise specified, nonconformities shall be scored on an individual basis, i.e. each dimension, etc.

Table I - End Item Examination

<u>Examine</u>	<u>Nonconformity</u>
Dimension	Tank less than 5- ³ / ₄ inches or more than 6 - ¹ / ₄ inches in diameter
Capacity	Tank less than 1- ¹ / ₄ gallons or greater than 1- ¹ / ₂ gallons
Design	Not designed to utilize diesel and gasoline mixtures as specified in 3.2.5
	12 inch spout not stowable as specified in 3.2.6
	No fuel trap in the spout
	No breather valve provided, breather valve does not seal, thumb screw is not 1/2" in diameter and usable with gloved hand
	No regulating valve provided, regulating valve does not seal, valve handle not 1" in diameter and usable with gloved hand
	Vent tube does not extend near bottom of tank, interferes with stowage of 12 inch spout as specified in 3.2.9
	Tank fill opening diameter less than 2 inches as specified in 3.2.11
	Handle not as specified in 3.2.12
	Material not as specified in 3.2.3
	Markings
Color	Markings not permanent or unreadable
	Tank and handle not painted red per 3.4
Instructions	Valves or any threads painted
	Does not refer user to agency or bureau policy regarding fuel mixtures
	Does not include spare parts list

5. PRESERVATION, PACKING AND MARKING. Shall be in accordance with the contract or purchase order.

6. NOTES

6.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification
- b. Preservation, packing and marking requirements
- c. Specify if first article inspection will be required and if certification shall be required.





Equipment Specifications for Drip Torches (continued)

6.2 Notice. When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility or any obligation whatsoever.

6.3 First article. When first articles are required, they shall be inspected and approved under the appropriate provisions of Federal Acquisition Regulation 52.209. The first article shall consist of three completely assembled items covered under this specification and shall be preproduction samples. The contracting officer should include specific instructions regarding arrangements for selection, inspection, and approval of the first articles.

6.4 RAL. German Institute for Quality Assurance and Certification e. V.
Siegburger Strasse 39
53757 Sankt Augustin
Germany
Phone: +49(0) 22 41 - 16 05 -0
Fax: +49(0) 22 41 - 16 05 -11
E-Mail: RAL-Institut@RAL.de
www.RAL.de

6.5 Preparing Activity. USDA Forest Service, Missoula Technology and Development Center (MTDC), 5785 Highway 10 West, Missoula, Montana 59808.



Contract Equipment Inspection Checklist

- Contractor drip torches must meet the standards established in this chapter.

Drip Torch References

See appendix B for additional ground ignition references.

Interagency Transportation Guide for Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel, PMS 442, available at <<http://www.nwcg.gov/>>.

Everyday Hazmat User’s Training Guide, 0471–2810–MTDC, available at <http://www.fs.fed.us/eng/everyday_hazmat/users_guide.htm>.

Fire Equipment Storage and Refurbishing Standards, PMS 448, available at <<http://www.nwcg.gov/>>.

Specification 5100-614A, Drip Torch (Diesel and Gasoline Mixture), available to Forest Service and BLM employees at <<http://fswb.mtdc.wo.fs.fed.us/programs/fire/specs.htm>>. Other agency employees can contact the MTDC ignition specialist at 406–329–3900.

Specification 5100-616, Drip Torch-Extended Spout (Diesel and Gasoline Mixture), available to Forest Service and BLM employees at <<http://fswb.mtdc.wo.fs.fed.us/programs/fire/specs.htm>>. Other agency employees can contact the MTDC ignition specialist at 406–329–3900.



Chapter 4—Flares and Flare Launchers

Equipment Description

Flares are used to ignite areas remotely that are not easily accessible on foot. When used with a flare launcher in a flare system, the point of ignition can be 300 feet away. One of the two basic types of flare systems uses a flare launcher that breaks open so a self-contained cartridge similar to a shotgun shell can be loaded (figure 4-1). The cartridge contains the flare and the powder to propel it. The flare launcher is typically cast aluminum or plastic. The flare launcher is opened and a cartridge is inserted into the launcher. The launcher is pointed toward the area to be burned and the operator pulls the trigger, igniting the powder

and launching the flare. These flare launchers typically range in size from 12 gauge to 25 millimeters.

A second type of flare system (figure 4-2) has a launcher with separate cartridges (also known as blanks or power loads) to propel the flare. The cartridges are loaded into a cylinder that is installed in the launcher. Each cylinder holds nine cartridges. A flare is loaded into the barrel, the launcher is pointed in the desired direction, and the trigger is pulled. The cartridge fires, ignites the flare, and propels it to the area to be burned. Up to nine flares may be fired before the cylinder must be removed and reloaded with new cartridges.



Figure 4-1—An Orion flare launcher with an Orion 12-gauge flare.



Figure 4-2—A FireQuick flare launcher, 22-cal power loads, and a FireQuick flare.

Flares and Flare Launchers

Advantages	Advantages and Disadvantages of Using Flares and Flare Launchers	
	Advantages of using flares and flare launchers	Disadvantages of using flares and flare launchers
	Easy to obtain	Some launchers are not designed for repeated firing
	Lightweight and compact	Firing pins bend on some brands
	Allow remote ignition in steep or inaccessible terrain	Frames may develop cracks
	Easy to use and operate with minimum training	Very loud, can cause hearing damage if hearing protection is not worn
	Allow firefighters to ignite fuels quickly inside the fireline to draw fire away from the fireline	Flares may cost more than \$3 each



Sources of Equipment That Meet Standards

Manufacturers of approved flares and launchers

FireQuick Products, Inc.
1137 Red Rock Inyokern Rd.
P.O. Box 910
Inyokern, CA 93527
Phone: 855-374-3473
Fax: 760-377-5761
Web site: <http://www.firequick.com>

Orion Safety Products
3157 North 500 W.
Peru, IN 46970
Phone: 800-851-5260
Fax: 765-473-3254
Web site: <http://www.orionsignals.com>

Situations Favorable for Flare Launcher Use

A flare and a flare launcher work well when:

- Burning dry, light, continuous ground fuels
- Burning fuels across a water barrier, or in terrain that is steep, hazardous, or otherwise inaccessible
- Igniting fuels to draw flames away from the fireline

Safety Requirements

Hazard analysis information for use of flares and flare launchers is provided in the “Flare and Flare Launcher Resources” section at the end of this chapter. Prepare and review your hazard analysis document before beginning work.

Required Personal Protective Equipment (PPE)

- Hardhat
- Flame-resistant pants
- Flame-resistant shirt
- Leather gloves
- Approved boots
- Eye protection
- Hearing protection

Transporting Flare Launchers

- Do not transport the flare launcher loaded with flares or cartridges.
- Do not transport the flare launcher on commercial aircraft.

Transporting Cartridges

- Do not transport cartridges on commercial aircraft.
- Transport cartridges loose in original boxes, or other strong packages.
- Keep cartridges dry.

See the “Interagency Aviation Transport of Hazardous Materials” guide (NFES 1068) for additional information on transporting flare cartridges on Government contract helicopters.



Transporting FireQuick Flares

Ground Transportation

- Transport FireQuick flares in their original boxes if the total weight of all hazardous materials, including the flares, does not exceed 440 pounds. Other hazardous materials that must be included in the 440-pound limit include drip torch fuel, gasoline, and plastic spheres used for ground and aerial ignition.
- If the flares (in their original boxes) are packed in another package, such as a strong cardboard box, the total weight of each package cannot be more than 66 pounds.
- If more than 440 pounds of hazardous materials will be transported in a vehicle, the flares must be transported in their original boxes and packed in a strong package, such as a cardboard box. Each package cannot weigh more than 66 pounds.
- Do not transport flares with explosives, corrosive liquids, or poisonous gases and liquids.
- Do not transport flares in a vehicle's passenger compartment.
- Keep flares dry.

Transportation by a Government Contract Helicopter

- Transport flares in original boxes whenever possible.
- Do not transport broken flares.
- Do not transport flares where they could be exposed to batteries or battery fluids.
- Do not transport flares with explosives.
- Do not transport flares on commercial aircraft.

See the "Interagency Aviation Transport of Hazardous Materials" guide (NFES 1068) for additional information.

Transporting Orion Flare Cartridges

Ground Transportation

- Transport flare cartridges to the burn site in the manufacturer's original shipping container.
- Do not transport flare cartridges in a vehicle's passenger compartment.
- Do not transport flare cartridges with explosives, corrosive liquids, or poisonous gases and liquids.
- Keep flare cartridges dry.

Transportation by a Government Contract Helicopter

- Transport flares in the manufacturer's original shipping container whenever possible.
- Do not transport flares where they could be exposed to batteries or battery fluids.
- Do not transport broken or damaged flare cartridges.
- Do not transport flares with explosives.
- Do not transport flare cartridges on commercial aircraft.

See the "Interagency Aviation Transport of Hazardous Materials" guide (NFES 1068) for further information.



Qualifications

To be qualified to use flares and flare launchers for incidents or projects, individuals must meet prerequisites and training requirements.

Prerequisites

Operators shall:

- Hold the position of Type 2 firefighter (FFT2) or prescribed fire crewmember (RXCM).

Instructors shall:

- Hold the position of FFT2 or RXCM.
- Demonstrate proficiency with flares and launchers.

Minimum Training

Operators shall:

- Read and understand the “FireQuick Flare Systems User Training Workbook.”
- Read the Orion flare launcher manufacturer’s operating instructions.
- Demonstrate proficiency with the flare launcher under the guidance of an experienced operator.

Instructors shall:

- Demonstrate proficiency with the flare launcher.

Inspecting Flares and Flare Launchers

- Check flares or flare cartridges for visible defects, such as moisture or mechanical damage.
- Make sure that the flare launcher is not loaded with flares or cartridges.
- Ensure that the flare launcher is clean and operating properly.
- Check the launcher for cracking or damaged parts such as bent firing pins (figure 4–3), and other defects. Do not use a defective launcher.
- Return defective launchers to the manufacturer for repair or replacement.

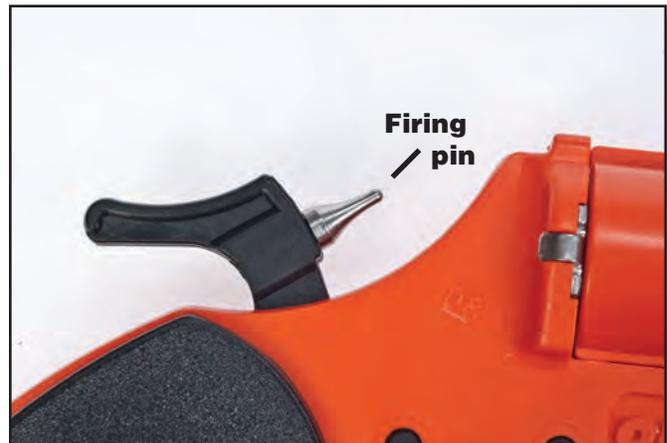


Figure 4–3—Before using a flare launcher, inspect the firing pin to make sure it has not been bent.



Normal Operating Procedures for FireQuick Flare Systems

The operator and all personnel nearby must wear proper PPE, including eye and hearing protection.

Preparing the Flare Launcher

- Make sure that the launcher is unloaded.
- Notify the appropriate supervisory personnel before beginning firing operations.

Using the Flare Launcher

- Always keep the launcher pointed in a safe direction away from personnel and equipment. Treat the launcher as you would a loaded firearm.
- Remove the cylinder retaining pin from the launcher frame.
- Remove the cylinder (figure 4-4).
- Load the cylinder with the proper power load cartridge (figure 4-5). Cartridges come in several power levels identified by a load level number and color. The power level numbers for .22 caliber cartridges range from No. 1 (least powerful, gray with a brass case) to No. 7 (most powerful, gray with a nickel-colored case).



Figure 4-4—To load the FireQuick flare launcher, remove the cylinder.



Figure 4-5—Insert power loads into the cylinder.



The manufacturer of the FireQuick Flare Systems recommends the following industrial loads:

- » No. 6 (purple with brass case) for most uses when launching Hot Shot flares (figures 4-6 and 4-7).
- » No. 7 (gray with nickel-colored case) when launching Stubby flares or when launching a Hot Shot flare for longer distances. These loads (figures 4-8 and 4-9) can damage the fired end

of the flare and cause more wear and tear on the launcher than No. 6 loads.

- » No. 5 (red with brass case) for less range than the No. 6 cartridges.
- » No. 4 (yellow with brass case) or lower power loads are not recommended because they will not shoot the flare far enough.



Figure 4-6—A box containing No. 6 power loads. This is the load that should normally be used to launch flares.



Figure 4-8—A box containing No. 7 (the most powerful) power loads. These loads are harder on the launcher than lighter loads and can damage the flare.



Figure 4-7—A No. 6 power load. The crimped end of the brass case is painted purple, indicating the power of the load.



Figure 4-9—A No. 7 power load. The crimped end of the nickel-plated case is painted gray, indicating the power of the load.



- Install the cylinder in the launcher's frame.
- Replace the cylinder retaining pin. Make sure that the cylinder retaining pin is properly installed.
- Attempt to rotate the cylinder. If the cylinder is properly installed, the cylinder lock will prevent the cylinder from rotating.
- **Do not place your finger near the trigger until you are prepared to fire.** This is especially important when loading a flare in the FireQuick launcher because the hammer on a FireQuick launcher does not have to be cocked to fire.
- Make sure that no one is downrange of the launcher and that everyone nearby is at least 5 feet behind you and wearing PPE, including hearing and eye protection.
- Make sure that the flares you are preparing to load are designed for the launcher. Never use flares in a launcher that was not designed for them.
- With the barrel pointed toward the area to be burned, load a flare—cap-end first—into the barrel (figure 4–10). Make sure the flare is completely seated in the barrel. Do not seat the flare with your hand or against your body. Use a solid object, such as a tree or rock, to seat the flare.
- Make sure no one is downrange of the launcher.
- Raise the launcher and point it toward the area you want to burn. A 45-degree launch angle provides the maximum distance and helps ensure that the flare ignites after it hits the ground. If the launch angle is steeper than 45 degrees, the flare may ignite before it hits the ground. If the launch angle is less than 45 degrees, the flare may ricochet off the ground or obstructions nearby.
- Don't launch flares toward obstructions, such as trees, that may send the flare ricocheting back toward you.
- Cock the hammer when you are prepared to fire.
- Before firing, verbally notify all personnel in the area that you are about to fire by loudly saying "firing."
- Pull the trigger to launch the flare (figure 4–11).
- Up to nine flares can be launched from a cylinder.
- When firing operations are complete, make sure the launcher is unloaded. Never transport or store a launcher loaded with either flares or cartridges.



Figure 4–10—Loading a flare into the FireQuick launcher.



Figure 4–11—Launching a flare with the FireQuick flare launcher.

Spare Cylinders

Spare cylinders preloaded with flare cartridges can be carried to reduce the time required to reload the launcher.



Emergency Operating Procedures for FireQuick Flare Systems

FireQuick Flare System operators need to know what to do in the following situations:

- Misfire (cartridge fails to fire)
 - » Keep the launcher pointed downrange over the fire area. Notify all personnel in the immediate area by loudly saying “misfire.”
 - » With the launcher pointed downrange, wait about 30 seconds to make sure the cartridge does not “hang fire.”
- Fire
 - » Repeat the launch procedure.
 - » If the second cartridge does not fire, keep the launcher pointed downrange and wait at least 30 seconds.
 - » Unload the flare and cartridges from the launcher.
 - » Inspect the launcher for defects according to the “FireQuick Flare Systems User Training Workbook.”
- Fire
 - » If a flare ignites in barrel of the launcher, immediately discard the launcher, preferably inside the burn area, away from yourself and others.

Flares and Flare Launchers

Troubleshooting

FireQuick Flare System Troubleshooting Procedures		
Malfunction	Likely problem	Corrective action
Flare departs launcher, travels a good distance, but does not ignite	Dud flare	Test other flares in the launcher to assess operation of the launcher.
Flare departs launcher, travels a short distance	Weak cartridge Flare not properly seated in barrel	Test other flares to assess the operation of the launcher. Make sure the flares are properly seated in launcher.
Flare does not depart launcher	Dud flare cartridge	Fire the next cartridge.
Flare does not depart launcher after several tries	Launcher firing pin damaged	Remove the cylinder, dry fire the launcher, and make sure that the firing pin is visible.
Cylinder will not rotate	Burr on cylinder	Remove the cylinder and lightly sand the ratcheted side to remove any burrs.
Trigger catches or does not fire properly	Launcher is dirty	Clean the launcher thoroughly, dry fire the launcher to check trigger operation.
	Firing pin is damaged	Send the launcher back to the manufacturer for repair
Cartridge casing has expanded in cylinder after firing	Gas port has become fouled with soot	Remove the cylinder and clean the gas port using firearm cleaning solvent and a pipe cleaner.
Flare is difficult to insert into launcher	Residue buildup in launcher barrel	Use gun cleaning solvent and a small wire brush to clean the barrel.



Normal Operating Procedures for Orion Flare Systems

The operator and all personnel must wear proper PPE, including eye and hearing protection.

Preparing the Flare Launcher for Use

- Make sure the launcher is unloaded.
- Notify the appropriate supervisory personnel before firing operations begin.

Using the Flare Launcher

- Make sure no one is downrange of the launcher and that everyone nearby is at least 5 feet behind you and wearing PPE, including hearing and eye protection.
- Keep your finger away from the trigger.
- With the barrel pointed toward the area to be burned, break open the launcher barrel and insert a flare cartridge. Make sure the flare cartridge is completely seated in the chamber (figure 4–12).



Figure 4–12—Loading an Orion flare launcher.

- Close the launcher barrel. The barrel should snap shut. If the barrel does not fully close, do not force it—replace the launcher.
- Make sure no one is downrange of the launcher.
- Raise the launcher and point it toward the intended target. A 45-degree launch angle provides the maximum distance and helps ensure that the flare ignites after it hits the ground. A launch angle that is too steep may cause the flare to ignite before it hits the ground. A launch angle that is too shallow may cause the flare to ricochet.
- Cock the hammer.
- Before firing, verbally notify all personnel in the area that you are about to fire by loudly saying “firing.”
- Pull the trigger to launch the flare.
- Break open the barrel and remove the empty flare cartridge casing. Do not discard the empty casing in the burn area. Dispose of the casing properly.
- During prolonged firing operations, periodically inspect the launcher for cracking, damaged parts such as bent firing pins, and other defects. Do not use a defective launcher. Return defective launchers to the manufacturer for repair or replacement.
- When firing operations are complete, make sure that the flare launcher is unloaded.



Emergency Operating Procedures for Orion Flare Systems

Orion Flare System operators need to know what to do in the following situations:

- Misfire (flare cartridge fails to fire)
 - » Keep the launcher pointed downrange over the fire area. Notify all personnel in the immediate area by loudly saying “misfire.”
 - » With the launcher pointed downrange, wait about 30 seconds to make sure the flare cartridge does not “hang fire.”
 - » Remove the dud cartridge from the launcher.
- Fire
 - » Insert a new flare cartridge and attempt to launch a flare.
 - » If the flare does not launch, keep the launcher pointed downrange for about 30 seconds before removing the cartridge from the launcher and inspecting the launcher for defects.
 - » Dispose of defective cartridges properly.

Flares and Flare Launchers

Orion Flare System Troubleshooting Procedures		
Malfunction	Likely problem	Corrective action
Flare departs launcher, travels a good distance, but does not ignite	Dud flare	Test other flares in the launcher.
Flare departs launcher, travels a short distance	Weak powder charge in flare cartridge	Test other flares in the launcher
Flare does not depart launcher	Dud flare cartridge	Wait 30 seconds before removing the flare cartridge from the launcher. Insert a new flare cartridge and attempt to launch the flare. If the new flare cartridge does not fire, inspect the launcher's firing pin for damage. Replace the damaged launcher.
Flare cartridge is difficult to insert into launcher or will not chamber completely	Damaged flare cartridge Obstruction in chamber of launcher Dirty launcher	Inspect the flare cartridge for damage. Replace the damaged flare cartridge. Inspect the launcher for an obstruction in the chamber. Remove any obstruction or replace the launcher. Clean or replace the launcher.



Maintenance and Storage

Cleaning and Repair

- Make sure the launcher is not loaded with flares or flare cartridges.
- Inspect your launcher and check for worn parts, cracks, or other signs of excessive wear. Return damaged or worn launchers to the manufacturer for repair or replacement.
- Clean your launcher.
 - » Clean the FireQuick flare launcher using firearms cleaning solvent.
 - » Clean the Orion flare launcher using soap and water. Take care not to get soap and water in the firing mechanism. Do not use cleaning solvent on the Orion launcher, solvent could weaken the plastic.

Launcher Replacement

- Orion launchers should be replaced annually.
- Old-style FireQuick launchers that use epoxy to seal the barrel shall be replaced because the epoxy can fail and injure the user (figures 4–13 and 4–14).



Figure 4–13—Brown epoxy used to seal the barrel of this FireQuick flare launcher can dislodge when the launcher is fired, injuring the user. This launcher should be replaced with a newer model that does not have epoxy sealing the barrel.



Figure 4–14—This is an example of a FireQuick flare launcher that does not have epoxy sealing the barrel.



Storing the Launcher

- Always store the launcher unloaded.
- Keep your launcher protected in a case or pouch to reduce risk of damage or unnecessary wear.
- Store the launcher in a dry area where access is controlled.

Storing Flares

- Maintain controlled access to flares (figure 4–15).
- Store flares in the original manufacturer's packaging in a cool, dry environment.
- Do not store flares near flammable liquids or other flammable materials.
- Keep the storage area free of sparks or heat sources; prohibit smoking within 50 feet (15 meters) of the storage area.
- Contact your hazardous materials coordinator for additional storage information.

Additional storage information can found in MTDC's "Everyday Hazmat User's Training Guide."



Figure 4–15—This cabinet is labeled properly for storing flares.

Disposing of Damaged or Dud Flares

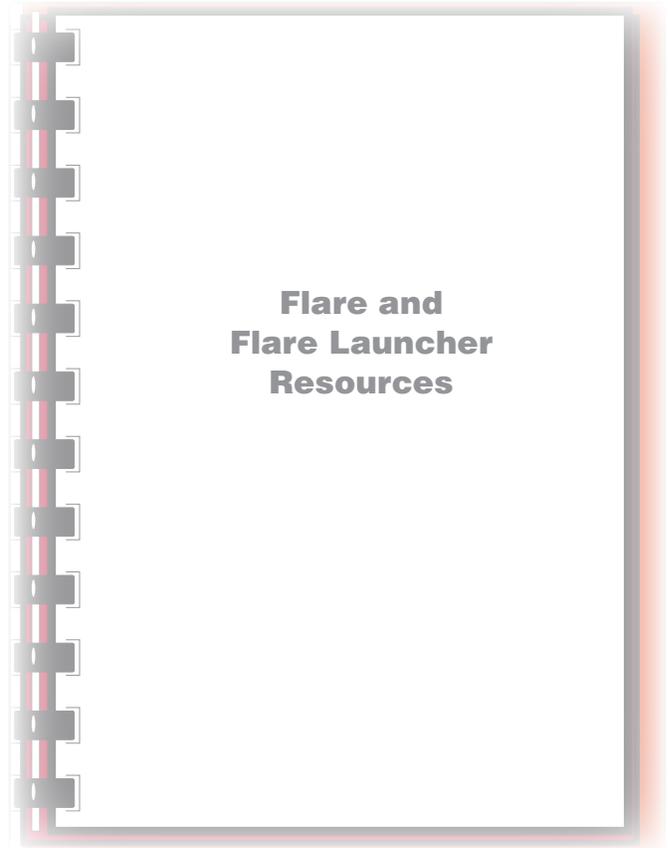
- Always treat flares held for disposal as though they could ignite; follow the same safe storage instructions as for good flares.
- Flares held for disposal should be clearly marked as defective and stored separately from good flares.
- Call the manufacturer for specific disposal instructions and procedures. Check with your local unit or State safety officer for agency policy.



Flare and Flare Launcher Resources

This section includes the following resources:

- Information for inclusion in a hazard analysis
- List of required material safety data sheets
- Recommended spare parts
- Cache refurbishment
- Equipment standards for flares and flare launchers
- Contract equipment inspection checklist
- Flare and flare launcher references





Hazard Analysis

This information can be used when preparing a job hazard analysis (used by the Forest Service) or similar hazard analysis.

Flares and Flare Launchers

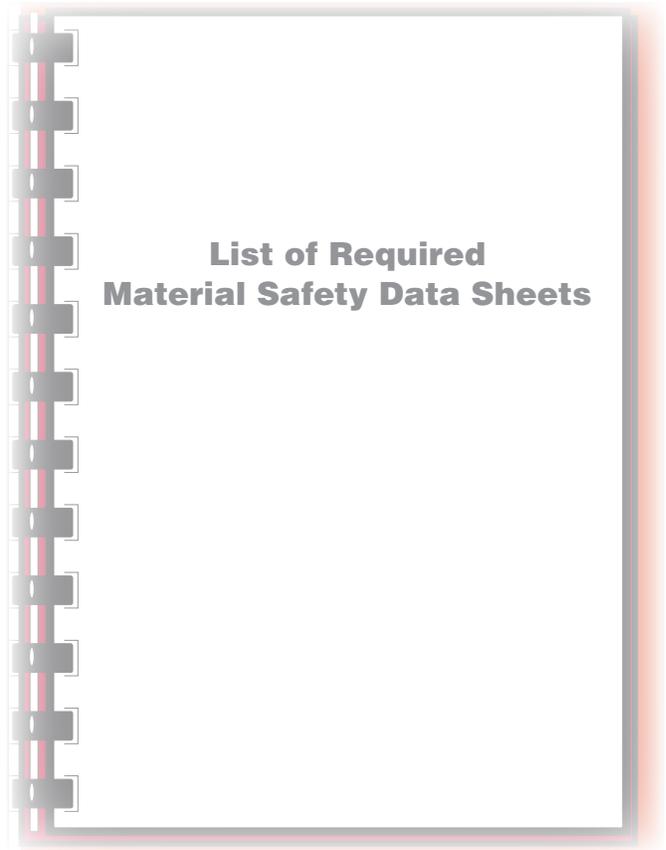
Information for Flare and Flare Launcher Hazard Analyses		
Task	Hazards	Abatement actions
Loading the launcher	Pinched fingers	Take care when installing the cylinder of a Firequick launcher. Keep your fingers away from the chamber when closing the Orion launcher. Wear leather gloves.
	Accidental discharge of the launcher	Keep the launcher pointed in the direction of the intended target area and away from yourself and others. Keep your fingers away from the launcher trigger.
Handling a loaded launcher	Accidental discharge of the launcher	Keep the launcher pointed in the direction of the intended target area and away from yourself and others. Keep your fingers away from the launcher trigger.
Launching flares	Loud noise	Wear hearing protection.
	Unburned powder escaping from the gap between the cylinder and the barrel of the FireQuick launcher	Wear eye protection. Wear gloves. Keep all bystanders at least 5 feet behind the operator of the launcher.
	Potential for launcher failure	Wear all PPE including eye protection, gloves, a long-sleeve shirt, a hardhat, hearing protection, and boots.
	Premature ignition of the flare as it departs from the launcher	Wear all PPE including eye protection, gloves, a long-sleeve shirt, hardhat, hearing protection, and boots.
	Misfire of the power cartridge or flare cartridge	Keep the launcher pointed in a safe direction and wait a minimum of 30 seconds. After at least 30 seconds, pull the hammer back and attempt to launch the flare again. If the flare does not launch, wait another 30 seconds and then unload the launcher. Inspect the launcher for damage.
	Dud flare	Wait at least 30 seconds before retrieving the flare for disposal.



List of Required Material Safety Data Sheets

Material safety data sheets for all ground ignition systems are in appendix A. The material safety data sheets for flares and flare launchers include:

- FireQuick flare
- Orion flare
- Cartridges (industrial loads) for FireQuick Flare System



Flares and Flare Launchers



Recommended Spare Parts

- FireQuick Launcher
 - » Spare cylinder
- Orion Launcher
 - » Spare launcher

Cache Refurbishment Standards

Fire Equipment Storage and Refurbishing Standards

ITEM: FLARE SYSTEM

- Cache Items
 - » Hot Shot flares
 - » No. 6 power cartridges
 - » Spare cylinders
- Initial Inspection/Disposal Criteria
 - » Inspect the launcher for damage; replace damaged parts or return to the factory, manufacturer for repair.
- Refurbishing Procedures
 - » Clean the launcher

Equipment Standards for Flares and Flare Launchers

Flares

- Packaged, labeled, and marked in accordance with DOT shipping requirements.
- Must have an MSDS available.
- Moisture resistant.
- Must reliably ignite 1-hour fuels, such as grass, needles, and leaves.
- Have a shelf life of at least 2 years.

The flares and cartridges must not be considered ammunition or explosives by the Bureau of Alcohol, Tobacco, Firearms and Explosives. A letter from BATFE or other documentation stating the flares and/or cartridges are not ammunition or explosives must be supplied by the manufacturer or distributor.

Flare Launchers

- Off-the-shelf design. (Both the launcher and flares must be readily available.)
- Designed for multiple launches.
- Easy to carry (about the size of a handgun).
- Usable by people with small hands.
- Easy to use with gloved hands.
- Trigger pull: at least 4 pounds.
- Weight: about 3 pounds or less.
- Range: about 300 feet.
- Accuracy: plus or minus 10 degrees under calm conditions.

The launcher must not be considered a firearm by Bureau of Alcohol, Tobacco, Firearms and Explosives. A letter from the BATFE or other documentation stating the launcher is not a firearm must be supplied by the manufacturer or distributor.



Contract Equipment Inspection Checklist

- Contractor flares and launchers must meet the standards established in this chapter.

Flare and Flare Launcher References

See appendix B for additional ground ignition references.

FireQuick Flare Systems User Training Workbook, available from FireQuick Products, Inc., 855-374-3473

Everyday Hazmat User's Training Guide, 0471-2810-MTDC, available at <http://www.fs.fed.us/eng/everyday_hazmat/users_guide.htm>.



Notes

Flares and Flare Launchers



Equipment Description

A fusee is a handheld disposable ground ignition device with a self-contained ignition system (figure 5-1). Like common road flares, fusees generate a flame about 5 inches long. Fusees are effective for igniting vegetation during firing operations and are commonly carried by firefighters, who use them if they need to create emergency safety zones.



Figure 5-1—A burning fusee shortly after being ignited.

Sources of Equipment That Meet Specifications

Fusees must meet the requirements of the latest revision of Forest Service Specification 5100-360 (figure 5-2). Do not use road flares or other signaling devices for ground ignition.

- New fusees are available from GSA (NSN 1370-00-294-1279) and from the National Interagency Support Caches (NFES 0105).

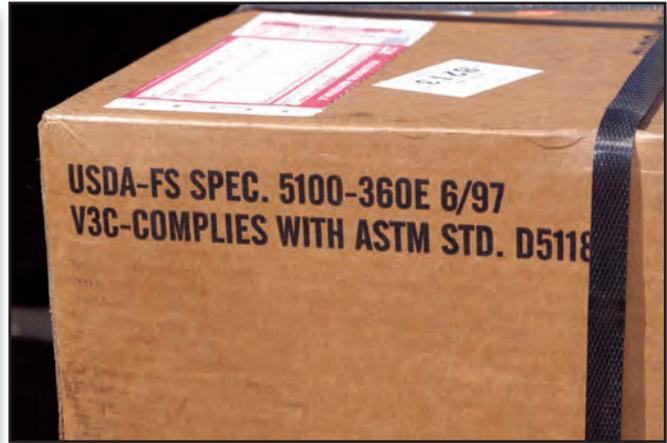


Figure 5-2—Fusees must meet the requirements of Forest Service Specification 5100-360.

Fusees

Advantages

Advantages and Disadvantages of Using Fusees

Advantages of using fusees	Disadvantages of using fusees
Easy to obtain from most fire caches	Not effective in wet or noncontinuous fuels
Inexpensive, easy to use, portable	Will not function if they become wet
Effective in all continuous fuel types	Cannot be transported on airlines; require disclosure to helicopter pilots if transported in contract helicopters
Lightweight and have a weather-resistant wax coating	
Can be used from a utility vehicle or while walking	Special transportation requirements because they are a hazardous material
Can be used to light other ignition devices	Burn at temperatures higher than 1,400 °F
Can be carried in fireline packs	Emit noxious fumes
Burn for up to 10 minutes	Drip and splatter molten material that can burn through protective clothing
Can be connected to other fusees or a stick, keeping the burning fusee away from your body	Hard to extinguish once they are ignited, but may extinguish when thrown if they are not fully burning
Safe and stable to store, requiring little storage space	Contain potassium perchlorate that may harm fish and other aquatic species and contaminate ground water.



Situations Favorable for Fusee Use

Fusees may work well when:

- Burning grass, pine needles, leaves, brush, and similar dry fuels that ignite readily and radiate enough heat to sustain combustion
- Creating emergency safety zones

Safety Requirements

Hazard analysis information for the use of fusees is provided in the “Fusee Resources” section at the end of this chapter. Prepare and review your hazard analysis document before beginning work.

Required Personal Protective Equipment (PPE)

- Hardhat
- Flame-resistant pants
- Flame-resistant shirt
- Leather gloves
- Approved boots
- Eye protection



Figure 5-4—Use the original shipping box (shown) to transport fusees whenever possible.

if the fusees ignite. Do not transport fusees with explosives, poisonous gases, or poisonous or corrosive liquids.

- Transport fusees in a container, box, or pack. Use the original shipping box whenever possible (figure 5-4).
- Pack the fusees so they cannot shift around inside the packaging during transport.
- Secure the package so it won’t move around in the vehicle.
- Protect the package from puncture, wetting, ignition sources, and impact

Fusees may not be transported on commercial airlines. Fusees are classified by the DOT as a flammable solid. No more than 440 pounds of hazardous materials, including fusees, should be transported in one vehicle.

If you are transporting more than 440 pounds, combined total weight of fusees and other hazardous materials, DOT hazardous material training is required and you must carry shipping papers, the MSDS, and a copy of the “Emergency Response Guidebook” in the vehicle.

If you are transporting 1,001 pounds or more of fusees and other hazardous materials, you must have a commercial driver’s license in addition to DOT hazardous materials training. Shipping papers, the MSDS, and a copy of the “Emergency Response Guidebook” must be carried in the vehicle, and the vehicle must be placarded.

Fusees

Transporting Fusees

Do not transport fusees that are damaged, broken, that do not have the protective striker caps installed (figure 5-3), or that are in sealed containers that will not release pressure

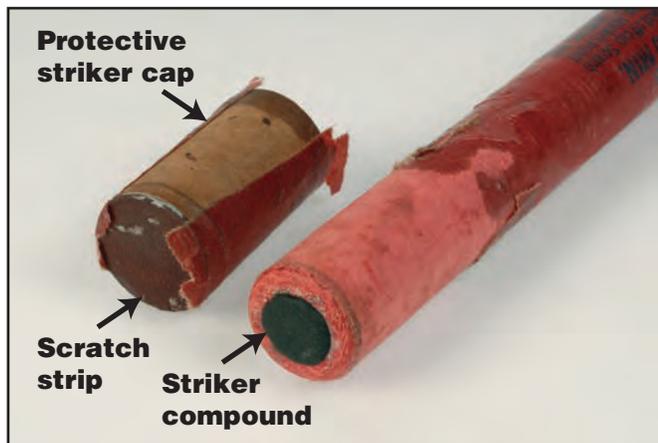


Figure 5-3—A fusee with the protective striker cap (left) removed. Do not transport fusees without the protective striker cap installed.



Qualifications

To be qualified to use a fusee for incident or project work, individuals must meet prerequisites and training requirements.

Prerequisites

Operators shall:

- Hold the position of Type 2 firefighter (FFT2) or prescribed fire crewmember (RXCM).

Instructors shall:

- Hold the position of FFT2 or RXCM.
- Demonstrate proficiency with a fusee.

Minimum Training

Operators shall:

- Read and understand the information in this chapter.
- Read the manufacturer's operating instructions.
- Receive operational training from an instructor.

Instructors shall:

- Demonstrate proficiency with a fusee.

Safety Precautions

- Always read and follow the fusee manufacturer's warnings, precautions, and safety instructions.
- Inspect each fusee for damage and for missing protective striker caps.
- Do not use fusees that are damaged.
- Do not transport fusees that are missing their protective striker caps.
- Do not expose fusees to open flames or temperatures higher than 167 °F.
- Always hold burning fusees downwind and downward, well away from your body. Fusees drip molten materials (figure 5-5) that can burn through protective clothing and cause serious burns.
- Do not breathe the fumes. Fusees emit noxious smoke.
- Do not look directly at the flames of fusees.
- Do not ignite a fusee until you are ready to use it.
- Keep burning fusees well away from people and other objects.
- Do not take fusees inside your fire shelter during deployment.



Figure 5-5—Fusees drip molten material that can cause serious burns.



Normal Operating Procedures for Fusees

- Remove the protective striker cap (figure 5–6) and ignite the fusee away from your body.
- Once a fusee has been lit, never carry it outside the area to be burned because molten materials can drip and start fires.
- Use a stick or other fusees as an extension handle (figure 5–7) to keep burning fusees away from your body during burning operations.
- When throwing a fusee, make sure all other people are away from you so they will not be hit with molten material.
- Make sure fusees are fully burning before throwing them.
- Allow fusees to burn completely (figure 5–8). Unburned and partially burned fusees contain potassium perchlorate that should not be allowed to contact surface or ground water because it may harm fish and other aquatic species and contaminate ground water.
- Pick up all the used striker caps and dispose of them properly.



Figure 5–7—Several fusees may be joined together to form an extension handle to keep burning fusees away from your body.

Fusees

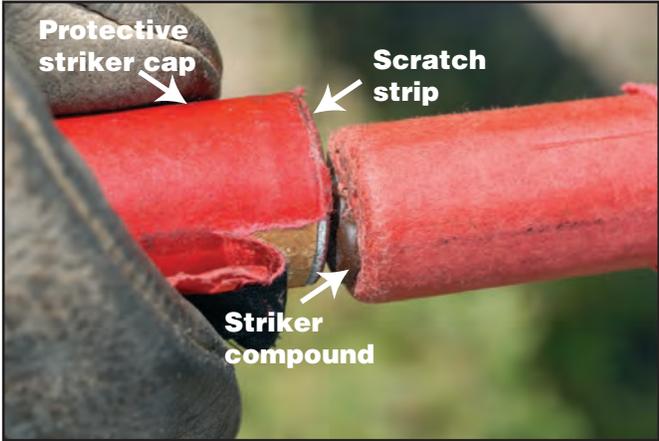


Figure 5–6—Use the striker on the end of the protective cap to ignite the fusee. Always strike the fusee away from your body.



Figure 5–8—Allow fusees to burn completely. The ferrule usually does not burn completely.



Storage

- Store fuses in a clean, dry place at temperatures from 40 to 90 °F.
- Avoid storing fuses at temperatures higher than 120 °F for longer than 1 week. Normal recommended storage temperatures are from 40 to 90 °F.
- Never store fuses near an ignition source (such as sparks or flames).
- Keep fuses away from oil and water and out of direct sunlight.
- Rotate the stock of fuses to keep a fresh supply.
- Do not stack heavy items on fuses.

For further storage information, consult the “Everyday Hazmat User’s Training Guide,” agency policy, and your local hazardous materials coordinator.

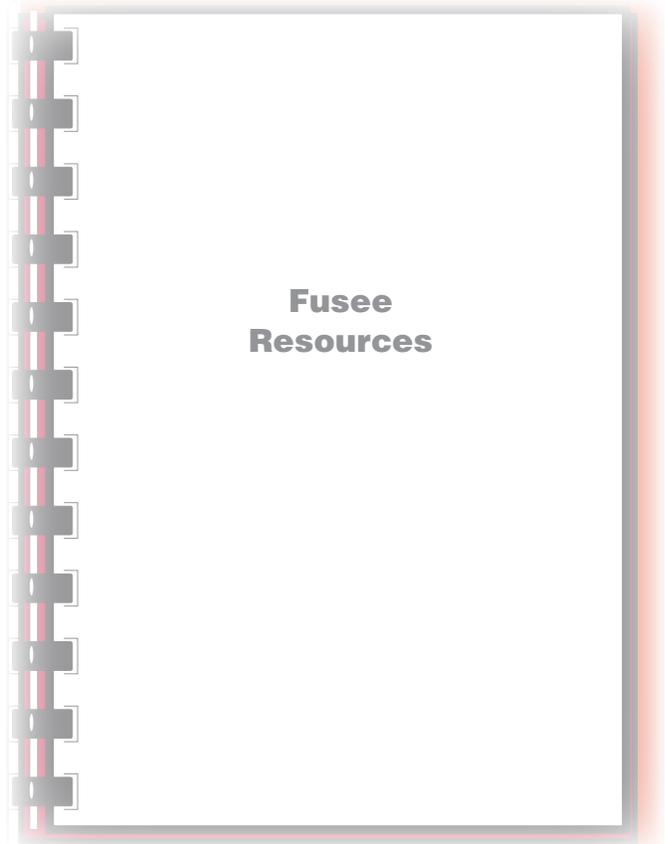
Disposal of Fuses

Dispose of fuses in accordance with Federal, State, and local requirements. If you are unsure about these requirements, contact a hazardous waste disposal contractor.

Fusee Resources

This section includes the following resources:

- Information for inclusion in a hazard analysis
- List of required material safety data sheets
- Equipment specifications for fuses
- Fusee references





Hazard Analysis

This information can be used when preparing a job hazard analysis (used by the Forest Service) or similar hazard analysis.

Information for Fusee Hazard Analyses		
Task	Hazards	Abatement actions
Igniting and using the fusee	Burns	Wear gloves, flame-resistant clothing, boots, a hardhat, and eye protection.
		Point the fusee away from your face and body when igniting it.
		Keep the burning fusee away from other people and objects.
		Keep fusees away from heat sources to prevent fusees from self-igniting.
Using the fusee	Noxious smoke	Hold the fusee away and downwind from your body.

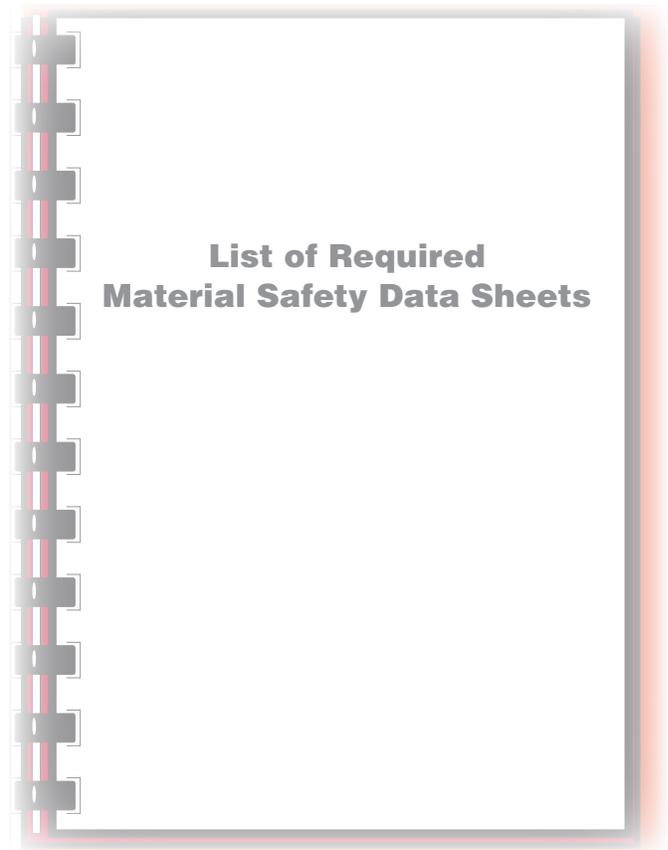


List of Required Material Safety Data Sheets

Material safety data sheets for all ground ignition systems are in appendix A. The material safety data sheets for fuses include:

- Orion fusee

The latest version of the fusee material safety data sheet is available on the Orion Web site at <<http://www.orionsignals.com/safetydata/>>.



Fuses



Equipment Specifications for Fuseses

Forest Service Specification 5100-360F, 4/09

5100-360F
April 6, 2009
Supersedes
5100-360E
June 1997

**U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

SPECIFICATION

FUSEE, BACKFIRING**

1. SCOPE

1.1 Scope. This specification covers the requirements for one size and type of hand-held water-resistant fusee.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of the invitation for bids or request for proposals (see 6.2).

SPECIFICATIONS

MILITARY

MIL-DTL-32075 - Label: For Clothing, Equipage, and Tentage (General Use)

(Unless otherwise indicated, copies of federal and military specifications and standards are available online at <http://assist.daps.dla.mil/quicksearch/> or in hard copy from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Ave., Philadelphia, PA 19111-5094. Copies of Forest Service specifications are available from the preparing activity, see 6.4.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data that may be used in improving this document should be addressed to: USDA Forest Service, Missoula Technology and Development Center, 5785 Highway 10 West, Missoula, MT 59808, ddavis02@fs.fed.us.

FSC 1370

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Equipment Specifications for Fusees (continued)

DOCUMENTS

U.S. DEPARTMENT OF TRANSPORTATION

- 49 CFR 172.420 - FLAMMABLE SOLIDS label
- 49 CFR 178.516 - Standards for fiberboard boxes

(The Code of Federal Regulations is for sale from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9325. Reprints of certain regulations may be obtained from the Federal agency responsible for issuing them.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of the solicitation.

AMERICAN SOCIETY FOR QUALITY (ASQ)

- Z1.4 - Sampling Procedures and Tables for Inspection by Attributes

(Copies are available from the American Society for Quality, PO Box 3005, Milwaukee, WI 53201-3005.)

ASTM

- D 1974 - Standard Practice for Methods of Closing, Sealing, and Reinforcing Fiberboard Boxes
- D 3951 - Standard Practice for Commercial Packaging
- D 5118 - Standard Practice for Fabrication of Fiberboard Shipping Boxes
- SI-10 - Standard For Use of the International System of Units (SI): The Modern Metric System (IEEE/ASTM Standard available from ASTM)

(Copies are available from ASTM International, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959, www.astm.org.)

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT

- National Motor Freight Classification

(Copies are available from American Trucking Associations, Inc., 2200 Mill Rd., Alexandria, VA 22314.)

(Non-Government standards and other publications normally are available from the organizations that prepare and distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.



Equipment Specifications for Fusees (continued)

3. REQUIREMENTS

3.1 First article. Unless otherwise specified (see 6.2), the item shall be subjected to first article inspection (see 6.3) in accordance with 4.3.1. During the term of the contract the contractor shall be required to notify the contracting officer in writing when a component, or the component supplier, changes in any way; when a major manufacturing process changes in any way; and when a manufacturing location changes. The contracting officer may at any time require the contractor to submit a new first article sample when substantive changes occur during the term of the contract.

3.2 Materials and construction. Materials and construction shall be as specified herein and shall provide finished fusees of sufficient strength and quality to comply with all inspection and test requirements defined in section 4.

3.2.1 Fusee body. Each fusee shall be manufactured in such a manner that it passes the strength test specified in 4.5.1 and the heat exposure test specified in 4.5.8. Each finished fusee shall have a diameter, exclusive of the protective cap and ferrule, of 1 inch +0 inches/-¼ inch. The length of the fusee, including protective cap and ferrule shall be 13 inches +1 inch/-0 inches. The base shall be closed with a plug made of wood, paper, or other appropriate material. The fusee body and shall be red in color, the shade shall be manufacturer's option.

3.2.2 Ferrule. Each fusee shall have a paper, metal, or composition ferrule of appropriate diameter to provide a snug fit over the fusee body. When constructed of paper, the ferrule shall be similar to the fusee body and shall be equal or greater in strength. The ferrule shall project not less than 2-¾ inches beyond the fusee base, and the interior shall be unobstructed to permit insertion of another fusee from which the cap has been removed. The ferrule shall be tested in accordance with 4.5.2 and 4.5.4.

3.2.3 Fusee head. The fusee head shall be the ignition end and shall have affixed to it a bead of friction type striker compound (3.2.3.1) protected by a removable cap (3.2.3.2).

3.2.3.1 Striker compound. The bead of striker compound shall be securely attached to the head of the fusee. The rim of the fusee shall be free of any such compound. The bead shall not break or become detached when the fusee samples are undergoing testing required in 4.5.4 and 4.5.5. The compound shall have an ignition temperature greater than 350 degrees Fahrenheit when tested in accordance with 4.5.7.

3.2.3.2 Protective cap. The head of the fusee shall be protected by a removable protective cap. The protective cap shall be of an appropriate diameter to provide a snug fit over the body of the fusee, and shall be constructed in such a way and of materials to protect the striker compound bead from accidental ignition or exposure. Scratch material (3.2.3.2.1) shall be affixed to the top of the plug. The cap shall be attached to the fusee body in such a manner as to facilitate cap removal but prevent accidental detachment. A secondary cap to protect the scratch material is acceptable.

3.2.3.2.1 Scratch strip. The removable portion of the cap shall include scratch material that shall be protected from exposure and shall ignite the fusee samples after they have been tested for water resistance in accordance with 4.5.4.

3.2.4 Fuel composition. Fusees containing sulphur shall contain no more than 2.6% potassium chlorate or an equivalent amount of any other chlorate. Devices containing a chlorate shall not contain ammonium salts. Compactness of the fuel shall be sufficient to pass the test specified in 4.5.5. The fuel shall not spontaneously ignite when tested in accordance with 4.5.6.

Fusees





Equipment Specifications for Fusees (continued)

3.2.5 Flame. Each fusee shall produce a flame having a minimum temperature of 1400°F when tested as specified in 4.5.3 and shall not “chimney” in any manner to significantly obscure the flame. Flame length shall be a minimum of 5 inches and flame width a minimum of ¾ inch at its widest part when tested in accordance with 4.5.3.2. Burning time of the flame shall be a maximum of 13 minutes and a minimum of 10 minutes. Color of the flame shall be either yellow or red.

3.2.6 Waterproofing. Each finished fusee shall be sufficiently coated with a water-resistant material to ensure reliable ignition and burning after long periods of storage under humid conditions and otherwise comply with the test requirements specified in 4.5.4.

3.2.7 Marking. Each fusee shall be marked with the following information in black fade-proof ink and in a size to be clearly legible at up to 3 feet. The removal of the cap instructions shall be modified as necessary to accommodate the removal method if different from the wording stated.

DIRECTIONS -- Pull tape over head of cap. Twist off cap. Scratch end of cap against black lighter on head of fusee.
ALWAYS POINT FUSEE AWAY FROM FACE AND BODY WHILE IGNITING AND AFTERWARDS.
AFTER IGNITING, HOLD 5 SECONDS BUT NOT MORE THAN 10 SECONDS BEFORE DROPPING.
(nominal burning time in minutes)1/
(month/year of manufacture)1/
(manufacturer’s name)1/
NSN 1370-00-294-1279

1/ Insert appropriate information.

3.3 Material Safety Data Sheet (MSDS). Each box (5.2), shall have an MSDS inserted prior to closing the box.

3.4 Workmanship. All items shall conform to the quality of product established by this document. The occurrence of nonconformities shall not exceed the applicable acceptable quality levels. There shall be no nonconformities that affect use, appearance, or serviceability.

3.5 Metric products. Products manufactured to metric dimensions will be considered on an equal basis with those manufactured using inch/pound units, provided they fall within the tolerances specified using conversion tables contained in the latest revision of IEEE/ASTM SI-10, and all other requirements of this specification are met.

3.6 Recovered materials. The offeror/contractor is encouraged to use recovered material to the maximum extent possible in accordance with paragraph 23.403 of the Federal Acquisition Regulation.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection and test requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his/her own or any other facilities suitable for the

Fusees



Equipment Specifications for Fusees (continued)

performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known nonconforming material, either indicated or actual, nor does it commit the Government to accept nonconforming material.

4.1.2 Responsibility for dimensional requirements. Unless otherwise specified in the contract or purchase order, the contractor is responsible for ensuring that all specified dimensions have been met. When dimensions cannot be examined on the end item, inspection shall be made at any point or at all points in the manufacturing process necessary to ensure compliance with all dimensional requirements.

4.1.3 Certificate of compliance. Where certificates of compliance (COC) are submitted, the Government reserves the right to check test such items to determine the validity of the certification (see 4.4.2.1).

4.1.3.1 COC contents. The COCs shall be supported by test reports, these test reports shall also be submitted as a part of the first article submission. Test reports supplied by the manufacturer are acceptable. The COC shall include the following:

- Specification with type, class, etc.
- Quantity purchased
- Purchase source, address, and telephone number Purchase date

4.2 Sampling for inspections and tests. Sampling for inspections and tests shall be made in accordance with ASQ Z1.4. The inspection level and acceptable quality level (AQL) shall be as specified. All fusees manufactured at one time shall be considered a lot for purposes of acceptance inspection and test. A sample unit shall be one complete fusee.

4.3 Quality conformance inspection. Each end item lot shall be sampled and inspected as specified in 4.3.2. Each lot shall be sampled and tested as specified by 4.5. Test reports showing compliance with 4.5.1 through 4.5.8 shall be submitted as part of quality conformance inspections. The packaging shall be inspected as specified in 4.4.

4.3.1 First article inspection and testing. Unless otherwise specified (see 6.2), first articles submitted in accordance with 3.1 shall be inspected as specified in 4.3.2 and tested as specified in 4.5. The presence of any nonconformity or failure to pass any test shall be cause for nonacceptance of the first article. Packaging is not required when first articles are presented. The contractor shall supply the number of fusees specified by the contract for first article inspection and testing along with laboratory test reports documenting findings of the tests specified in 4.5. Such testing shall have been done by a laboratory acceptable to the Government. The contractor shall supply two copies of the test reports to the contracting officer or contracting officer's representative, and include two more copies of the test reports with the first article samples themselves. The test reports shall identify the name of the testing laboratory and shall be signed by the test engineer, chemist, or other appropriate laboratory official.

Fusees





Equipment Specifications for Fusees (continued)

4.3.2 End item examination. The end items shall be examined for the nonconformities listed in table I. The inspection level shall be I, the acceptable quality level (AQL), expressed in terms of nonconformities per hundred units, shall be 4.0.

TABLE I. Classification of nonconformities

<u>Examine</u>	<u>Nonconformity</u>	<u>Classification</u>	
		<u>Major</u>	<u>Minor</u>
Fusee	Overall length of tube not as specified	X	
	Overall diameter of tube not as specified	X	
	Any part broken, bent, or otherwise damaged	X	
	Color not as specified		X
Ferrule	Depth not as specified	X	
Markings	Omitted, incomplete, incorrect, illegible, or misplaced		X

4.4 Packaging examination. The fully packaged end items shall be examined for the nonconformities in Table II. The sample unit shall be one shipping container fully prepared for delivery except that it need not be closed. Nonconformities of closure listed in Table II shall be examined on shipping containers fully prepared for delivery. The lot size shall be the number of shipping containers in the end item inspection lot. The inspection level shall be S-2 and the AQL, expressed in terms of nonconformities per hundred units, shall be 2.5.

Table II. Packaging Examination

<u>Examine</u>	<u>Nonconformity</u>
Markings	Omitted; incorrect; illegible; of improper size, location, sequence, or method of application.
Materials	Any component missing or not as specified. Any component damaged, affecting serviceability.
Workmanship	Inadequate application of components, such as: incomplete closure of container flaps, improper taping, loose strapping, inadequate stapling. Bulged or distorted container.
Contents	Number of items per container is more or less than required.

4.5 End item testing. Unless otherwise specified, the sample size for testing shall be S-3 and the AQL expressed in terms of nonconformities per hundred units shall be 2.5 for all testing. The samples selected as specified shall be evenly divided into two groups. One group shall be subjected to the tests specified in 4.5.1, 4.5.2, and 4.5.3. The other group shall be subjected to the tests specified in 4.5.4 and 4.5.5. Any sample that fails to comply with its specified tests shall be classified as a nonconforming and rejected. In addition, should the bead of striker compound come loose from its fusee head when attempting to ignite the fusee during testing specified in 4.5.4 and 4.5.5, that sample shall be classified as a nonconforming and rejected.

Fusees



Equipment Specifications for Fusees (continued)

For the tests required in 4.5.6, 4.5.7, and 4.5.8 a separate random sample of 15 fusees, 5 for each test, shall be selected from the lot and tested as specified. If any sample in any test fails, the lot shall be rejected.

4.5.1 Fusee body strength. The strength test to determine compliance with 3.2.1 shall be conducted as described and illustrated in figure 1. Any visible evidence of the fusee breaking within 5 minutes shall constitute a failure of the sample.

4.5.2 Ferrule strength. Ferrule testing to determine compliance with 3.2.2 shall be conducted as illustrated in figure 2. Complete separation of the fusees at the slip joint within 1 minute shall constitute failure of the ferrule and of the sample fusee.

4.5.3 Flame test. The flame as specified in 3.2.5 shall be tested as follows:

4.5.3.1 Flame temperature. The sample torch shall be ignited then inclined, ignition end down, at an angle of approximately 20 degrees from the vertical. The flame temperature shall be determined within the flame, approximately 2 inches from the base of the flame. Any non-conformance to specified requirements shall constitute a failure for that sample.

4.5.3.2 Flame dimension. The flame shall be measured while the torch is held at the same angle as specified for the flame temperature test (4.5.3.1). Flame length shall be measured from the burning end of the torch to the tip of the flame. Flame width shall be measured near its middle or apparent maximum width.

4.5.3.3. Burning time. To determine burning time, the fusee shall be held in the same position as for the flame temperature test (see 4.5.3.1).

4.5.4 Water resistance. The torch shall be submerged horizontally to a depth of 1 inch in water maintained at room temperature ($70^{\circ} \pm 5^{\circ}\text{F}$) for 20 minutes. Immediately after the soak period, the torch shall be ignited by use of the ignition cap provided and shall burn for a minimum of 1 minute before proceeding to the test in 4.5.5. Any non-conformance to specified requirements shall constitute a failure of the sample. Also any noticeable decrease in ferrule strength of the sample, after soaking, shall constitute failure of the sample.

4.5.5 Fuel compactness. This test shall be performed immediately after the test specified in 4.5.4 and with the same sample. After the fusee has been allowed to burn for a minimum of 1 minute from the previous test, the tester shall grasp the fusee by the ferrule, holding the sample 45 degrees from the horizontal, with the arm fully extended horizontally in front of the body. In this position, the tester shall swing the fusee through a 90° arc starting straight out (horizontally) from the body to straight down (vertically) and backup up to complete one cycle. Each cycle shall be completed in 1 second and five consecutive cycles shall be made to complete the test. If the sample does not remain ignited throughout the test, the sample shall be considered nonconformant and rejected. Note: Re-ignition of the fuel by the flame from the burning paper tube shall not be considered as maintaining ignition of the fuel.

4.5.6 Spontaneous ignition. A 20-gram sample of the fuel shall be taken from each of the 5 sample fusees. Each 20-gram sample shall be moistened with 5 grams of water then placed in separate, loosely covered vessels (beakers). The vessels shall then be placed in an oven for 72 consecutive hours maintained at a temperature of $212^{\circ}\text{F} \pm 5^{\circ}\text{F}$. If spontaneous combustion occurs to 1 or more samples during the 72-hour exposure period, the lot shall be rejected.





Equipment Specifications for Fusees (continued)

4.5.7 Ignition temperature. The ignition head and 20 grams of fuel shall be taken from each of 5 sample fusees. Each ignition head and each 20-gram fuel sample shall be placed in separate vessels. The 10 vessels shall then be placed in an oven maintained at a temperature of 350°F ±5°F for 1 hour. Ignition or explosion of any ignition head or fuel sample shall cause nonacceptance of the lot. An oven warm-up period may be permissible provided the vessels remain in the oven at 350°F for one hour.

4.5.8 Heat exposure. Five sample fusees shall be placed in an oven maintained at a temperature of 167 -0° +5°F for 48 hours. If any sample ignites or shows visible decomposition or failure of components, except for the exterior waterproofing, the lot shall be rejected.

5. PACKAGING

5.1 Preservation. Preservation shall be as specified in the contract or purchase order.

5.2 Packing. Seventy-two (72) fusees together with an appropriate material safety data sheet shall be packed into a fiberboard box meeting the requirements of 49 CFR 178.516. The box shall conform to the latest version of ASTM D 5118 and comply with the National Motor Freight Classification. The size of the box shall be 14-½ inches by 12-½ inches by 5-¾ inches, +/- ½ inch. Closure shall be with a nonmetallic banding.

5.3 Marking. In addition to any special marking required by this specification, marking shall be in accordance with the contract or purchase order.

6. NOTES

6.1 Intended use. This fusee is designed to be used by wildland firefighters for backfiring and by individuals conducting controlled burning operations. The ferrule is designed to have another fusee, or a properly sized stick, inserted to lessen the need to bend over to use.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of the specification.
- b. When first article samples are not required (see 3.1, 4.3.1, and 6.3).
- c. When certificates of compliance are acceptable in lieu of lot by lot testing (see 4.3.1).
- d. Preservation, packing, and marking required in addition to specification requirements (see section 5).

6.3 First article. First articles are required and shall be inspected and approved under the appropriate provisions of FAR 52.209. The contracting officer should specify the appropriate type of first article and the number of units to be furnished. The contracting officer should include specific instructions regarding arrangements for selection, inspection, and approval of the first articles.

6.4 Preparing activity. USDA Forest Service, Missoula Technology and Development Center, 5785 Highway 10 West, Missoula, MT 59808, ddavis02@fs.fed.us.



Fusee References

See appendix B for additional ground ignition references.

Everyday Hazmat User’s Training Guide, 0471–2810–MTDC, available at <http://www.fs.fed.us/eng/everyday_hazmat/users_guide.htm>.

Specification 5100-360F, Fusee, Backfiring, available to Forest Service and BLM employees at <<http://fsweb.mtdc.wo.fs.fed.us/programs/fire/specs.htm>>. Other agency employees can contact the MTDC ignition specialist at 406–329–3900.

Fusees



Chapter 6—Gelled Fuel Blivets

Equipment Description

In the past, blivets were made locally by filling plastic bags with gelled gasoline. Because of the hazards of mixing, packaging, and transporting gelled gasoline, commercial blivets are a better alternative. Commercial blivets are about 10 inches long and 1¾ inches in diameter and contain an alcohol-based gel (figure 6–1). They may be ignited with a drip torch, fusee, or other means and will produce a strong, open flame that lasts about 20 minutes.



Figure 6–1—This commercially available blivet is called a FireSnake or Heat Source Slash Burner.

Sources of Equipment That Meets Standards

Heat Source Slash Burners are one commercial brand of gelled fuel blivets. These blivets, also known as FireSnakes, are available from Wildfire at <<http://www.wildfire-environmental.com>>, (800–426–5207), which has two regional offices:

Wildfire
 16311 NE. Cameron Blvd.
 Portland, OR 97230
 Phone: 503–257–7900
 Fax: 503–257–7979

Wildfire
 950 Riverside Parkway
 Suite 50
 West Sacramento, CA 95605
 Phone: 916–372–9004
 Fax: 916–372–9006

Advantages and Disadvantages of Using Gelled Fuel Blivets	
Advantages of using gelled fuel blivets	Disadvantages of using gelled fuel blivets
Long-lasting flame ignites slash piles that are damp or that do not have enough fine fuels to ignite with a drip torch	The concentrated heat source is not suited for igniting large areas
Easily transported on foot; small enough that several can be carried in a pack	Blivets may leak and contaminate a pack
	Locally made blivets require highly flammable fuel to be mixed with a gelling agent



Situations Favorable for Gelled Fuel Blivet Use

A gelled fuel blivet may work well when:

- Slash piles or concentrated pockets of fuel do not have enough fine fuels to ignite with a drip torch
- Burning during wet or cold weather.

Safety Requirements

Hazard analysis information for gelled fuel blivet operations is provided in the “Gelled Fuel Blivet Resources” section at the end of this chapter. Prepare and review your hazard analysis document before beginning work.

Required Personal Protective Equipment (PPE)

- Hardhat
- Flame-resistant pants
- Flame-resistant shirt
- Leather gloves
- Approved boots
- Eye protection

Transporting Gelled Fuel Blivets

Heat Source Slash Burners and other gelled fuel blivets are Packing Group II flammable liquids (Class 3).

- Transport blivets in the original steel pails (figure 6–2) that the distributor shipped them in.

- If the pails have been discarded, transport the blivets in DOT specification containers, such as UN 1A2 drums or steel pails 5 gallons or smaller.
- Install a FLAMMABLE LIQUID label (figure 6–3) on the pail or drum if the drum or pail does not already have one.
- For Heat Source Slash Burners only, mark the drum or pail with ISOPROPANOL if the drum or pail has not already been marked by the vendor.
- Include the required MSDS with each shipment.
- Make sure that all fuel containers are properly secured during transportation.
- Avoid transporting more than 440 pounds of hazardous materials, including blivets, in one vehicle. All hazardous materials must be in containers smaller than 8 gallons and weigh 66 pounds or less.

If you are transporting more than 440 pounds of blivets or other hazardous materials or if any fuel container is larger than 8 gallons or weighs more than 66 pounds, DOT hazardous materials training is required. Shipping papers and a copy of the “Emergency Response Guidebook” must be carried in the vehicle.

If you are transporting 1,001 pounds or more of fuel blivets or if any container is larger than 119 gallons, the driver must have a commercial driver’s license (CDL) and DOT hazardous materials training. Shipping papers and a copy of the “Emergency Response Guidebook” must be carried in the vehicle, and the vehicle must be placarded.



Figure 6–2—Transport blivets in a UN 1A2 steel pail or another container that meets DOT specifications.

Qualifications

To be qualified to use gelled fuel blivets for incidents or projects, individuals must meet prerequisites and training requirements.

Prerequisites

- Operators shall:
- Hold the position of Type 2 firefighter (FFT2) or prescribed fire crewmember (RXCM).

- Instructors shall:
- Hold the position of FFT2 or RXCM.
 - Demonstrate proficiency with gelled fuel blivets.

Minimum Training

- Operators shall:
- Read and understand the information in this chapter.
 - Read the blivet manufacturer’s operating instructions.
 - Receive operational training from an instructor.

- Instructors shall:
- Demonstrate proficiency with gelled fuel blivets.

Inspecting Gelled Fuel Blivets

Before gelled fuel blivets are used, inspect each blivet for leakage and damage.



Figure 6–3—Make sure a FLAMMABLE LIQUID label is installed on pails used to carry blivets.



Normal Operating Procedures for Gelled Fuel Blivets

The operator must wear the proper PPE.

Preparing Blivets for Use

Line a pack with plastic to prevent blivets from soaking the pack if they leak.

- Remove the blivets from the steel pail they're shipped in (figure 6-4).
- Inspect each blivet to make sure it's not leaking before putting the blivet in the pack.
- Seal each leaking blivet in a separate plastic bag. Use these blivets first.
- Do not allow gel to leak on clothing or skin.



Figure 6-5—Blivets can be ignited with a drip torch.



Figure 6-6—This blivet is completely ignited.

Gelled Fuel Blivets



Figure 6-4—Put blivets inside a plastic bag before carrying them in the field.

Preparing Blivets for Transportation and Storage

- After burning operations are complete, remove the unused blivets from the pack and return them to the pail they were shipped in.
- Once all blivets have been returned to the pail they were shipped in, seal the pail for transport and storage (figure 6-7).



Figure 6-7—This steel pail is properly sealed for transport and storage.

Using Blivets

- Remove the blivet from the pack and place the blivet where fuel is closely packed.
- Ignite the blivet with a drip torch, fusee, or other ignition device (figure 6-5).
- Make sure that the blivet has ignited (figure 6-6).
- Verify that the blivet has ignited the fuel in the pile before moving to the next location.

Maintenance and Storage

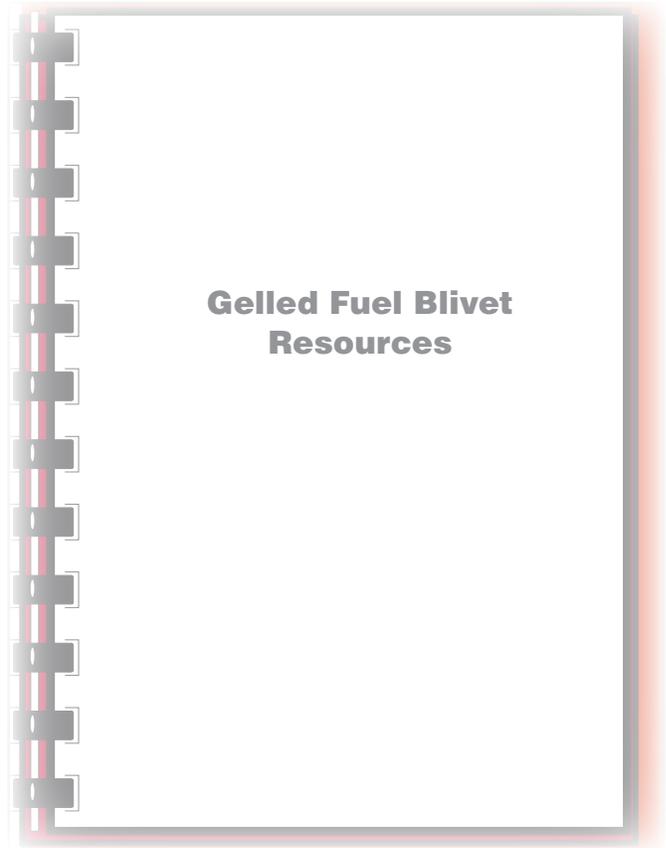
Store the unused blivets inside their shipping pails in a storage area for flammable materials.



Gelled Fuel Blivet Resources

This section includes the following resources:

- Information for inclusion in a hazard analysis
- List of required material safety data sheets
- Equipment standards for gelled fuel blivets
- Contract equipment inspection checklist
- Gelled fuel blivet references



Gelled Fuel Blivets



Hazard Analysis

This information can be used when preparing a job hazard analysis (used by the Forest Service) or similar hazard analysis.

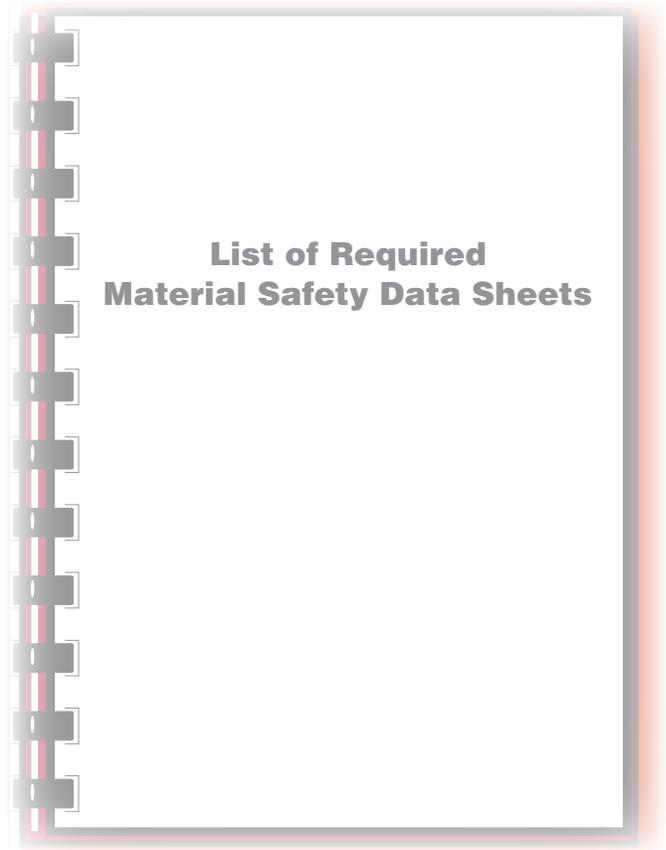
Information for Gelled Fuel Blivet Hazard Analyses		
Task	Hazards	Abatement actions
Transporting blivets	Container leakage, identification of contents	Use only DOT-specification containers for transporting blivets. Properly seal containers before transporting blivets. Properly label and mark containers.
Using blivets	Exposure to gelled fuel	Inspect blivets for leaks before use. Place leaking blivets in a plastic bag; make sure that the bag does not leak. Use plastic to line a pack or use a plastic bag inside the carrying bag when carrying the blivets in the field.
	Burns	Wear proper PPE, including leather gloves. Ensure PPE does not become contaminated with fuel. Set the blivet in place before igniting it. Do not attempt to move or throw burning blivets.



List of Required Material Safety Data Sheets

Material safety data sheets for all ground ignition systems are in appendix A. The material safety data sheets for gelled fuel blivets include:

- FireSnake/Heat Source Slash Burner



Gelled Fuel Blivets



Equipment Standards for Gelled Fuel Blivets

- The blivet casing must be compatible with the gel and must not degrade because of contact with the gel.
- The casing must be sealed so the blivet does not leak.
- The casing must be durable enough to withstand normal transportation and handling.
- A drip torch should be able to ignite the casing.
- Blivets must be small enough that several can be carried in a pack or carrying bag.
- Blivets must not “flash” when ignited.
- Blivets must burn for at least 15 minutes.
- The flame from the blivet must be able to ignite 10-hour fuels, such as 1-inch diameter branches.

Contract Equipment Inspection Checklist

- Contract gelled fuel blivets must meet the standards established in this chapter.

Gelled Fuel Blivet References

See appendix B for additional ground ignition references.

Everyday Hazmat User’s Training Guide, 0471–2810–MTDC, available at http://www.fs.fed.us/eng/everyday_hazmat/users_guide.htm.



Chapter 7—Plastic Spheres and Launchers

Equipment Description

Plastic spheres, originally developed for aerial ignition systems, have been adapted for ground ignition. Each sphere contains potassium permanganate. During burning operations, the sphere is injected with ethylene glycol (automotive antifreeze). After about 20 seconds, a chemical reaction ignites the plastic in the sphere (figure 7-1). The burning sphere ignites the surrounding vegetation.

Three manufacturers make plastic spheres that can be used for ground ignition. All of these spheres contain about 3 grams of potassium permanganate. The white spheres manufactured by PremoFire (Vanguard Plastics Ltd.) and those manufactured for Aerostat, Inc. are 1¼ inches in diameter. The orange-and-white plastic spheres manufactured by SEI Industries Ltd. are 1 inch in diameter (figure 7-2). If you are using a commercially produced sphere launcher, make sure you use the proper spheres.



Figure 7-1—A burning plastic sphere.



Figure 7-2—Plastic spheres shown from left to right: Premo, Aerostat, and SEI.

Plastic Spheres and Launchers

Advantages	Advantages and Disadvantages of Using Plastic Spheres and Launchers	
	Advantages of using plastic spheres and launchers	Disadvantages of using plastic spheres and launchers
○	Plastic spheres allow remote ignition in steep or inaccessible terrain	Plastic spheres do not burn as intensely as flares or other types of ignition systems, which can limit the sphere's effectiveness in certain types of vegetation
	Plastic spheres cost much less than flares (about 25 cents per sphere compared to about \$5 per flare)	Plastic sphere launchers are not as convenient to carry as flare launchers
	Plastic spheres work well in 1-hour fuels, such as grass, needles, and leaves, and are good for understory burning	Plastic sphere launchers can be three times more expensive than flare launchers



Slingshots, available at most sporting goods stores, can be used to launch plastic spheres (figure 7-3). To make it easier to inject ethylene glycol, drill a hole into the plastic sphere and cover the hole with Cellophane tape. The sphere may be injected through the tape using a syringe filled with ethylene glycol. You will need to inject about 1 cubic centimeter of ethylene glycol. Load the sphere into the slingshot and shoot it 150 to 200 feet toward the area you want to burn.



Figure 7-3—Slingshots may be used to launch plastic spheres.

Field Support Services of Chamblee, GA, has developed the PyroShot plastic sphere launcher, which uses compressed springs to launch SEI plastic spheres (figure 7-4). The launcher's plastic reservoir is filled with ethylene glycol and the hopper is filled with plastic spheres. The operator points



Figure 7-4—The PyroShot plastic sphere launcher.

the launcher in the desired direction, pulls back on the slide, and pushes the slide forward. The launcher injects the sphere with ethylene glycol and propels it about 50 feet.

The PyroShot HS (figure 7-5), also developed by Field Support Services, is a handheld plastic sphere launcher that uses nonflammable compressed gas, such as air or carbon dioxide, to propel SEI plastic spheres. The launcher's plastic reservoir is filled with ethylene glycol and the hopper is filled with plastic spheres. The operator points the launcher in the desired direction, pulls back the front grip to prime the sphere with glycol, pushes forward on the front grip as far as possible to drop the sphere into the chamber, pulls back using the metal hook to seal the barrel, and then pulls the trigger to launch the sphere. The launcher can propel a sphere about 300 feet, depending on the gas pressure setting.

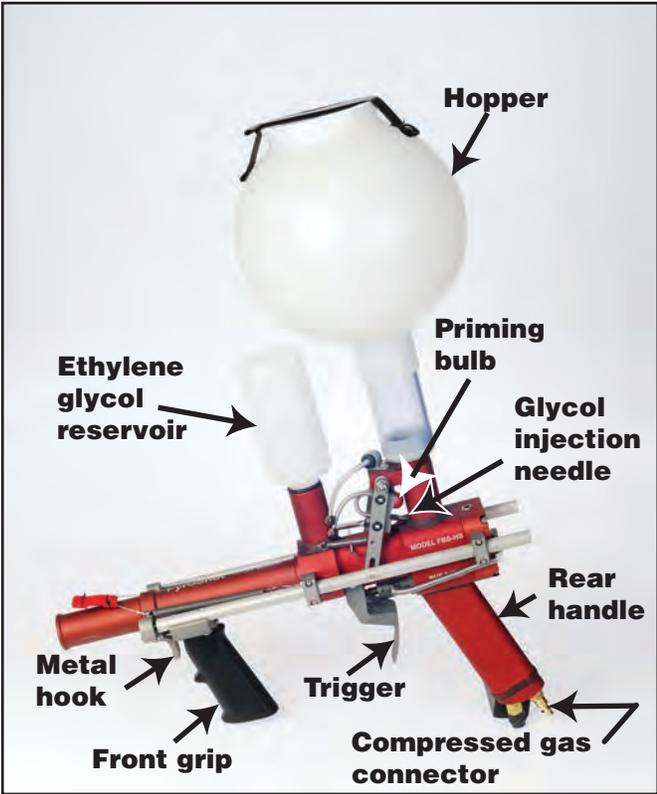


Figure 7-5—The PyroShot HS plastic sphere launcher with an optional 150-sphere hopper.

The PyroShot HS needs to be kept clean to prevent potassium permanganate and glycol from building up between the priming and firing chambers. Clean the residue at least at the end of each day or when spheres hesitate to fall into the chamber.

The compressed gas causes the PyroShot HS to launch plastic spheres with considerable power. Additional caution should be used to avoid injuring others and to prevent igniting areas outside the burn area.

The SEI Green Dragon (figure 7-6) is a plastic sphere launcher that was being developed at the time this guide was written. The Green Dragon is designed to be mounted on a wide range of vehicles and to use nonflammable compressed gas, such as air or carbon dioxide, to propel SEI plastic spheres. Prototypes of the launcher can propel a sphere about 200 feet, depending on the gas pressure setting. Contact SEI Industries Ltd. for more information.



Figure 7-6—The SEI Green Dragon plastic sphere launcher mounted on a UTV.



Sources of Equipment That Meet Standards

Plastic Spheres

Aerostat

Distributor

Aerostat, Inc.
8830 Airport Blvd.
Leesburg, FL 34788
Phone: 352-787-1348

Premo

Manufacturer and Distributor

PremoFire (a Vanguard Plastics Ltd. company)
20160 92A Ave.
Langley, BC, Canada V1M 3A4

SEI

Manufacturer

SEI Industries Ltd.
7400 Wilson Ave.
Delta, BC, Canada V4G 1E5

Distributors

Field Support Services
2001 Flightway Dr.
Chamblee, GA 30341
Phone: 770-454-1130

Type One Incident Support, Inc.
P.O. Box 8209
Bend, OR 97708-8209
Phone: 541-330-4340

Ethylene Glycol Antifreeze

Use only undiluted ethylene glycol automotive antifreeze or laboratory-grade ethylene glycol. Do not use the propylene glycol antifreeze that is often advertised as being environmentally safe.

PyroShot Plastic Sphere Launcher

Manufacturer

Field Support Services
2001 Flightway Dr.
Chamblee, GA 30341
Phone: 770-454-1130

Distributors

Field Support Services
2001 Flightway Dr.
Chamblee, GA 30341
Phone: 770-454-1130

Type One Incident Support, Inc.
P.O. Box 8209
Bend, OR 97708-8209
Phone: 541-330-4340

Situations Favorable for Plastic Sphere Use

Plastic spheres may work well when:

- Burning dry, light fuels, such as grasses, needles, and leaves.
- Burning areas where foot access is limited, such as canals, cliffs, or areas of thick vegetation.



Safety Requirements

Hazard analysis information for plastic spheres and launchers is provided in the “Plastic Sphere Resources” section at the end of this chapter. Prepare and review your hazard analysis before beginning work.

- The operator and everyone nearby shall be wearing PPE, including eye protection.
- Always keep the launcher or slingshot pointed away from all personnel and equipment.
- Do not inject a sphere with antifreeze until the moment you are ready to launch it.
- Use the proper size sphere for the launcher.

Required Personal Protective Equipment (PPE)

- Hardhat
- Flame-resistant pants
- Flame-resistant shirt
- Leather gloves
- Approved boots
- Eye protection

Transporting Plastic Spheres and Ethylene Glycol Antifreeze

Transportation in Vehicles—Plastic Spheres

- The potassium permanganate in plastic spheres is classified by the DOT as a Division 5.1 Oxidizer
- Transport plastic spheres in the manufacturer’s original boxes.
- Do not transport plastic spheres in the same compartment as ethylene glycol antifreeze.
- Do not transport plastic spheres with explosives, poisonous gases, or poisonous liquids.

A total of no more than 440 pounds of hazardous materials, such as gasoline, drip torch fuel, diesel, fuses, and plastic spheres, should be carried in one vehicle.

If plastic spheres must be transported with flammable liquids (such as gasoline) or corrosive liquids (such as Flash 21 gelling agent), they must be separated so that the contents from any leaking package cannot contact the contents of any other package.

Transportation in Vehicles—Ethylene Glycol Antifreeze

- Transport antifreeze in the manufacturer’s original containers.
- Make sure that the containers do not leak before transporting them.
- Secure containers so they will remain upright during transport.
- Do not transport antifreeze in the same compartment as plastic spheres.

Transportation in Aircraft

- Separate plastic spheres from antifreeze (glycol) containers so that the contents from any leaking container of plastic spheres cannot contact the contents of any leaking container of antifreeze.
- Do not transport plastic spheres where they could be exposed to batteries or battery fluids.
- Do not transport plastic spheres with explosives.

For more information, see the “Interagency Aviation Transport of Hazardous Materials” guide (NFES 1068).



Qualifications

To be qualified to use plastic spheres and launchers at incidents or during projects, operators must meet prerequisites and training requirements.

Prerequisites

Operators shall:

- Hold the position of Type 2 firefighter (FFT2) or prescribed fire crewmember (RXCM).

Instructors shall:

- Hold the position of FFT2 or RXCM.
- Demonstrate proficiency with a plastic sphere launcher.

Minimum Training

Operators shall:

- Read and understand the information in this chapter.
- Read the plastic sphere launcher manufacturer's operating instructions.
- Demonstrate proficiency annually in operating, maintaining, and troubleshooting a plastic sphere launcher, under the guidance of an experienced operator.

Instructors shall:

- Be selected by the local fire management officer or the officer's designee.
- Demonstrate proficiency annually in operating, maintaining, and troubleshooting a plastic sphere launcher.

Inspecting Plastic Spheres and Launchers

Before plastic spheres and launchers are used, the equipment must be inspected and readied for the field.

Plastic Sphere Inspections

- Inspect spheres for cracks, defective seams, breakage, and other damage. Do not use damaged spheres.
- Make sure that the potassium permanganate is granulated and has not formed a solid mass inside the sphere.

Slingshot (Launcher) Inspections

- Inspect the rubber tubing for brittleness, weather checking, cuts, and other damage. Replace rubber tubing as needed.
- Inspect the handle for bends, breakage, and other damage. Repair or replace the slingshot as necessary.

PyroShot Launcher Inspections

- Inspect the launcher following the instructions in the inspection section of the PyroShot launcher operator's manual.
- Repair the launcher as necessary before use.



Normal Operating Procedures for Slingshots

- If you're using a sling shot, drill holes in the spheres so you can inject ethylene glycol. Here's how:
 - » Prepare a wooden block to support the sphere by drilling a hole smaller than the sphere (figure 7-7).



Figure 7-7—Support the sphere on a wooden block when drilling a hole so antifreeze can be injected.

- » When drilling the spheres, use a drill bit about twice the diameter of the needle that you will use to inject the spheres.
- » Drill a single hole through one side of each sphere, using a drill press if possible. Make sure the surface surrounding the hole is smooth.
- » Cover each hole with Cellophane tape.
- Use a two-person team: one person to prime the spheres and the other to launch them.
- The person who will launch the spheres gets the slingshot ready.
- The person priming the spheres injects about 1 cubic centimeter of ethylene glycol and immediately hands the primed sphere to the person with the slingshot.
- The person with the slingshot loads the sphere and launches it immediately.

Emergency Operating Procedures for Slingshots

- If there is a delay launching a sphere and the sphere begins to ignite, drop the sphere on the ground. Let the sphere burn itself out or extinguish it with dirt or water.



Normal Operating Procedures for PyroShot Launchers

- Fill the glycol bottle with undiluted ethylene glycol.
- Manually prime the glycol pump.
- Fill the hopper with SEI plastic spheres (orange and white).
- With the launcher pointed in the direction of the target area, grasp the handle of the launcher's barrel.
- Grasp the slide handle with the other hand.
- Place the launcher's butt plate against your hip.
- Elevate the launcher about 30 degrees. Make sure that the launcher is pointed toward the area you wish to burn.
- Pull the slide back as far as it will go, cocking the launcher.
- Push the slide all the way forward to launch a sphere.
- To adjust the launcher's range, loosen the thumbscrew and rotate the launcher's base counterclockwise (to increase the range) or clockwise (to decrease the range). Tighten the thumbscrew when the range is adjusted properly (figure 7–8).
- The launcher will pump glycol whether or not a sphere has been loaded. Make sure that the launcher does not run out of spheres while it has ethylene glycol.

For additional operating instructions, see the PyroShot launcher operator's manual.

Normal Operating Procedures for PyroShot HS Launchers

- Fill the glycol bottle with undiluted ethylene glycol.
- Manually prime the glycol pump.
- Fill the hopper with SEI plastic spheres (orange and white).
- Connect the compressed gas hose to the base of the rear handle grip and adjust to the desired pressure.
- With the launcher pointed in the direction of the target area, grasp the rear handle grip.
- Grasp the front grip with the other hand.
- Pull back on the front grip to prime the sphere with glycol.
- Push forward on the front grip until it hits the forward stop to allow the primed sphere to fall into the chamber. This will push the barrel assembly forward as far as it will go.
- Pull back on the barrel assembly using the metal hook until the barrel is fully seated. Make sure not to pull the front grip back past the point where the metal hook stops because this will prime another sphere.
- To launch the sphere, point the launcher at the desired target and pull the trigger.
- To adjust the launcher's range, adjust the pressure of the compressed gas. Excessive pressure will cause erratic flight of the spheres.
- The launcher will pump glycol whether or not a sphere has been loaded. Make sure that the launcher does not run out of spheres while it has ethylene glycol.

For additional operating instructions, see the PyroShot HS launcher operator's manual.

Emergency Operating Procedures for PyroShot and PyroShot HS Launchers

- If an injected sphere becomes lodged in the launcher, the fire may burn itself out. Drop the launcher if the fire becomes too intense.
- If an injected sphere fails to fall into the chamber of the PyroShot HS, fire will contact the priming bulb and destroy the bulb.

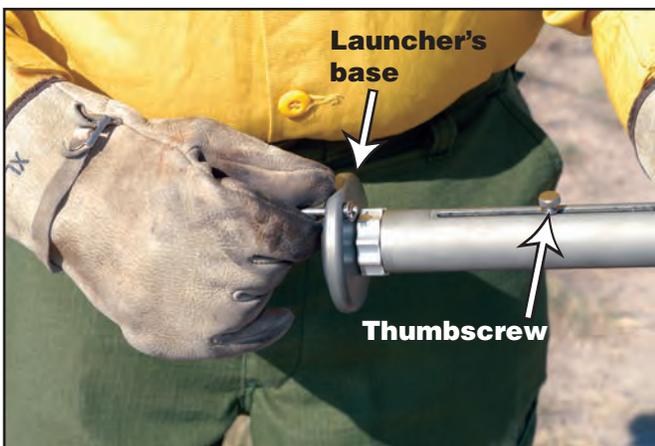


Figure 7–8—Adjusting the PyroShot launcher's range.



Maintenance and Storage

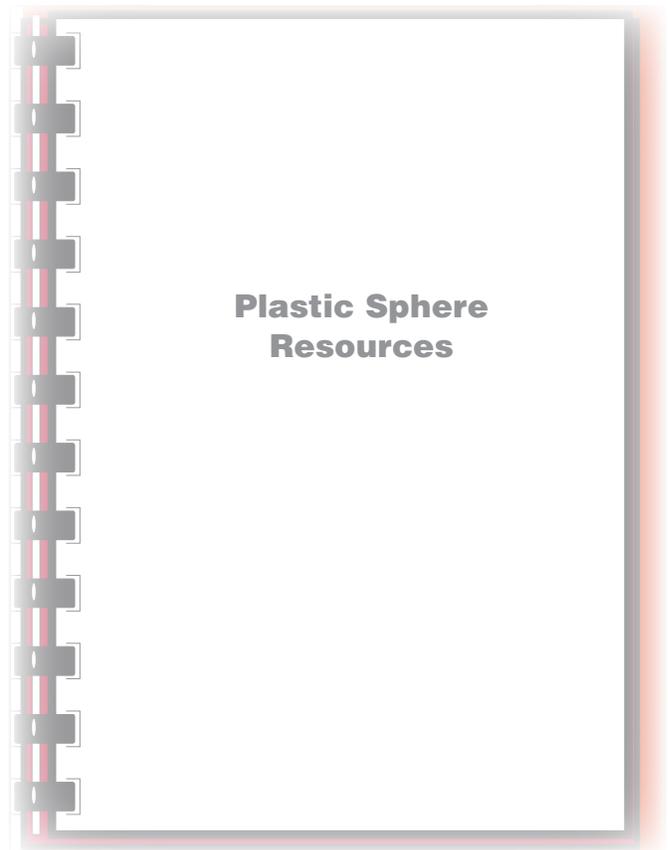
Follow these procedures to make sure the slingshots and plastic sphere launchers will be ready the next time they're needed.

- Unload spheres and glycol from the launcher.
- Return unused spheres and glycol to storage. Do not store spheres and glycol together.
- Inspect the slingshot or launcher for damage. Repair or replace the slingshot or launcher as required.
- Clean and lubricate the PyroShot launcher following the instructions in the operator's manual.

Plastic Sphere Resources

This section includes the following resources:

- Information for inclusion in hazard analyses for slingshots and PyroShot launchers
- List of required material safety data sheets
- Recommended spare parts
- Equipment standards for plastic spheres and launchers
- Contract equipment inspection checklist
- Plastic sphere and launcher references





Hazard Analysis

This information can be used when preparing a job hazard analysis (used by the Forest Service) or similar hazard analysis.

Plastic Spheres and Launchers

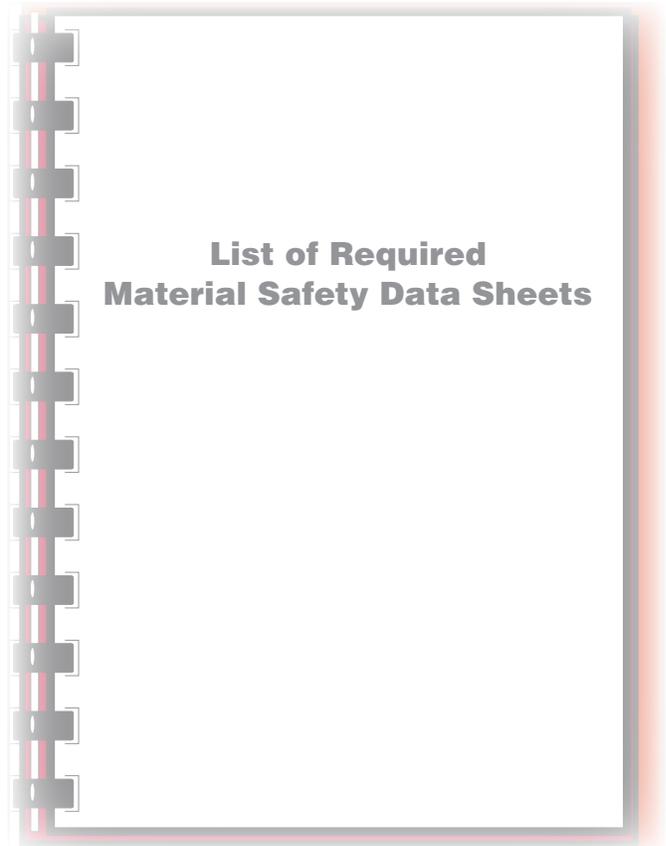
Information for Slingshot and Plastic Sphere Launcher Hazard Analyses		
Task	Hazards	Abatement actions
Drilling spheres for injection for use with slingshots	Plastic chips in eyes	Wear eye protection
	Hand injury	Use a drill press when drilling spheres.
Injecting spheres for use with slingshots	Puncture wounds to hand	Drill the spheres and cover the hole with Cellophane tape to make it easier to inject ethylene glycol and to allow the sphere to vent.
	Sphere bursting in hand	Wear leather gloves.
	Debris in eyes	Wear eye protection.
Handling primed spheres for use with slingshots	Burned hands	Wear leather gloves. At the first sign of ignition, allow the sphere to fall to the ground and ignite. Allow the sphere to burn out or extinguish it with dirt or water.
Handling a slingshot with a primed sphere	Accidental launch of primed sphere	Keep the slingshot pointed toward the area you want to burn and away from yourself and others.
Loading the launcher magazine	Accidental discharge of launcher	Make sure the launcher is not cocked.
Handling a launcher with a loaded magazine	Accidental discharge of launcher	Make sure the launcher is not cocked until you are ready to launch a sphere. Keep the launcher pointed toward the area you want to burn and away from yourself and others.
Launching spheres with launchers or slingshots	Primed sphere deflected by obstructions, landing in the launch area	Before beginning the launch sequence, note any obstructions such as tree trunks and limbs. Move to a clear area if necessary. Wear eye protection and a hardhat.
	Hitting someone with a primed sphere	Make sure that everyone is behind you in the launch area. Make sure that no one is near the target area.
	Sphere does not land where intended	Keep the launcher pointed toward the area you want to burn and away from yourself and others. Have handtools and/or water available to extinguish fires.
Handling a launcher if a primed sphere becomes lodged inside	Burned hands	If an injected sphere becomes lodged in the launcher, the fire may burn itself out. Drop the launcher if the fire becomes too intense.



List of Required Material Safety Data Sheets

Material safety data sheets for all ground ignition systems are in appendix A. The material safety data sheets for plastic spheres and launchers include:

- Ethylene glycol antifreeze
- Potassium permanganate



Plastic Spheres and Launchers



Recommended Spare Parts

- Slingshot
 - » Rubber bands
 - » Syringe and needles
- PyroShot
 - » Needles
 - » Glycol bottles
 - » Piston pin bumpers

Equipment Standards for Plastic Spheres and Launchers

Accuracy

- Launcher is accurate to within +/- 10 degrees from the point of aim.

Delay

- The spheres must not ignite within 20 seconds after being injected with ethylene glycol.

Functioning

- The launcher must not damage spheres during feeding.
- The launcher must inject the correct amount of ethylene glycol for proper ignition of the spheres.
- The needle must be the proper size or it may bend when the sphere is injected.
- The needle's design must prevent it from becoming clogged during injection.
- The launcher must not damage spheres during launch.
- The launcher must not leak glycol.
- The launcher must have a failure rate no higher than 1 percent.

Safety

- Must be capable of launching the injected sphere before it ignites.
- Must not pinch fingers during use.
- Injection needle must be located where it cannot puncture fingers or other parts of the body.



Contract Equipment Inspection Checklist

- Contract plastic spheres and launchers must meet the requirements in this chapter.
- Contract plastic spheres and launchers must be in good operating condition.

Plastic Sphere and Launcher References

See appendix B for additional ground ignition references.

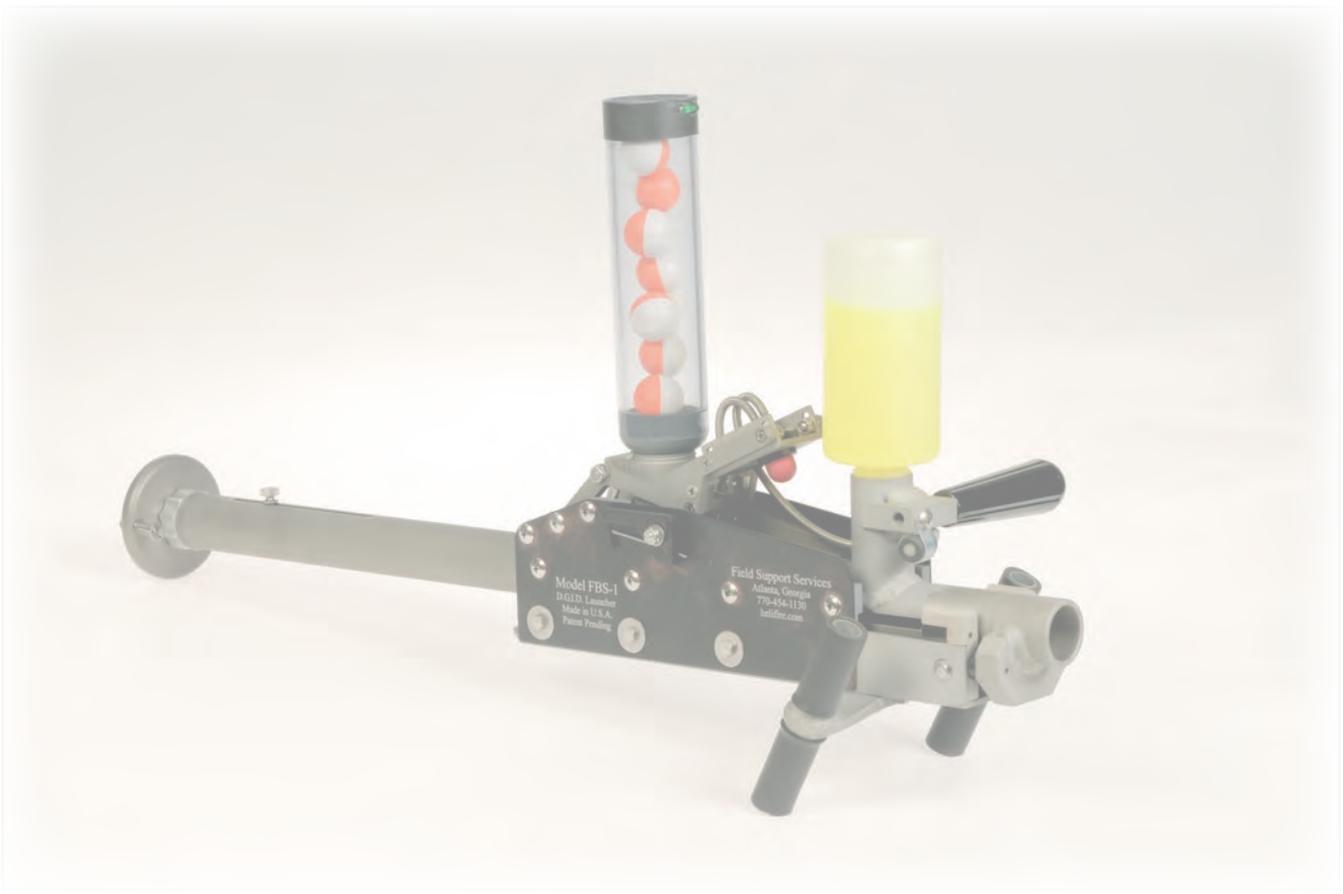
PyroShot Model FBS-1 Delayed Ground Ignition Device Launcher Operator's Manual, available at <[http://helifire.com/FBS-1 Ops Manual 7 Nov 07.pdf](http://helifire.com/FBS-1%20Ops%20Manual%207%20Nov%2007.pdf)>.

Everyday Hazmat User's Training Guide, 0471-2810-MTDC, available at <http://www.fs.fed.us/eng/everyday_hazmat/users_guide.htm>.



Notes

Plastic Spheres and Launchers



Equipment Description

Power torches (figure 8–1) are specialized ignition devices that can be used in situations where ATV torches or terra torches would not be suitable. They often are mounted on a variety of all-terrain vehicles including UTVs, airboats, swamp buggies, and marsh buggies (also known as Marsh Masters). These torches often hold more fuel than a traditional ATV torch, but less than a terra torch. They usually dispense drip torch fuel instead of the gelled fuel used by a terra torch. Power torches dispense fuel under pressure from a fuel pump through a handheld wand that has an external igniter. Power torches can shoot a stream of burning fuel farther than a traditional ATV torch but not as

far as a terra torch. Power torches encompass a variety of devices that often are built by local fire management units to fill special needs. When used properly, power torches can enhance the safety and efficiency of burn operations in many types of terrain and fuels.

Because most power torches are built locally, they may not be widely commercially available, and may vary in construction, configuration, operating procedures, and mounting options.

Situations Favorable for Power Torch Use

A power torch may work well when:

- Foot travel or ATV operations are potentially hazardous or impractical, such as when burning marshes and vegetated areas by rock pinnacles or canals.
- You need to carry more fuel (on a vehicle) or when you need to adjust the amount of fuel and the distance it is dispensed.

Sources of Equipment That Meet Standards

Most power torches are locally procured and must conform to the requirements in the “Equipment Standards for Power Torches” section at the end of this chapter.



Figure 8–1—This power torch uses the same setup and components as a UTV torch but the operator uses a handheld wand with an extension hose rather than a mounted wand.

Advantages

Advantages and Disadvantages of Using Power Torches

Advantages of using power torches	Disadvantages of using power torches
Have a larger fuel tank and can direct burning fuel farther and with greater accuracy than handheld drip torches or ATV torches	May create more fire than desired
Volume or pressure can be regulated to increase or decrease the distance and the amount of fuel used, allowing a wide variety of ignition tactics	Require careful attention to ignition tactics to prevent increased fire behavior and protect people working near the torch
May be mounted in a variety of different vehicles	
Can be used in areas where foot travel is potentially hazardous or impossible, such as marshes or canals	
Generally don't require as much training and additional support personnel as a terra torch	



Safety Requirements

Hazard analysis information for use of power torches is provided in the “Power Torch Resources” section at the end of this chapter. Prepare and review your hazard analysis document before beginning work.

Required Personal Protective Equipment (PPE)

- Hardhat
- Flame-resistant pants
- Flame-resistant shirt
- Leather gloves
- Approved boots
- Eye protection
- Hearing protection

Additional PPE may be required based on the vehicle carrying the torch. See PPE recommendations in the Safety Equipment Summary table.

Minimum Safety Devices Required

A dry chemical fire extinguisher (10–B:C minimum) shall be readily accessible, but not attached directly to the torch. The extinguisher’s location may vary; but it should be easy to reach. This extinguisher is in addition to any that may be required for the vehicle carrying the torch.

Communications

Communications between the power torch operator and support personnel are crucial for safety. Because many specialized vehicles, such as airboats and marsh buggies, are noisy, radio headsets may be needed.

Additional Safety Considerations

When a power torch is installed on an airboat or motor vessel, a vessel (or airboat) is needed that can be used in case of equipment failure during burning operations. This vessel needs to be in front of the ignition vessel.

If the power torch is installed in an airboat or motor vessel, extra care shall be taken. The combined weight of the fueled torch and operators must not exceed the rated vessel capacity and must not upset the vessel’s balance.



Safety Equipment Summary				
	Airboats	Marsh buggies	Rollagons/ Swamp buggies	Aluminum boats
PPE	Nomex life jackets Standard fireline PPE	Standard fireline PPE	Standard fireline PPE	Nomex life jackets Standard fireline PPE
Communications	Radio headsets	Radio headsets	Radio headsets	Radio headsets
Fire extinguishers	10–B:C minimum (for ignition device)			
Other safety considerations	Additional lead airboat	Winch	Winch	Additional lead boat
Equipment operator requirements	Agency-specified training	Agency-specified training	Agency-specified training	Agency-specified training
Weight limits	Within vessel certification	Within vehicle load limits	Within vehicle load limits	Within vessel certification
Mounting requirements	Bolt or affix the torch's skid to the deck of the vessel or vehicle. The unit must be electrically bonded to the vessel or vehicle to prevent static electricity from building up.	Bolt or affix the torch's skid to the deck of the vessel or vehicle. The unit must be electrically bonded to the vessel or vehicle to prevent static electricity from building up.	Bolt or affix the torch's skid to the deck of the vessel or vehicle. The unit must be electrically bonded to the vessel or vehicle to prevent static electricity from building up.	Bolt or affix the torch's skid to the deck of the vessel or vehicle. The unit must be electrically bonded to the vessel or vehicle to prevent static electricity from building up.
Bonding requirements when filling the power torch	Bond the fuel source to the torch, bond the torch, and bond the hose nozzle to the torch.	Bond the fuel source to the torch, bond the torch, and bond the hose nozzle to the torch.	Bond the fuel source to the torch, bond the torch, and bond the hose nozzle to the torch.	Bond the fuel source to the torch, bond the torch, and bond the hose nozzle to the torch.



Transporting Power Torch Fuel

- Use approved containers (jerricans, safety cans, UN-specification power torches, UN- or DOT-specification fuel tanks).
- Avoid transporting fuel on public highways in power torches that do not meet DOT specifications.
- Make sure that all fuel containers are properly secured when they are being transported.

If you are transporting hazardous materials, a total of no more than 440 pounds of hazardous materials, including power torch fuel in containers smaller than 8 gallons, should be carried in one vehicle.

If more than 440 pounds of power torch fuel or other hazardous materials are transported, or if any fuel container is larger than 8 gallons, DOT hazardous material training and shipping papers are required and a copy of the “Emergency Response Guidebook” must be carried in the vehicle.

If 1,001 pounds or more of power torch fuel is transported or if any container is larger than 119 gallons, the driver must have a commercial driver’s license (CDL) and DOT hazardous materials training. The vehicle must be placarded and must carry shipping papers and a copy of the “Emergency Response Guidebook.”

For more information on transporting fuel, see the “Interagency Transportation Guide for Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel.”



Qualifications

To be qualified to use a power torch for incident or project work, individuals must meet prerequisites and training requirements.

Prerequisites

Torch operators shall:

- Hold the position of Type 2 firefighter (FFT2) or prescribed fire crewmember (RXCM).
- Demonstrate proficiency with all torch operational and safety procedures.

Firing vehicle operators shall:

- Demonstrate proficiency operating the firing vehicle in accordance with agency policy, such as policies for boat operators, tracked vehicle operators, and so forth.

Instructors shall:

- Hold the position of FFT2 or RXCM.
- Demonstrate proficiency with a power torch.

Minimum Training

Torch operators shall:

- Receive ignition operations (S-234) training.
- Receive intermediate wildland fire behavior (S-290) training.
- Receive training from a qualified instructor, including an orientation to the power torch and its practical operation in the field.

Firing vehicle operators shall:

- Become familiar with turning the torch on and off, extinguishing the wick, emergency procedures, and the location and use of the fire extinguisher(s).

System Organization and Position Responsibilities

Power torch operators shall:

- Operate the power torch.
- Coordinate ignition actions closely with the firing vehicle operator and additional fire personnel.
- Be responsible for the preparation, installation, operation, maintenance, care, and cleaning of the power torch.
- In coordination with the firing boss, verify that the desired ignition tactics are being used and are effective. The operators need to adjust ignition patterns as required.
- Recognize malfunctions and act accordingly.

Firing vehicle operators shall:

- Operate the firing vehicle.
- Coordinate actions closely with the torch operator and additional fire personnel.
- Be responsible for the preparation, operation, maintenance, and care of the vehicle carrying the power torch.
- Ensure that the torch is correctly installed and that the vehicle is within its weight limits and that it is not unbalanced by the weight of the power torch and fuel



Inspecting Power Torches

Before power torches are used, the equipment must be inspected and readied for the field.

Inspections

Inspect the following:

- All electrical connections and wiring.
- All fasteners or straps that attach the torch to the firing vehicle or mounting rack to ensure that they are in place, tight, and in good working order.
- The date when the fire extinguisher was last serviced. Service or replace the fire extinguisher when needed.
- The ignition system to make sure that it is clean and functional (figure 8–2).
- The torch and its quick release mechanism (if it has one) to make sure they are in good working order and that all of their parts are installed properly.
- Caps, seals, and connections for fuel leaks (figure 8–3).

Repair or replace any damaged components.

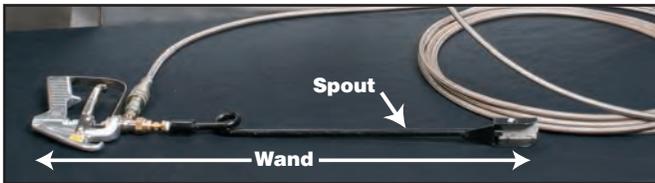


Figure 8–2—Power torch wand and hose. This wand is fitted with the spout from a Panama drip torch. The wand components and braided metal fuel line are compatible with gasoline and diesel.

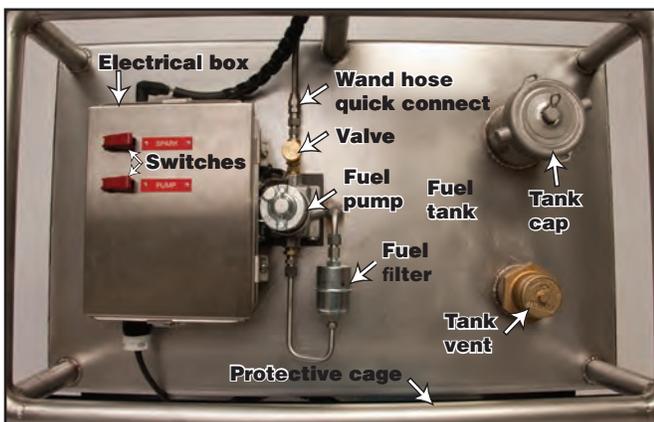


Figure 8–3—An example of the components of a power torch. The spark switch is not needed when a drip torch-style wick ignites the fuel. Specific components vary depending on the model.

Firing Vehicle Inspections

- Use an appropriate inspection checklist, if applicable, for the vehicle carrying the power torch.

Preventative Maintenance

Follow the land management unit’s standard operating procedures (SOPs).

Installation Procedures

- Due to the nature and design of power torches, installation procedures will vary. The torches’ mounts must be installed in accordance with the manufacturers’ instructions, if available, for the power torch and for the vehicle carrying the power torch. Make sure that the torch is securely fastened to the vehicle. Specifics will be addressed in the unit’s SOP for the equipment.

Mixing Power Torch Fuel

When mixing fuel:

- Wear proper PPE.
- Use only approved containers (jerricans, safety cans, and fuel tanks that meet DOT specifications).
- Make sure that the fuel containers are labeled properly.
- Select the proper fuel mixture for the job. See your agency’s policy for authorized fuel mixtures. Mixtures other than those authorized by the agency require an additional hazard analysis, such as the Forest Service’s job hazard analysis (JHA), before the mixtures can be used.
- Containers shall be properly bonded while they are being filled. Ensuring that the fuel nozzle stays in contact with the container is one way to provide bonding.
- Do not fill fuel containers or mix fuel in the bed of a vehicle.
- Mix fuel only in well-ventilated areas.
- Ensure that fuel is thoroughly mixed before using it in a power torch.



Normal Operating Procedures for Power Torches

Follow these procedures when using a power torch.

Project Briefing

- Make sure that a thorough briefing is conducted with all personnel involved with the firing operation before ignition.
- All ignition personnel should:
 - » Be familiar with the area proposed for ignition so they understand the location of safe and accessible ignition routes, escape routes, and safety zones.
 - » Have a clear understanding of strategy and tactics to be used.
 - » Know the ignition pattern(s) before beginning ignition.
 - » Know the emergency procedures before beginning ignition.

Communications

Communications between the power torch operator and the firing boss are crucial to a successful operation. Because power torches are carried by specialized, noisy vehicles, such as airboats and marsh buggies, radio headsets and hand signals may be needed for communication.

Fueling the Torch

Turn the vehicle engine off.

- Make sure that the torch's wick is completely extinguished and cooled.
- Ensure the tank is properly bonded before filling.
- Do not allow smoking or an open flame within 25 feet while filling the power torch.
- Avoid spilling fuel.
- Do not completely fill the torch's tank—fill it only to about 90 percent of its capacity before replacing the cap. Overfilling may cause pressure to build in the torch's tank, forcing fuel out of the wand.
- Clean up any spills during fueling.

Using the Torch

- Remember that the wind can blow burning fuel from the wick toward the firing vehicle.
- Adjust ignition patterns as the ignition progresses or as the fire behavior changes.
- Be aware of fuels, terrain, and ignition tactics because they affect fire behavior, escape routes, and safety zones.
- Stay within the burn unit while lighting the wick.
- Maintain communications with all firefighters at the site while firing.
- Remember—torches can put a lot of fire on the ground in a short time (figure 8–4).
- Watch out for obstacles in the vehicle's path to avoid getting the vehicle stuck or damaging it.
- Be aware of barriers such as ditches, dense vegetation, or large canals that could block escape routes.



Figure 8–4—A power torch at work.



Emergency Operating Procedures for Power Torches

The firing vehicle and its torch are not worth injury or risk of life. Get away from the firing vehicle if becomes a hazard.

In the event of an emergency, the torch operator needs to tell the firing vehicle operator there is a problem and give a brief description of the emergency.

Power torch operators need to know what to do in the following situations:

- Torch or Vehicle Catches Fire
 - » If the torch or firing vehicle catches fire, attempt to extinguish the fire in its initial stage.
 - » If the fire is persistent, remove the torch from the firing vehicle, if possible.
 - » If the torch cannot be removed, leave the firing vehicle and go to a safe area. Notify the appropriate personnel.

Maintenance and Storage

Follow these procedures to make sure that power torches will be ready for their next use.

Cleaning and Repair

- Clean the torch and inspect it for damage.
- Repair or replace any damaged or broken parts.

Storing the Torch

- Drain the fuel to the lowest practical level.
- Store the torch out of the weather in a secure location.

Storing Power Torch Fuel

- Store the torch fuel according to agency policy.
- For further guidance on torch and fuel storage, consult your local hazardous materials coordinator and the “Everyday Hazmat User’s Training Guide.”

Power Torches

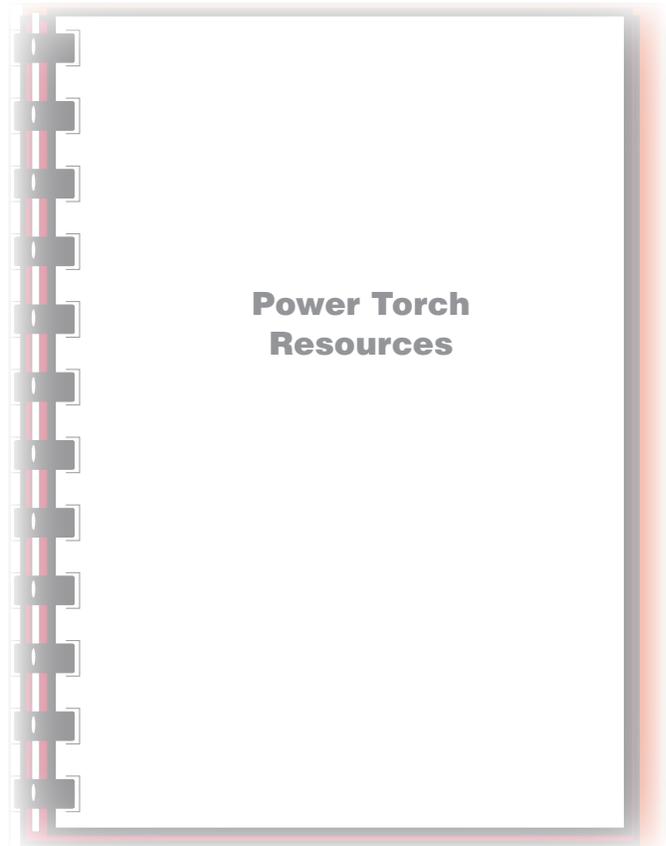
<p>Troubleshooting</p>	Torch Does Not Dispense Fuel
	<p>Check the electrical system—it may be disconnected. Make sure the wiring is intact and not damaged or broken. Make sure the fuse is not blown. Make sure the pump is not defective. Make sure the tank vent is open and clear. Make sure that the hoses, piping, and tubing are unobstructed.</p>
	Torch Goes Out
	<p>Check the fuel mixture—it may have too much diesel. Make sure the wick or propane torch is adjusted properly. Make sure the propane bottle has fuel (propane ignition systems only).</p>
	Fuel Burns Up Before Reaching Vegetation
	<p>Check the fuel mixture—it may have too much gasoline.</p>



Power Torch Resources

This section includes the following resources:

- Information for inclusion in a hazard analysis
- List of required material safety data sheets
- Recommended spare parts
- Equipment standards for power torches
- Contract equipment inspection checklist
- Power torch references





Hazard Analysis

This information can be used when preparing a job hazard analysis (used by the Forest Service) or similar hazard analysis.

Power Torches

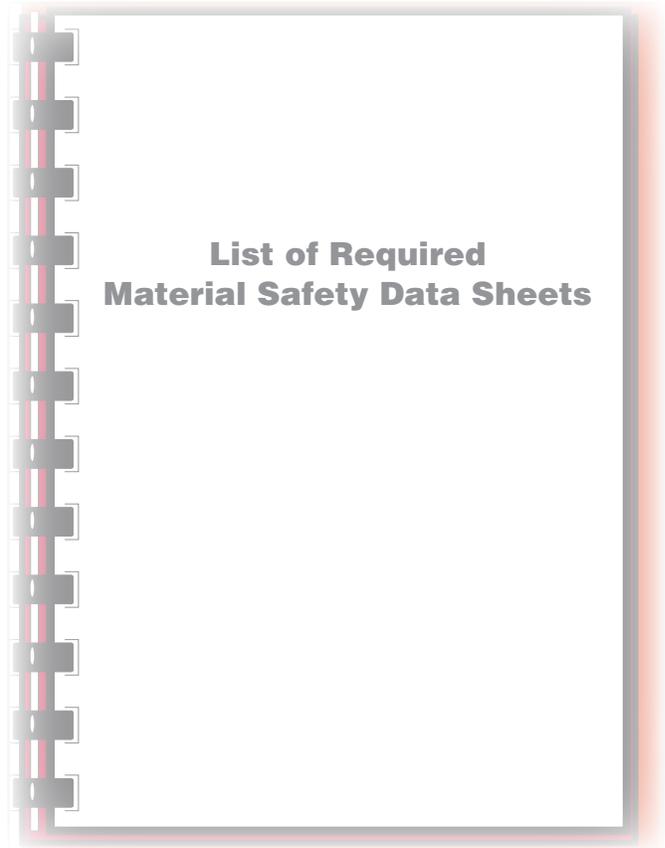
Information for Power Torch Hazard Analyses		
Task	Hazards	Abatement actions
Fueling or refueling the torch	Fuel spills Breathing fuel vapors Fuel spilled on skin Burns Lifting heavy loads	Wear PPE. Have a spill kit available. Keep ignition sources at least 25 feet away from the refueling area. Use safety cans with proper spouts. Know the proper fuel mixture. Check for fuel leaks. Avoid breathing fumes. Use proper lifting techniques.
Igniting the torch	Burns Fumes and smoke	Wear PPE. Keep the wand pointed away from all personnel and equipment. Use the proper methods when igniting the torch. Avoid breathing fumes.
Burning operations	Burns Fumes and smoke	Wear PPE. Keep the wand pointed away from all personnel and equipment. Know the ignition sequence before starting. Always have a way out. Watch your speed and obstacles. Avoid breathing fumes. Maintain lookouts, communications, escape routes, and safety zones (LCES). Be aware of where the fire is burning, where you are driving, and which way the wind is blowing.
Extinguishing the torch	Burns Fumes and smoke	Wear PPE. Use proper techniques when extinguishing the torch. Avoid breathing fumes.
Operating the firing vehicle	Hazardous when not operated properly	Only qualified firing vehicle operators with knowledge of torch and ignition operations are allowed to drive firing vehicles.



List of Required Material Safety Data Sheets

Material safety data sheets for all ground ignition systems are in appendix A. The material safety data sheets for power torches include:

- Diesel
- Gasoline
- Propane



Power Torches



Recommended Spare Parts

- Fuel pump
- Fuel filters
- Fuel line assemblies
- Fuses
- Electrical tape
- Extra wiring
- Extra wicks
- Extra wand
- Fuel caps
- Pressure relief valve (if equipped)

Equipment Standards for Power Torches

All components must be compatible with diesel and gasoline.

Fuel Tank

- Capacity varies, but the weight when filled must not exceed the load rating of the firing vehicle.
- Baffles are recommended inside the tank.
- Must be made of metal—welded aluminum has been the preferred material.
- Must be vented to prevent pressure from building up and to allow the fuel pump to operate properly.
 - » Tanks with more than 60 gallons capacity must be designed to be filled from the bottom.
 - » Tanks smaller than 55 gallons do not need to conform to DOT specifications, but only if a DOT-specification tank cannot be found.
 - » Tanks 55 gallons or larger must meet DOT specifications.
- The fuel pump must be originally designed for gasoline and diesel use.

Torch Arm or Wand

- Construction varies, but the arm or wand must include an on/off valve or trigger.
- Power torches may use a wand similar to a terra torch or an arm similar to an ATV torch.
- Flashback protection must be installed (such as a fuel trap or a check valve).

Ignition System

- A conventional drip torch nozzle and wick may be used. Some power torches may use a propane ignition system.

Hoses/Fuel Lines

- Metal pipe or tubing may be used.
- Hoses must be compatible with diesel and gasoline and have a metal braided cover.
- Hoses must use swaged end connections; hose clamps shall not be used.
- If the fuel pump or wand is gravity fed, a manually operated shutoff valve must be installed upstream of the pump on the tank or the fuel line and the valve must be protected so it cannot be torn loose during operation. Pumps that draw fuel from the top of the tank do not require a tank shutoff valve.

Electrical System

- Wiring must be free of splices.
- All wiring must be housed in abrasion-resistant covering.
- All electrical connections must be sealed with RTV (room temperature vulcanizing silicone rubber) to prevent sparking, except for the quick disconnect that allows the torch to be removed from the vehicle that carries it.
- An inline fuse must be installed as close to the power source as possible.
- The minimum fuse size is determined by multiplying the total electrical load required by all of the torch's electrical equipment by 1.5.
- A pump shutoff switch shall be located within easy sight and reach of the torch operator.
- Solenoid valves (if used) must have explosionproof solenoids.
- The torch must be properly bonded to the mounting vehicle.

The tank and the torch should be mounted on a single base that is securely attached to the vehicle that carries them. This mounting should be designed to ensure that the vehicle's balance is maintained.



Contract Equipment Inspection Checklist

- Metal fuel tanks are required.
- The weight of the torch and full tank do not exceed the load rating of the vehicle that carries them.
- The fuel tank is vented to prevent pressure from building up and to allow the fuel pump to operate properly.
- The fuel pump was originally designed for use with gasoline and diesel.
- The arm or wand has an on/off valve or trigger.
- If the fuel pump or wand is gravity fed, a manually operated shutoff valve is installed upstream of the pump on the tank or the fuel line and the valve is protected so it cannot be torn loose during operation. Pumps that draw fuel from the top of the tank do not require a tank shutoff valve.
- All components are compatible with diesel and gasoline.
- All hoses have a braided metal cover and swaged end fittings.
- The wiring is free of splices.
- An inline fuse is installed as close to the power source as possible.
- The fuse size is at least 1.5 times the total electrical load required by all torch equipment.
- All wiring has an abrasion-resistant covering for protection.
- All electrical connections except the quick disconnect used to remove the torch from the firing vehicle are sealed with RTV silicone rubber to prevent sparks.
- Solenoid valves (if used) have explosionproof solenoids.
- The torch's electrical controls are within easy sight and reach of the operator.
- The torch is mounted on a single base that is securely attached to the firing vehicle.

Power Torch References

See appendix B for additional ground ignition references.

Interagency Transportation Guide for Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel, PMS 442, available at <<http://www.nwcg.gov/>>.

Everyday Hazmat User's Training Guide, 0471-2810-MTDC, available at <http://www.fs.fed.us/eng/everyday_hazmat/users_guide.htm>.



Notes

Power Torches



Equipment Description

A typical propane torch that can be used as a ground ignition device consists of a torch assembly, a propane cylinder, a hose, and a regulator or flame adjustment valve. Most torches use propane vapor as the fuel, although some are designed to use liquid propane.

Sources of Equipment That Meet Standards

Propane torches, commonly used for weed burning, may be found at hardware and ranch supply stores.

Situations Favorable for Propane Torch Use

A propane torch (figure 9-1) may work well when:

- Burning grass, pine needles, leaves, brush, and similar fine fuels that ignite readily.
- Burning in areas where fuel residue from other ignition devices, such as drip torches and fusees, may be an issue.



Figure 9-1—A propane torch equipped with a pack frame. Propane torches also may be carried by hand.

Propane Torches

Advantages	Advantages and Disadvantages of Using Propane Torches	
	Advantages of using propane torches	Disadvantages of using propane torches
○	Readily available from several commercial sources	Not as portable as other ignition devices and can be cumbersome to carry
	Leave no fuel residue	Not as effective (as other ignition devices) for burning heavier fuels
		Performance of the torch declines as temperature falls
		Propane fuel requires special hazardous materials consideration for transportation and storage



Safety Requirements

Hazard analysis information for propane torch operations is provided in the “Propane Torch Resources” section at the end of this chapter. Prepare and review your hazard analysis document before beginning work.

Required Personal Protective Equipment (PPE)

- Hardhat
- Flame-resistant pants
- Flame-resistant shirt
- Leather gloves
- Approved boots
- Eye protection

Transporting Propane Cylinders

- Secure all propane cylinders before transport. Secure all material in the vehicle cargo compartment so that the material cannot get loose and damage the cylinders when the vehicle is moving.
- Do not transport propane cylinders with explosives, poisonous gases, poisonous or corrosive liquids, or radioactive materials.
- Do not transport damaged cylinders.
- Transport propane cylinders in aircraft in accordance with chapter 6 of the “Interagency Aviation Transport of Hazardous Materials” guide (NFES 1068).

According to the DOT, propane fuel is a Class 2, Division 2.1 flammable gas. This means that you should not transport more than 440 pounds of hazardous materials, including propane, in one vehicle. The propane should be transported in cylinders with a gross weight of no more than 220 pounds.

If you are transporting more than 440 pounds of propane, other hazardous materials, or the propane cylinders weigh more than 220 pounds gross weight, DOT hazardous

materials training is required and you must carry shipping papers and a copy of the “Emergency Response Guidebook” in the vehicle.

If you are transporting 1,001 pounds or more of propane or other hazardous materials, you must have a commercial driver’s license (CDL) with a hazardous materials endorsement in addition to DOT hazardous materials training. You must carry shipping papers and a copy of the “Emergency Response Guidebook” in the vehicle, and the vehicle must be placarded.

Qualifications

To be qualified to use a propane torch for incidents or projects, individuals must meet prerequisites and training requirements.

Prerequisites

Operators shall:

- Hold the position of Type 2 firefighter (FFT2) or prescribed fire crewmember (RXCM).

Instructors shall:

- Hold the position of FFT2 or RXCM.
- Demonstrate proficiency with a propane torch.

Minimum Training

Operators shall:

- Read and understand the information in this chapter.
- Read the operator’s manual or instructions for the specific model of propane torch.
- Receive training in operation and maintenance of propane torches from an instructor.

Instructors shall:

- Demonstrate proficiency with a propane torch.



Inspecting Propane Torches

Before propane torches are used, the equipment must be inspected and readied for the field.

Inspections

Inspect the following:

- Cylinder for dents.
- Protective collar for damage (figure 9-2).
- Foot ring for rust (figure 9-3).
- Hoses, regulators, valves, gauges, and fittings for damage, wear, and leakage. Use soapy water to check for leaks; never use a match or open flame.

Repair or replace equipment that is damaged or that leaks. Verify that the propane cylinders have enough propane to complete burning operations.

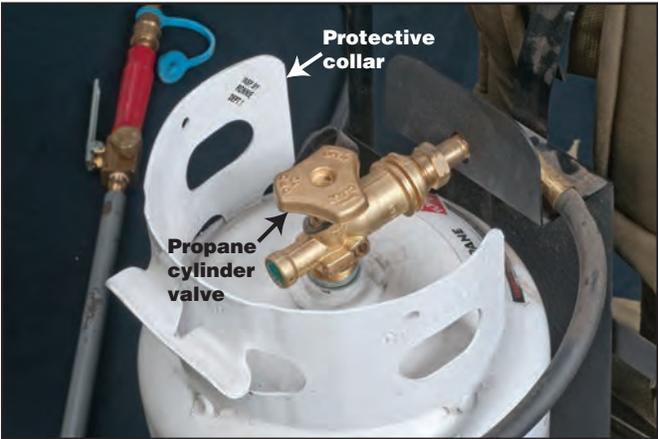


Figure 9-2—Top view of a propane tank.

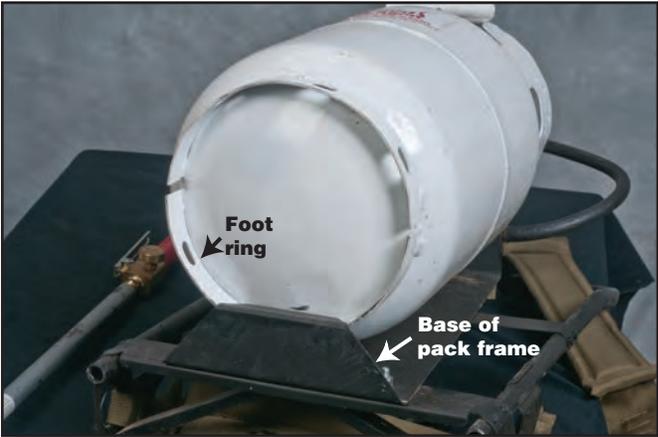


Figure 9-3—Bottom view of a propane tank attached to a pack frame

Propane Torches



Normal Operating Procedures for Propane Torches

Follow these procedures when using a propane torch.

Preparing the Torch for Use

- The operator must wear the proper PPE.
- Use the proper cylinder for your torch. Some torches are designed to burn propane vapor. Others are designed to burn liquid propane. Each type of torch needs to be used with the appropriate fuel cylinders.
- Always read and follow the manufacturer’s warnings, precautions, and safety instructions.
- Use soapy water to check for leaks. Never use a match or open flame.
- Do not use the torch if you can smell propane.
- Never carry a propane cylinder by the valve.
- Do not ignite the torch before you have reached the area you want to burn.
- Open the cylinder valve when you are ready to ignite the torch.

Igniting the Torch

- Light the torch using an igniter that keeps your hand well away from the flame. Do not use matches or a cigarette lighter (figure 9–4).
- Make sure that the flame adjustment valve or regulator is operating in accordance with the manufacturer’s instructions (figure 9–5).



Figure 9–4—A small hand torch can be used to ignite a propane torch.

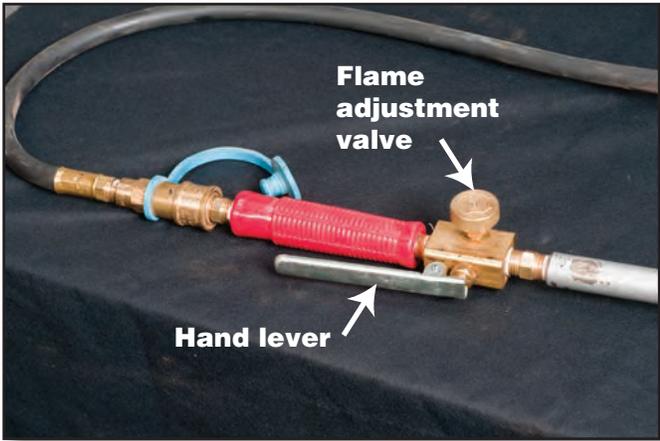


Figure 9-5—A flame adjustment valve with a hand lever. After the valve has been set, the hand lever is used to adjust the flow of the propane.

Using the Torch

- Point the burning torch away from yourself, other objects, and people.
- Keep the torch, open flame, and other sources of ignition away from the propane cylinder, the hose, and the regulator.

- Do not heat the propane cylinder to increase its pressure.
- Never leave a burning torch unattended.
- Keep the propane cylinder’s valve closed when the torch is not being used.

Extinguishing the Torch

- Extinguish the torch by shutting off the cylinder’s valve and allowing gas to burn out of the lines.

Preparing the Torch for Transportation and Storage

- Allow the torch to cool before transporting or storing it.
- Always secure propane cylinders so they are level and upright while transporting them in vehicles or on watercraft. Do not lay cylinders on their side or store them upside down. Because propane vapors are heavier than air, they can accumulate in low areas such as truck beds and boat hulls. The vapors can catch fire and could displace oxygen in enclosed areas, causing burns or suffocation.

Propane Torches

Troubleshooting	Torch Will Not Light
	Make sure the gas cylinder’s valve is open and unobstructed.
	Check to see whether the gas cylinder is empty.
	Make sure the regulator is functioning normally.
	Torch Assembly Leaks Gas
	Make sure the connections are tight.
	Check the propane hose for damage.



Emergency Operating Procedures for Propane Torches

Propane torch operators need to know what to do in the following situations:

- Smell of propane detected during use.
 - » Stop using the torch immediately.
 - » Move the torch away from any sources of ignition.
 - » Close the propane cylinder's valve.
 - » Repair or replace the equipment.
- Torch assembly or propane cylinder catches fire.
 - » Drop the equipment and leave the area immediately.

Storing Propane Cylinders

- Store propane cylinders outside in a controlled access area.
 - » Store propane cylinders upright unless the cylinders are designed to operate while horizontal.
 - » Store propane cylinders at least 20 feet away from flammable liquids such as gasoline and drip torch fuel, flammable solids such as fusees, and oxidizing gases such as oxygen.
 - » Store the torch assembly (disconnected from the propane cylinder) in a dry location out of the sunlight.

For further guidance on storing propane cylinders and torch assemblies, consult your local hazardous materials coordinator and the “Everyday Hazmat User’s Training Guide.”

Maintenance and Storage

Follow these procedures to make sure that propane torches will be ready for their next use.

Cleaning and Repair

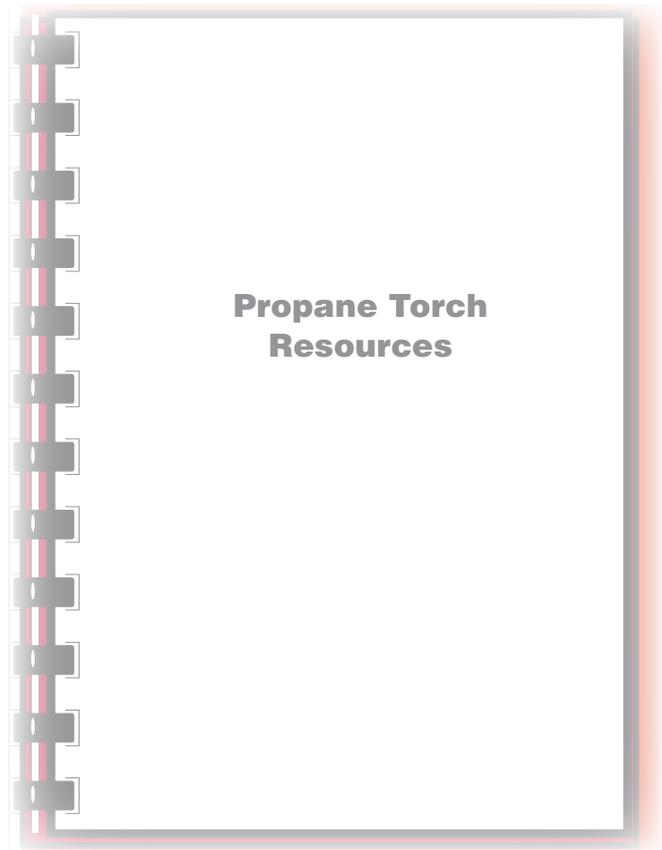
- Disconnect the torch assembly from the cylinder.
- Inspect the torch assembly and cylinder for damage.
- Repair any damaged equipment.



Propane Torch Resources

This section includes the following resources:

- Information for inclusion in a hazard analysis
- List of required material safety data sheets
- Equipment standards for propane torches
- Propane torch references





Hazard Analysis

This information can be used when preparing a job hazard analysis (used by the Forest Service) or similar hazard analysis.

Information for Propane Torch Hazard Analyses		
Task	Hazards	Abatement actions
Checking the torch for leaks	Burns	Use soapy water to check for leaks. Do not use matches or other open flame.
Igniting the torch	Burns	Wear gloves, flame-resistant clothing, boots, a hardhat, and eye protection. Point the torch away from your body and other people and objects when you are lighting it. Use an igniting device that allows the torch to be ignited while your hand is far away.
Using the torch	Burns	Wear gloves, flame-resistant clothing, boots, a hardhat, and eye protection. Point the torch away from your body and other people and objects. If you smell propane, stop using the torch immediately. Repair or replace the torch.
Using the torch	Muscle strain	Use a cart or other device to carry the cylinder if practical. Use the smallest cylinder that will do the job. Set the cylinder down often. Watch your footing while carrying the torch.

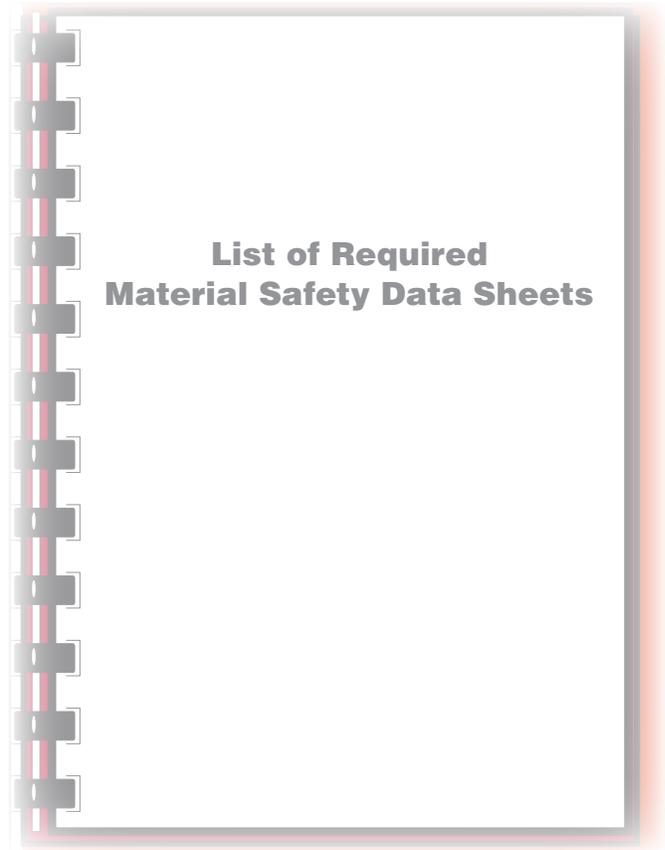
Propane Torches



List of Required Material Safety Data Sheets

Material safety data sheets for all ground ignition systems are in appendix A. The material safety data sheets for propane torches include:

- Propane



Propane Torches



Equipment Standards for Propane Torches

Equipment must be listed by a nationally recognized testing laboratory such as Underwriters Laboratories (UL) or Canadian Standards Association (CSA).

Propane Torch References

See appendix B for additional ground ignition references.

Everyday Hazmat User's Training Guide, 0471-2810-MTDC, available at <http://www.fs.fed.us/eng/everyday_hazmat/users_guide.htm>.

Propane Torches



Equipment Description

The terra torch is a ground ignition device that dispenses ignited gelled fuel for firing operations (figure 10–1). Gelled fuel is a combination of a gelling agent and petroleum fuels such as gasoline, diesel fuel, or aviation fuel. One advantage of gelled fuel is that it is less volatile than ungelled fuels. The fuel is gelled in the terra torch tank and pumped from the tank through a wand equipped with a propane torch igniter. The ignited gelled fuel can be propelled 50 to 100 feet from the wand, depending on gel consistency, wind direction, and windspeed. In 2003, specifications were imposed that required standard safety features for all terra torches and batch mixers. The new torches include U.S. Department of Transportation (DOT)-specification tanks, rollover protection, and safety valves.



Figure 10–1—A terra torch in action.

Advantages

Advantages and Disadvantages of Using Terra Torches	
Advantages of using terra torches	Disadvantages of using terra torches
Increase the safety of firing operations by reducing firefighter exposure because fewer people are required	Require specialized training for crews
Enhance employee safety by allowing ignition of otherwise inaccessible areas (vegetation on the other side of water or other barriers, steep slopes, or thick vegetation)	Produce immediate intense fire, care must be taken not to ignite a larger area than the situation warrants
Produce an intense, continuous line of fire that can achieve better consumption of the vegetation than other ignition systems	May cause additional hazards because ungelled gasoline is highly flammable
Develop a convective column quicker, increasing control over the fire, and reducing smoke management issues	May have to haul bulk fuel and gelling agent to the site for larger burning operations
Can ignite a burn unit in less time than hand ignition, taking advantage of narrow burn windows	Increase the need for adequate hazmat removal and storage
More effective than other ignition systems for burning under a wide variety of fuel conditions and fuel types	Require the vehicle operator to have a CDL with a hazmat endorsement when transporting tanks larger than 119 gallons
Can be mounted on a variety of vehicles including trucks, trailers, boats, air boats, utility-terrain vehicles (UTV), and marsh buggies (also known as Marsh Masters)	Increase hazards to the ignition crew from the splatter of the burning gel
Gelled fuel provides a longer residual burning time on the vegetation	May require dedicated resources (additional crewmembers or an engine) that may not be needed with other ignition methods
	Increase risk of unwanted fire, operator injury, or vehicle damage caused by burning gel dripping from the wand



Sources of Equipment That Meet Standards

Terra Torches

Manufacturer

Firecon, Inc.
P.O. Box 657
Ontario, OR 97914

Existing Firecon Products

- 2400 Batch Mixer System
- Terra Torch Model 1400

Existing Firecon Nonspecification Product

- 40-gallon minitorch

The 40 gallon “minitorch” (figure 10–2) was developed for applications where a full-sized terra torch was not practical, such as in airboats. The minitorch is not equipped with a DOT-specification tank. These minitorches can be used under the following conditions:

- The torch is in good mechanical condition.
- With the exception of the DOT-specification tank, the torch conforms to the requirements in the “Terra Torch Resources” section at the end of this chapter.

Terra Torches



Figure 10–2—An example of a 40-gallon minitorch.

- The fuel tank is given a careful visual external inspection for leakage before each use. A torch with a leaking tank shall not be used.
- The torch is transported empty to and from the burn site. A torch is considered to be empty when the tank has been drained as low as practical, even if some residual fuel remains.
- All of the applicable parts of this guide are followed when using the minitorch.
- The torch will be stored empty. The torch is considered to be empty when the tank has been drained as low as practical, even if some residual fuel remains.

Gelling Agents

Distributor

Type One Incident Support, Inc.—Flash 21 and Firegel
P.O. Box 8209
Bend, OR 97708–8209
Phone: 541–330–4340

Situations Favorable for Terra Torch Operations

A terra torch may work well when:

- Burn units with continuous vegetation are immediately adjacent to vehicle access.
- Sites have sparse or patchy fuel distribution or high fuel moisture content. The intensity of the fire produced by the torch can provide sustained ignition and, under some conditions, reduce emissions.
- Ignition of fuels requires a concentrated, intense fire, such as standing timber, blowdown, or poorly compacted fuels.
- Burning areas where a quickly established convection column is desired.



Safety Requirements

Hazard analysis information for terra torch operations is provided in the “Terra Torch Resources” section at the end of this chapter. Prepare and review your hazard analysis document before beginning work.

Required Personal Protective Equipment (PPE)

Wear appropriate PPE for mixing and burning operations.

- Mixing operations using powdered or liquid gelling agents
 - » Cotton clothing (including underwear), Nomex III-A clothing, or Nomex clothing containing 2 percent carbon core or 3 percent conductive fiber (listed on the clothing label)
 - » Chemical resistant (Nitrile) gloves
 - » Goggles
 - » Approved boots
 - » Hardhat
 - » Mixing personnel may wear a dust mask. See the “Terra Torch Resources” section at the end of this chapter for dust mask use and storage requirements.
- Burning Operations
 - » Approved fireline PPE according to “Interagency Standards for Fire and Fire Aviation Operations” (chapter 7), including eye protection, shall be worn during burning operations.

Caution

A portable eyewash station is required onsite. OSHA 1910.151 and 1926.50 requires that when the eyes may be exposed to injurious corrosive materials, suitable facilities for the quick drenching or flushing of the eyes shall be provided for immediate emergency use—MINIMUM 15-MINUTE CONTINUOUS FLOW. The American National Standards Institute (ANSI) outlines what OSHA considers suitable facilities in ANSI Z358.1-1998.

Minimum Safety Equipment Required

Mixing Operations

- Two 20–B:C dry chemical fire extinguishers
- One burn kit
- One burn blanket
- One portable eye wash station (minimum 15-minute continuous flow)

Burning Operations

- Two 20–B:C dry chemical extinguishers
- One burn kit
- One burn blanket

Transporting the Gelling Agent and Fuel

- Transport bulk fuel whenever possible using a fuel truck with its own pumping system.
- Load and transfer all fuels in an area isolated from traffic to reduce unnecessary risk. In the field, the fueling area should be a clear, flat area at least fifty feet in diameter.
- Use a portable refueling system when it is not possible to transport bulk fuel.

Handling the Gelling Agent and Fuel

- Powdered gelling agents must be kept dry. Fire-Trol Firegel is nontoxic and can be disposed of in a landfill; no spillage should remain on the site after the operation is completed.
- Keep your entire operation clean and tidy. This includes the fueling and mixing sites, the vehicle, and the terra torch unit. Wipe up all minor spills immediately.



Qualifications

To be qualified to use a terra torch for incident or project work, individuals must meet prerequisites and training requirements.

Prerequisites

Operators shall:

- Hold the position of Type 2 firefighter (FFT2) or prescribed fire crewmember (RXCM).
- Hold the position of terra torch operator (TTOP).

Instructors shall:

- Hold the position of firing boss (FIRB).
- Hold the position of terra torch operator (TTOP).
- Receive agency certification.

Minimum Training

Operators shall:

- Receive operational training—consisting of a minimum of 4 hours each for classroom training and field exercises—on the following topics:
 - » Safety
 - » Operation
 - » Maintenance and troubleshooting
 - » Cleaning the terra torch after use
 - » Transportation
 - » Storage

Instructors shall:

- Receive operational training and demonstrate proficiency with a terra torch.

System Organization and Position Responsibilities

The recommended organization for terra torch operations consists of a terra torch lead operator, terra torch operator, and vehicle operator. For some burning operations, such as pile burning and air boat operations, only the vehicle operator and the lead terra torch operator positions may be required.

Terra Torch Lead Operator

- Oversees safe operation of the terra torch.
- Coordinates ignition actions closely with the vehicle operator and additional fire personnel.
- Maintains situational awareness.
- Ensures proper preparation, installation, operation, and maintenance of the terra torch.
- In coordination with the firing boss, verifies that desired ignition tactics are being used and are effective. Adjusts ignition patterns as required.
- Determines whether malfunctions have occurred and acts accordingly.

Terra Torch Operator

- Operates the terra torch.
- Prepares, installs, operates, and maintains the terra torch.

Vehicle Operator

- Operates the ignition vehicle.
- Coordinates actions closely with the terra torch lead operator and additional fire personnel.
- Maintains situational awareness.
- Ensures proper preparation, installation, operation, maintenance, and care of the ignition vehicle.
- Ensures the proper weight and balance of the vehicle is maintained.



Inspecting Terra Torches and Mixing Fuel

Before terra torches are used, the equipment must be inspected and readied for the field.

Inspections

The inspector shall:

- Verify that all tank inspections are up to date. For more information, see the “Interagency Transportation Guide for Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel.”
- Verify that the tank is properly placarded and marked.
- Check the engine oil level before operation. Add oil if needed.
- Check the tension on the belts and adjust if needed (figure 10–3).
- Check all fasteners for tightness. Tighten any loose fasteners.
- Check the hose fittings and general integrity of unit.
- Make sure that all seals are in place and in good condition.
- Inspect the tank, plumbing, pump, hoses, valves, and applicator wand for leaks. Correct any leakage before use.
- Verify the electrical continuity of the vapor recovery/removal hose between the end fittings and bonding cables.



Figure 10–3—Inspect the pump drive belts for damage and wear. Adjust the tension as needed.

Mixing Terra Torch Fuel

When mixing fuel, personnel must understand the hazards of terra torch operations and know the precautions they should take. Mixing should take place only after all personnel involved are adequately trained and equipped.

Precautions

Hazards to the mixing personnel include vapors from gasoline, flammability of gasoline, skin contact with fuel, and dust from the gelling agent. Review the “Terra Torch Resources” section at the end of this chapter and the material safety data sheets in appendix A.

- Avoid prolonged and direct exposure to gasoline vapors. They depress the nervous system and are known carcinogens.
- Make sure personnel keep their hands out of gasoline and fuel mixtures. Special care must be taken to keep fuel from the mouth, eyes, open cuts, and abrasions.
- Make sure only trained personnel will handle and mix fuel (according to agency or bureau policies).
- Set up the mixing areas with special attention to the safety equipment available and the training of the mixing crew.
- **Remember nonferrous mixing equipment must be used (to prevent sparks) and all bonding procedures must be followed.**
- Make sure that precautions are exercised to eliminate direct exposure of skin to gelling agent or fuel.
- Make sure NO SMOKING signs are conspicuously posted around the mixing area, including near the outlets of all vapor removal hoses.

Caution

No plastic of any kind shall be used in mixing operations when powdered gelling agent is used. All dispensing equipment must be made of metal capable of being bonded—no plastic components. Do not pour gelling agent directly from the bag into the drum/tank (NFPA 77, p. 8 to 11).

Caution

All handheld electronic devices such as radios, pagers, cell phones, and so forth shall be turned off within 50 feet of any fuel preparation/vapor removal area.



Caution

Do not use **biodiesel** or **fuels oxygenated with ethanol**. These fuels will not gel.

Fuels

The following fuels or combinations of the following fuels may be used with Flash 21 gelling agent to make gelled fuel:

- Gasoline
- Avgas
- Gasoline or Avgas/JP8 (50:50)
- Gasoline or Avgas/Diesel (50:50)
- Gasoline or Avgas/Jet A (50:50)

The above ratios are recommended starting points when using Flash 21 gelling agent and may be adjusted as required to achieve the desired consistency. Other gelling agents may require different mix ratios. An ideal gelled mix creates a flame that appears at the top of the arc when shooting gel. Flames appearing closer to the wand result in less gelled fuel on target.

Fire Protection

Designate a “fire protection” person during fueling operations and make sure this person has ready access to a 20–B:C fire extinguisher. This individual will wear appropriate PPE for fire suppression and will be responsible for properly charging extinguishers before fueling.

Provide additional care and security when fueling at public service stations.

Fueling From Bulk Fuel Supply

- Verify the electrical continuity of the fuel supply hose and bonding cables.
- Make a bonding connection to prevent static electricity from building up during fueling operations. Pull out retractable bonding wire from the bonding reel of the terra torch. Attach the bonding wire to the fuel source, using an alligator jaw grip clamp at the end of the wire.
- Remove the camlock cover from the vapor recovery shutoff valve. Remove the camlock covers from the vapor recovery hose. Attach the vapor recovery hose to the camlock vapor recovery fitting at the top of the tank. Open the vapor recovery shutoff valve.
- Make sure the tank is clean.
- Dispense the desired quantity of fuel in the fuel port (figure 10–4).

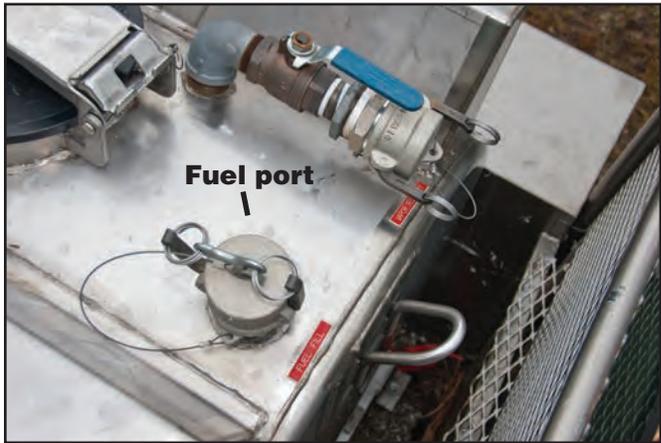


Figure 10–4—Fill the terra torch through the fuel port, not through the tank hatch cover, to avoid generating static electricity that could ignite fuel vapors.



Gelling Agents

Firegel (also known as SureFire)

Firegel is a powdered gelling agent designed to thicken fuels used in prescribed burning.

- Formulated to be used at 3 to 5 pounds to 54 gallons of fuel.
- Mixes with various fuels including straight gas, Jet B, diesel, or a gas/diesel mix. For best results, straight gas is preferred.
- **Firegel is in the process of being phased out and replaced with Flash 21 by most operators.**

Mixing Procedures for Firegel

- Break up clumps of Firegel before mixing.
- Make sure that the mixing tank is clean.
- Add 15 to 20 gallons of fuel.
- Start the engine and recirculate the fuel. Make sure that all tank valves are open, the recirculation valve is open, and the recirculation switch is on.
- Add Firegel very slowly to the fuel. The amount of Firegel required will depend on the type of fuel, the fuel's temperature, and thickness of the gel desired. For cooler fuels (such as 30 to 40 °F or colder) add $\frac{1}{3}$ to $\frac{1}{2}$ more Firegel to ensure complete gelling. Warm fuels (60 to 70 °F) require less Firegel and will set up quickly.
- Add the remainder of fuel while recirculating.
- Continue to recirculate for about 5 to 10 minutes after all fuel has been added and the Firegel is dissolved. Recirculate periodically.
- Close the mixing tank and allow the gel to set up.
- Check the thickness. The gel should be the consistency of "applesauce." General rules of thumb for mixing: The colder the temperature, the longer the mix will need to set for proper consistency.

Gelling powder cannot be added once the mixture has begun to set up.

Petrol Jel

Petrol Jel is a liquid gelling agent designed to thicken fuels used in prescribed burning.

- Specifically formulated for one 4-litre container to be used with 54 gallons of fuel. Settling of the product in the container is normal.
- Sets up quickly, especially in warm fuels, but may take up to 30 minutes in cold fuels. Under normal conditions, there is no need to mix Petrol Jel until the burn operation is confirmed.
- Known to break down (thin) quickly.
- Can be mixed with various fuels including straight gas, Jet B, diesel, or a gas/diesel mix. For best results, straight gas is preferred.
- **Petrol Jel is in the process of being phased out and replaced with Flash 21 by most operators.**

Mixing Procedures for Petrol Jel

- Agitate the Petrol Jel container until the powder is completely suspended in the liquid.
- Make sure that the mixing tank is clean.
- Fill the mixing tank with fuel.
- Start the engine and recirculate the fuel. Make sure that all tank valves are open, the recirculation valve is open, and the recirculation switch is on.
- Add one to two 4-litre containers of Petrol Jel for every 50 gallons of fuel to achieve the desired consistency. Recirculate the fuel while adding Petrol Jel.
- Continue to recirculate the fuel until all of the Petrol Jel has been added and allowed to set up.
- Do not start mixing fuel until the burn operation is confirmed because the gel will break down quickly.



Flash 21

Flash 21 is ICL Performance Products' (formerly Fire-Trol Canada) new fuel gelling agent (figure 10–5). This two-part liquid gelling agent:

- Provides fast, reliable gelling.
- Designed to be added to fuel as two parts (A and B)—1 liter of each.
- One box of Flash 21 has 12 liters of product, 6 of Flash 21A and 6 of Flash 21B. One liter of Flash 21A and one liter of Flash 21B will gel 50 to 55 gallons of fuel.
- Mixes with various fuels including nonoxygenated gasoline, Avgas, diesel, Jet A, and JP8.
- Developed to allow users to mix this product with fuel regardless of temperature, ensuring a consistent gelled fuel mixture.
- Will not lose viscosity, allowing the gel to be used during the entire burning operations.
- Mixes and disperses throughout the fuel with no lumping and sets up quickly.



Figure 10–5—Flash 21 is a two-part liquid gelling agent that gels quickly and stays gelled for a long time.

Mixing Procedures for Flash 21

- Make sure that the mixing tank is clean.
- Fill the mixing tank with the desired amount of fuel.
- Start the engine and recirculate the fuel. Make sure that all tank valves are open, the recirculation valve is open, and the recirculation switch is on.

- Add 1 liter of Flash 21A for every 50 gallons of fuel, continue recirculating the fuel.
- After the Flash 21A has been added, add 1 liter of Flash 21B for every 50 gallons of fuel. Continue recirculating the fuel.
- Continue recirculating the fuel for about 5 minutes until the fuel reaches the desired viscosity.
- Use additional equal parts of the Flash 21 components to achieve the desired consistency (depending on type of base fuel used).
- The fuel will gel to the desired viscosity in less than 10 minutes. Warm temperatures will not affect the gel's quality.
- If the operator wants to thicken the gel, additional Flash 21 may be added, using equal amounts of each component. Make sure the Flash 21A is thoroughly mixed in the gel before adding the Flash 21B.
- If the fuel will not gel because it contains ethanol, try the following:
 - » Determine the amount of gasoline in the fuel mixture.
 - » Add water (5 percent of the gasoline volume) to the fuel mixture and recirculate.
 - » If the resulting gel is too thin, add a bottle of Flash 21A and recirculate until the Flash 21A is thoroughly mixed with the fuel. Continue recirculating the fuel and add a bottle of Flash 21B.
 - » If too much water was added, a small amount of free water may be present in the gel. This should have only a small effect on the performance of the gel. If free water is present, reduce the amount of water used in the next batch of gel.
- **Unused gelled fuel made with Flash 21 may be stored in the mix tank and used later with no adverse effects.**

Safety Preparations

Conduct a safety briefing that at a minimum:

- Identifies terra torch operations, fire protection, and first aid personnel.
- Ensures all personnel involved in the burn understand their roles and responsibilities.



- Ensures all personnel involved in the burn understand the burn, and the firing and contingency plan (objectives of the burn and firing sequences to be followed as well as contingencies in place in the event of slopovers or spot fires).
- Identifies escape routes and an emergency meeting place (rally point) where personnel could congregate to ensure everyone is accounted for and safe.
- Describes the medical evacuation plan.
- Describes procedures in the event of an equipment malfunction.
- Describes procedures to be used if the terra torch catches fire, ensuring personnel safety and extinguishment of the fire, if possible.
- Ensures the LCES checklist has been reviewed and implemented.
- Ensures the following radio frequencies have been established, checked, and reviewed:
 - » Terra torch module to burn boss
 - » Operator to driver
 - » Burn boss to dispatch/ICP

Prepare the equipment for burning:

- Place fire extinguisher(s) in accessible location(s) within ready reach of the driver and the terra torch operator. The extinguisher(s) shall be located away from the fuel tank.
- Remove the wand and torch hose(s) from the storage rack.
- Connect the end of the torch's hose to the quick disconnect coupler at the pump.
- Plug the electrical connection for the torch wand into the receptacle at the control panel (figure 10-6).

- Attach the propane cylinder to the wand.
 - » Install the propane cylinder onto the propane gas hose. Tighten by hand.
 - » Mount the cylinder to the wand and secure with two clamps.
 - » Make sure the propane gas valve is closed.
- As required, loosen the setscrew and slide the igniter bracket along the barrel to position the igniter as shown (figure 10-7). Tighten the setscrew.
- As required, adjust the position of the grip handle. Turn the handle counterclockwise (to the left) to loosen, slide the grip handle along the barrel to the desired position, then turn the handle clockwise (to the right) to tighten.



Figure 10-6—The terra -torch control panel showing the three-way switch in the OFF position. To the right of the switch is the engine hour meter, and to the right of the hour meter is the electrical outlet for the torch wand.

Terra Torches

Caution

The emergency rally point should be identified (OSHA 29 CFR 1910.38). Emergency escape route, emergency shutdown of operations, procedures to account for all employees, rescue and medical duties, and means of reporting fires and emergencies should be covered. The alarm system to be used for employee notification should be outlined.



Figure 10-7—Position the igniter as shown to ensure reliable ignition.



Normal Operating Procedures for Terra Torches

Follow these procedures when using a terra torch.

Preparing the Torch for Use

- To purge any residual fuel in the torch hose and wand:
 - » Start the engine.
 - » Close the recirculation valve.
 - » Open the torch shutoff valve at the pump.
 - » Set the three-way switch to the TORCH position.
 - » Point the wand in direction of desired ignition and dispel all unused fuel.
 - » Set the three-way switch to the OFF position and shut down the engine (see figure 10–6).

Igniting the Torch

- Open the propane gas valve fully and ignite the propane.
- Adjust the propane flame by closing the gas valve to create the minimum flame required to ignite the gel consistently.

Using the Torch

- Restart the engine, move the three-way switch to the TORCH position, squeeze the wand trigger, and begin the firing operation.
- Direct the burning gel toward the vegetation to be burned.
- Fire from the rear of the terra torch vehicle. Direct the burning gel outward at an angle and **only** to the area behind the vehicle.

- Make sure that the tailgate is open to prevent fumes from pooling in the truck's bed.
- To produce optimal gel coverage, the operator will need to experiment and learn from experience. The wand is factory-equipped with a No. 12 orifice disc at its tip. The orifice disc may be replaced with discs with different sizes of orifices, depending on the desired results.
 - » Increase or decrease pressure, by adjusting the terra torch engine's revolutions per minute, to adjust the distance of the gel stream.
- To improve firing in a crosswind, adjust the angle of the propane torch:
 - » Loosen the nut at the end of the igniter bracket until the torch can be moved by hand.
 - » Rotate the torch 90 degrees left or right so it is on the windward side of the wand tip.
 - » Tighten the nut (at the end of the igniter bracket).
- To stop firing after a firing sequence is complete:
 - » Release the trigger and close the propane gas valve.
 - » Set the three-way switch to the OFF position.

Shutting Down the Torch

When firing operations are completed:

- Purge the hose and wand of any gelled fuel as described previously (see "Preparing the Torch for Use").
- Close the torch shutoff valve at the pump.
- Close the propane gas valve to conserve gas whenever you are not firing.



Emergency Operating Procedures for Terra Torches

Terra torch operators need to know what to do in the following situations:

- General
 - » If the terra torch malfunctions, shut down the torch until all problems are identified and corrected.
 - » Establish emergency contact procedures using radio notification.
- Torch catches fire—if time and fire size permit attempts to extinguish the fire:
 - » Shut down torch.
 - » Close the tank's emergency valves.
 - » Attempt to extinguish the fire using a Class B fire extinguisher or Class B foam, if practical.
- Torch catches fire—if time and fire size do not permit attempts to extinguish the fire:
 - » Abandon the torch and leave the area immediately.
- Major fuel spill
 - » Eliminate all sources of ignition in the area.
 - » Remove all personnel from the area.
 - » Restrict access to the area.
 - » Contact your local hazardous materials coordinator or environmental coordinator.

Caution

If the torch catches fire, do not jeopardize your safety to save the torch or the vehicle!



Troubleshooting

Terra Torches

Terra Torch Troubleshooting Procedures		
Malfunction	Test or inspection	Corrective action
Clutch does not engage the pump	Make sure the three-way switch is set to TORCH or RECIRCULATE.	Set the three-way switch to TORCH or RECIRCULATE. If the switch position is correct, proceed to the next step.
	Check the V-belts on the clutch.	If the V-belts are loose, tighten the V-belts. If the V-belts are worn or damaged, replace the V-belts. If the V-belts are not loose or damaged, proceed to the next step.
	Check the wiring system for damage.	Repair damaged wiring. If the wiring is not damaged, proceed to the next step.
	Make sure the battery has enough charge to activate the clutch. Set the three-way switch to TORCH, squeeze the wand's trigger, and listen for the clicking sound of the clutch being activated. Set the three-way switch to RECIRCULATE and listen for the clicking sound.	If there is no clicking sound, check the battery's charge. Charge or replace the battery. If there is a clicking sound, repair or replace the clutch.
Engine will not start	Make sure the fuel tank has fuel.	If the fuel tank is empty, fill the tank with fuel. If the tank has fuel, proceed to the next step.
	Make sure the fuel shutoff valve is open.	If the fuel shutoff valve is closed, open the fuel shutoff valve. If the fuel shutoff valve is open, proceed to the next step.
	Make sure the choke control lever is in the CHOKE position.	If the choke control lever is not in the CHOKE position, move the lever to the CHOKE position. If the choke control lever is in the CHOKE position, proceed to the next step.
	Make sure the throttle control is in the SLOW (IDLE) position.	If the throttle control lever is not in the SLOW (IDLE) position, move the lever to the SLOW (IDLE) position. If the throttle control lever is in the SLOW (IDLE) position, proceed to the next step.
	Inspect the battery and electrical connections.	If the battery or electrical connections are damaged, repair or replace the battery or electrical connections. If the battery and electrical connections are intact, proceed to the next step.
	Remove and inspect the spark plug.	If the spark plug is dirty or damaged clean or replace the spark plug. If the engine will not start, consult the engine manual or a small engine mechanic.





Troubleshooting

Terra Torch Troubleshooting Procedures (continued)

Malfunction	Test or inspection	Corrective action
No flame or weak flame at the propane torch	Make sure the propane valve is open.	If the propane valve is not open, open the valve. If the valve is open, proceed to the next step.
	Make sure the propane cylinder is not empty.	If the propane cylinder is empty, replace the propane cylinder. If the propane cylinder is not empty, proceed to the next step.
	Make sure the orifice disc in the propane torch is not blocked.	If the orifice disc is blocked, clean the orifice. If the orifice disc is not blocked, proceed to the next step.
	Inspect the propane fittings and hose for damage. Check for dirt, debris, or other obstructions at the igniter's orifice.	Replace damaged fittings or hose. Clean the igniter orifice with welding tip cleaners.
Pump does not operate	Make sure the clutch engages the pump.	If the clutch does not engage the pump, troubleshoot the clutch. If the clutch does engage the pump, proceed to the next step.
	Check the pump pressure.	Close the recirculation valve, set the switch to RECIRCULATE and check the gauge for pressure rise. If the pressure does not increase, repair or replace the pump.
Trigger on the torch does not activate the clutch	Make sure the torch hose electrical plugs are connected to the receptacles.	If the torch hose electrical plugs are not connected, connect them. If the torch hose electrical plugs are connected, proceed to the next step.
	Check the wiring from the torch to the clutch for damage.	If the wiring is damaged, repair the wiring. If the wiring is not damaged, proceed to the next step.
	Make sure the battery has enough charge to activate the clutch. Set the three-way switch to TORCH, squeeze the wand's trigger, and listen for the clicking sound of the clutch being activated. Set the three-way switch to RECIRCULATE and listen for the clicking sound.	If there is no clicking sound, check the battery's charge. Charge or replace the battery. If there is a clicking sound, repair or replace the clutch.
Unit fails to pump gel to the torch	Make sure the three-way switch is set to TORCH.	Set the three-way switch to TORCH. If the switch position is correct, proceed to the next step.
	Make sure the recirculation valve is closed.	If the recirculation valve is open, close the recirculation valve. If the recirculation valve is closed, proceed to the next step.





Troubleshooting

Terra Torches



Terra Torch Troubleshooting Procedures (continued)

Malfunction	Test or inspection	Corrective action
Unit fails to pump gel to the torch (continued)	Make sure the torch shutoff valve is open.	If the torch shutoff valve is closed, open the torch valve. If the torch shutoff valve is open, proceed to the next step.
	Make sure the tank valves are open.	If the tank valves are closed, open the tank valves. If the tank valves are open, proceed to the next step.
	Make sure the torch hose electrical and quick coupler connections are made and are secure.	Connect the electrical and quick coupler connections. If the connections are correct, proceed to the next step.
	Make sure the gel is not too thick.	If the gel is too thick, thin the gel. If the gel is the proper consistency, proceed to the next step.
	Make sure the battery has enough charge to activate the clutch. Set the three-way switch to TORCH, squeeze the wand's trigger, and listen for the clicking sound of the clutch being activated. Set the three-way switch to RECIRCULATE and listen for the clicking sound.	If there is no clicking sound, check the battery's charge. Charge or replace the battery. If there is a clicking sound, proceed to the next step.
	Make sure the gel has not formed a lump at the bottom of the tank.	If the gel has formed a lump at the bottom of the tank, cycle the tank outlet valve open and closed to dislodge the blockage. If the gel has not formed a lump at the bottom of the tank, proceed to the next step.
	Make sure the quick coupler is not blocked.	If the quick coupler is dirty, turn off the terra torch, close the torch shutoff valve, and remove the male end of the quick connect and clean it. If the quick coupler is not dirty, troubleshoot the pump.
Unit fails to recirculate the gel	Make sure the three-way switch is set to RECIRCULATE.	Set the three-way switch to RECIRCULATE. If the switch position is correct, proceed to the next step.
	Make sure the recirculation valve is open.	If the recirculation valve is closed, open the recirculation valve. If the recirculation valve is open, proceed to the next step.
	Make sure the torch shutoff valve is closed.	If the torch shutoff valve is open, close the torch valve. If the torch shutoff valve is closed, proceed to the next step.





Troubleshooting

Terra Torch Troubleshooting Procedures (continued)

Malfunction	Test or inspection	Corrective action
Unit fails to recirculate the gel (continued)	Make sure the tank valves are open.	If the tank valves are closed, open the tank valves. If the tank valves are open, proceed to the next step.
	Make sure the battery has enough charge to activate the clutch. Set the three-way switch to RECIRCULATE and listen for the clicking sound of the clutch being activated.	If there is no clicking sound, check the battery's charge. Charge or replace the battery. If there is a clicking sound, proceed to the next step.
	Make sure the gel is not too thick.	If the gel is too thick, thin the gel. If the gel is the proper consistency, proceed to the next step.
	Make sure the gel has not formed a lump at the bottom of the tank.	If the gel has formed a lump at the bottom of the tank, cycle the tank outlet valve open and closed to dislodge the blockage. If the gel has not formed a lump at the bottom of the tank, troubleshoot the pump.
Wand leaks at the handle	Make sure that the packing screw at the handle is tight.	Tighten the packing screw. If the packing screw is tight, proceed to the next step.
	Disassemble the wand and inspect the packing washer and the packing for compaction or damage.	Replace as needed.
Wand leaks at the tip	Make sure the brass cap at the end of wand is tight.	Tighten the brass cap. If the brass cap is tight, proceed to the next step.
	Disassemble the tip and make sure the nylon gasket is present and not damaged. Make sure an O-ring has not been used instead of the nylon gasket.	Install or replace the nylon gasket as needed.
Wand's trigger sticks	Make sure that the packing screw at the handle has not been overtightened.	Loosen the packing screw. If the packing screw has not been overtightened, proceed to the next step
	Inspect the barrel of the wand to make sure it has not been dented. If the barrel is dented, the guide vane can stick.	Disassemble the wand and replace the damaged parts.



Maintenance and Storage

The terra torch and mixing unit must have proper care to work reliably.

Cleaning and Repair

- Internal Cleaning
 - » Add 5 gallons of diesel fuel to the tank.
 - » Place the unit in the recirculation mode and recirculate diesel for 5 minutes.
 - » Set the three-way switch to TORCH. Close the RECIRCULATION valve and open the torch valve.
 - » With the propane cylinder removed, pump the liquid through the hose and wand and dispose of the liquid by burning it at the burn site.
 - » Add an additional 5 gallons of diesel fuel to the tank.
 - » Place the unit in the recirculation mode and recirculate the diesel fuel for 5 minutes.
 - » Set the three-way switch to TORCH. Close the RECIRCULATION valve and open the torch valve.
 - » Pump the liquid through the hose and wand into the tank.
 - » Use the liquid in the tank for the next batch of gel.

- External Cleaning
 - » Use solvent to remove hardened gel and powder from the outside of the motor compartment. Wash the unit with soap and water.
 - » Use only mild soap and water on the stainless steel tank.
- Preventative Maintenance
 - » Grease the pump and shaft bearings according to the manufacturer's instructions.
 - » Change the engine oil and filter as needed. Refer to the engine manual for additional service.
 - » Keep a record of all maintenance.

Storing Equipment and Fuel

- Store all equipment indoors or cover the equipment well.
- Store gelling agents in warehouses, keeping powdered gelling agents in dry, heated locations. Consult the material safety data sheets (appendix B) and your local hazmat coordinator for additional storage requirements.



Terra Torch Resources

This section includes the following resources:

- Information for inclusion in a hazard analysis
- List of required material safety data sheets
- Using a dust mask
- Recommended spare parts
- Equipment standards for terra torches
- Contract equipment inspection checklist
- Terra torch references



Terra Torches



Hazard Analysis

This information can be used when preparing a job hazard analysis (used by the Forest Service) or similar hazard analysis.

Caution

If gelled fuel is spilled, the preferred method of clean up is to burn the gelled fuel onsite. Consult with your local safety officer before cleaning or maintaining the interior of batch or modular mixers or cleaning up spills to determine the appropriate respiratory protection and other PPE.

Terra Torches

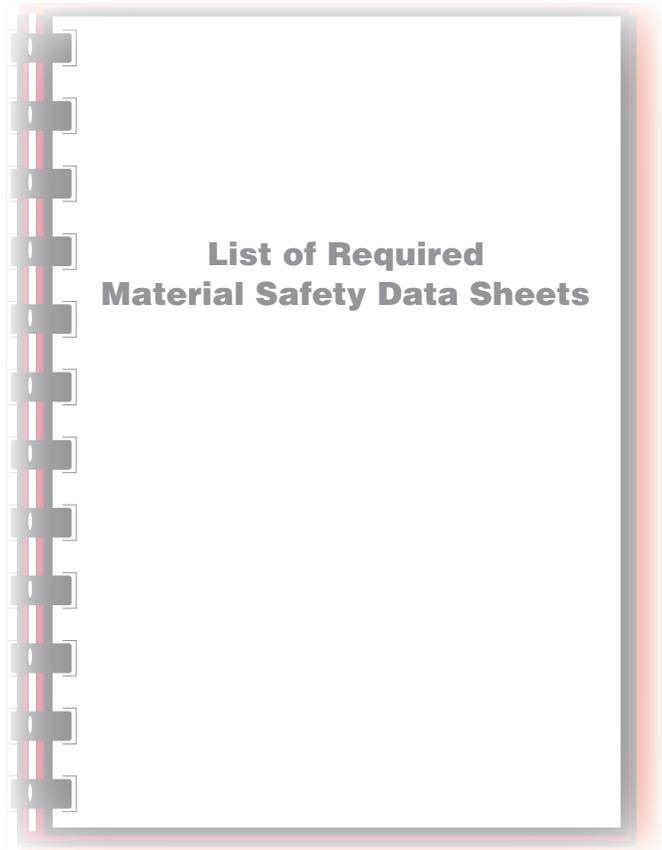
Information for Terra Torch Hazard Analyses		
Task	Hazards	Abatement actions
Transporting the terra torch	Torch falling off of the vehicle or trailer	Make sure the terra torch is secured to the vehicle or trailer.
Filling the tank and mixing fuel	Fuel spills Inhaling gel compound and gasoline fumes Static electricity (sparks)	Wear static-resistant Nomex or cotton clothing and nitrile gloves while mixing gelled fuel. Use safety cans with pour spouts. Electrically bond the unit with the proper static line. Avoid breathing fuel vapors.
Assembling components of the terra torch	Fuel spills Breathing fuel vapors Static electricity (sparks)	Wear the required PPE. Check for fuel leaks. Tighten all hose connections. Avoid breathing fuel vapors.
Igniting the terra torch	Burns Fumes Noxious smoke	Wear the required PPE. Be aware of the location of the wand's tip. Use proper ignition methods to light the propane torch. Avoid breathing fuel vapors
Burning operations	Burns Fumes Noxious smoke Dragging the torch operator with the vehicle Tripping, stumbling, or falling	Wear the required PPE. Be aware of where the wand tip is pointing. Only ignite vegetation behind the torch vehicle or trailer. When not firing, keep your fingers off the trigger. Move the vehicle slowly ahead of the operator. Make sure an assistant will control movement of the excess hose. Make sure the operator has secure footing. Avoid breathing fumes.
Extinguishing the terra torch	Fuel or gel spills	Wear the required PPE. Be aware that fuel may leak from the wand's tip.
Cleaning the terra torch	Fuel vapors Fuel on skin Fuel spills	Wear nonstatic Nomex or cotton clothing and nitrile gloves. Minimize exposure to fuel vapors and contact with the fuel. Clean up all fuel spills promptly.



List of Required Material Safety Data Sheets

Material safety data sheets for all ground ignition systems are in appendix A. The material safety data sheets for the terra torch include:

- Diesel
- Fire-Trol Firegel
- Fire-Trol Petrol Jel
- Fire-Trol Flash 21A
- Fire-Trol Flash 21B
- Gasoline
- Propane



Terra Torches



Using a Dust Mask

When dispensing or handling powdered gelling agent, if providing dust masks for voluntary use (as defined by OSHA in 29 CFR 1910.134) make sure that you:

- Supply a dust mask rated N95 (blocks about 95 percent of particles that are 0.3 microns or larger).
- Prevent contamination of N95 dust masks by storing them in a chemical- and dust-free sealed container.
- Make sure the N95 dust mask does not interfere with employees' ability to work safely
- Instruct employees that the N95 masks are for one-time use and a new one should be used each day.
- Make sure each employee reads a copy of Appendix D of 29 CFR 1910.134, which instructs employees on N95 dust mask limitations (warning them that wearing a dust mask does not protect them from organic vapors).

OSHA Appendix D to Sec. 1910.134

(Mandatory) Information for Employees Using Respirators When Not Required Under the Standard

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, or if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.
2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.
3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.
4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

—63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998]



Recommended Spare Parts

- Drive belts for pump
- Spare wand and hose
- Extra tips for the wand
- Packing for the wand
- Spark plug for the engine
- Engine fuel filters
- Engine air filter
- Engine oil
- Propane cylinders

Equipment Standards for Terra Torches

Fuel Tank Requirements

- Tanks or drums with a capacity of 55 gallons or greater must meet DOT specifications for transporting flammable liquids.
- Tanks with a capacity of less than 55 gallons must be leak free.
- Tanks larger than 119 gallons must have a FLAMMABLE placard and the 1203 UN identification number installed on all four sides of the tank or on the sides of the tank and the front and back of the transport vehicle. The 1203 identification number may be displayed separately or as part of the FLAMMABLE placard.
- Tanks or drums with a capacity of 119 gallons or less must have a FLAMMABLE LIQUID label installed and be marked GASOLINE, UN 1203.
- Tanks with a capacity larger than 119 gallons must have an emergency shutoff valve that is marked and easily accessible in the event of an emergency.
- Bolt or weld the tank to the skid or trailer frame. Bolting the tank to the trailer's expanded metal decking is not acceptable.
- Tanks with a capacity of larger than 119 gallons shall be installed so that the emergency shutoff valves are protected and not protruding from the vehicle.
- Tanks larger than 60 gallons shall be equipped with a fill spout that extends to within 6 inches of the tank bottom or be equipped to fill from the bottom to prevent static electricity from building up and discharging.

- All tanks or drums 55 gallons or larger shall be equipped with a 2-inch male camlock (cam and groove adapter) by male NPT (national pipe taper) thread for use with the vapor recovery/removal hoses. A dust cap shall be provided with the adapter to prevent contaminating the tank when the vapor hose is not being used.
- Tanks or drums must be equipped with a means such as a hatch or sight glass to see the fuel level.
- Tanks or drums must be equipped with a relief valve to allow air to enter and exit during pumping operations.

Pump

- Must have nonsparking internal components.
- Must have seals and gaskets that are compatible with gasoline.
- Must be designed to operate at the system's pressure and flow rate.
- Must be designed to operate at the design revolutions per minute of the system.

Pump Relief Valve

- The system must be equipped with a relief valve to prevent excessive pressure from building up if the pump's discharge piping is blocked.
- The discharge of the relief valve may be connected to the pump inlet or to the tank.
- The relief valve must be sized for full pump flow.
- The relief pressure setting must not exceed the pressure ratings of any of the system's components.
- All of the materials, including the seals and gaskets, must be compatible with gasoline.

Electrical Requirements

- Permanently seal electrical connections to prevent sparks.
- Install a protective housing over switch housings to reduce sparks.
- Install the battery in an enclosed battery holder as far away as possible from potential sources of fuel leakage. The battery shall be connected to the terra torch engine with No. 4 cables encased in plastic conduit. The conduit shall be secured to the terra



torch skid or vehicle bed. Alternatively, the terra torch may be connected to the vehicle's battery using No. 4 cables.

- Protect wiring from abrasion by using split loom, conduit, or other methods. Electrical tape is not considered adequate. Where wiring passes through frame members, it shall be protected by rubber grommets to protect the insulation.

Engine Installation

- Locate the fuel tank so the engine can be refueled without spilling fuel on a hot engine.
- Shield the engine or piping so that leaks in any of the piping, pump seals, hoses, or other components cannot spray gasoline or gel on a hot engine. The shielding shall not interfere with the cooling of the engine.

Hoses, Piping, Valves, and Fittings

- All hoses, piping, valves, and fittings shall be sized to allow adequate flow for mixing the fuel and gelling agent and for dispensing the fuel through the wand.
- All piping must be supported and secured.
- Hose installations shall be protected from abrasion.
- All hose assemblies shall have swaged end fittings.
- All hose assemblies shall be conductive.
- All cam and groove fittings shall be equipped with self locking levers or be provided with other means to prevent the levers from releasing accidentally.
- All valves shall be permanently labeled, indicating their function and direction of flow.
- The pressure gauge shall be isolated from the gelled fuel by a diaphragm assembly.

Vapor Removal and Recovery

- Each terra torch of 55 gallons or greater capacity shall be equipped with a vapor removal/recovery hose.
- The minimum hose length is 50 feet.
- The hose assembly shall be electrically conductive.
- The hose shall be compatible with gasoline vapor.
- The hose shall be equipped with a 2-inch male camlock (cam and groove adapter) by male NPT (national pipe taper) thread.

Bonding

- Each terra torch shall be equipped with an electrical bonding cable to be used during fueling.
- The terra torch shall be bonded at all times to the transport vehicle.

Securing the Torch to the Vehicle

- The torch shall be secured to the vehicle or trailer so that it does not move during transit or during the firing operation.

Trailer (Forest Service only)

If the terra torch is mounted on a trailer, the trailer must be equipped with brakes if the gross trailer weight rating is 1,500 pounds or more. The brakes must be designed so the operator can activate them independently of the vehicle foot brakes (FSH 7109.19, 31.3).



Contract Equipment Inspection Checklist

Fuel Tanks

- Fuel tanks or drums with a capacity of 55 gallons or more meet DOT specifications for transporting of flammable liquids.
- Fuel tanks with a capacity of less than 55 gallons are leak free.
- Tanks larger than 119 gallons have a FLAMMABLE placard and the 1203 UN identification number installed on all four sides of the tank or on the sides of the tank and the front and back of the transport vehicle. The 1203 identification number is displayed separately or as part of the FLAMMABLE placard
- Drums or tanks with a capacity of 119 gallons or less have a FLAMMABLE LIQUID label installed and are marked GASOLINE, UN 1203.
- The tank emergency shutoff valve is marked and easily accessible in an emergency.
- The tank is bolted or welded to the skid or trailer frame. Bolting the tank to expanded metal decking is not acceptable.
- The tank or drums are installed so the emergency shutoff valves are protected and not protruding from the vehicle.
- Tanks larger than 60 gallons are equipped with a fill spout that extends to within 6 inches of the tank bottom or are equipped to fill from the bottom to prevent static electricity from building up and discharging.
- All tanks or drums 55 gallons or larger are equipped with a 2-inch male camlock (cam and groove adapter) by male NPT (national pipe taper) thread for use with the vapor recovery/removal hoses. A dust cap is provided with the adapter to prevent the tank from being contaminated when the vapor hose is not being used.
- Tanks or drums are equipped with a means to visually determine the fuel level.
- Tanks or drums are equipped with a relief valve to allow air to enter and exit during pumping operations.

Pump

- The pump has nonsparking internal components.
- Pump seals and gaskets are compatible with gasoline.
- The pump is designed to operate at the system's pressure and flow rate.
- The pump is designed to operate at the system's design revolutions per minute.

Relief Valve

- The system is equipped with a relief valve to prevent excessive pressure from building up if the pump's discharge piping is blocked.
- The relief valve's discharge is connected to the pump inlet or to the tank.
- The relief valve is sized for full pump flow.
- The relief pressure setting does not exceed the pressure ratings of any of the system's components.
- All materials, including seals and gaskets, are compatible with gasoline.

Electrical

- Electrical connections are permanently sealed to prevent sparks.
- A protective housing is installed over switch housings to reduce sparks.
- The battery is installed in an enclosed battery holder as far away as possible from potential sources of fuel leakage.
- The battery is connected to the engine with No. 4 cables encased in plastic conduit. The conduit is secured to the terra torch's skid or vehicle bed.
- Wiring is protected from abrasion by split loom, conduit, or other methods. Electrical tape is not considered adequate. Where wiring passes through frame members, it is protected by rubber grommets to protect the insulation.



Engine

- ❑ The engine's fuel tank is located so the engine can be refueled without spilling fuel on a hot engine.
- ❑ The engine or piping is shielded so that leaks in any of the piping, pump seals, hoses, or other components cannot spray gasoline or gel on a hot engine. The shielding does not interfere with cooling of the engine.

Piping and Hoses

- ❑ All hoses, piping, valves, and fittings are sized to allow adequate flow for mixing the fuel and gelling agent and for dispensing the fuel through the wand.
- ❑ All piping is supported and secured.
- ❑ Hose installations are protected from abrasion.
- ❑ All hose assemblies have swaged end fittings.
- ❑ All hose assemblies are conductive.
- ❑ All cam and groove fittings are equipped with self-locking levers or have other means to prevent the levers from releasing accidentally.
- ❑ All valves are permanently labeled, indicating their function and the direction of flow.
- ❑ The pressure gauge is isolated from the gelled fuel by a diaphragm assembly.

Vapor Removal and Recovery

- ❑ Each terra torch 55 gallons or larger is equipped with a vapor removal and recovery hose.
- ❑ The vapor hose length is at least 50 feet long.
- ❑ The vapor hose is electrically conductive.
- ❑ The vapor hose is compatible with gasoline vapor.
- ❑ The vapor hose is equipped with a 2-inch cam and groove (camlock) socket.

Bonding

- ❑ The torch is equipped with a retractable bonding cable that prevents static electricity from building up when the terra torch is fueled.
- ❑ The bonding cable assembly is electrically bonded to the terra torch's fuel tank.

Miscellaneous

- ❑ All of the materials, including the seals and gaskets, must be compatible with gasoline.
- ❑ The torch is secured to the vehicle or trailer so that it does not move during transit or during the firing operation.
- ❑ If the terra torch is mounted on a trailer, if the gross trailer weight rating is 1,500 pounds or more the trailer must be equipped with brakes. The brakes must be designed so the operator can activate them independently of the vehicle foot brakes (Forest Service requirement—FSH 7109.19, 31.3).



Terra Torch References

See appendix B for additional ground ignition references.

Interagency Standards for Fire and Fire Aviation Operations, NFES 2724, available at <http://www.nifc.gov/policies/red_book.htm>.

Firecon Terra Torch Operation Manual, available from Firecon, Inc., P.O. Box 657, Ontario, OR 97914, 541-889-8630 or firecon@fmtc.com

Interagency Transportation Guide for Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel, PMS 442, available at <<http://www.nwcg.gov/>>.

Everyday Hazmat User's Training Guide, 0471-2810-MTDC, available at <http://www.fs.fed.us/eng/everyday_hazmat/users_guide.htm>.

29 CFR 1910, available at <<http://www.osha.gov>>. (Search for 29 CFR 1910.)

Forest Service Handbook FSH 7109.19, 31.3, available at <http://www.fs.fed.us/im/directives/fsh/7109.19/7109.19_30txt>.

Phos-Chek Web site at <<http://phos-chek.com>>.



Notes

Terra Torches



Appendix A— Material Safety Data Sheets



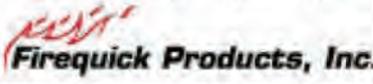
This appendix includes the following material safety data sheets:

- Flares and cartridges
 - » FireQuick flares
 - Also available at <http://www.firequick.com/content.php?_p_=3>.
 - » Orion flares
 - Also available at <<http://www.orionsignals.com/safetydata/>>.
 - » Cartridges (industrial loads) for FireQuick Flare Systems
- Fuels
 - » Diesel
 - » Gasoline
- Fusees
 - » Orion fusees
 - Also available at <<http://www.orionsignals.com/safetydata/>>.
- Gases
 - » Nitrogen
 - » Propane
- Gelling agents
 - » Fire-Trol Firegel/SureFire
 - » Fire-Trol Flash 21A
 - Also available at <<http://phos-chek.com>>.
 - » Fire-Trol Flash 21B
 - Also available at <<http://phos-chek.com>>.
 - » Fire-Trol Petrol Jel
- Gelled fuel blivets
 - » FireSnakes/Heat Source Slash Burners
 - Also available at <<http://www.wildfire-environmental.com>>.
- Plastic spheres
 - » Ethylene glycol antifreeze
 - » Potassium permanganate



Flares and Cartridges: FireQuick Flares

Material Safety Data Sheets

		<p>Firequick Products, Inc. P.O. Box 910 Inyokern, CA 93527 bsumners@firequick.com</p> 	
MATERIAL SAFETY DATA SHEET (MSDS)		HEALTH = 1 SLIGHT	FLAMMABILITY = 3 SEVERE
		REACTIVITY = 0 NONE	
SECTION I CRITICAL NUMBERS		SECTION I CRITICAL NUMBERS	
TRADE NAME FireQuick Flares "Hot Shot", "Stubby", "2 1/2-Inch", "Big Shot"		EMERGENCY TELEPHONE Infotrac (800) 535-5053	
Proper Shipping Name Flammable Solid, Inorganic, n.o.s. (Aluminum Powder)		DOT Classification UN 3178, 4.1, Packaging Group III	
MANUFACTURER NAME Firequick Products, Inc.		MANUFACTURER PHONE (760) 377-5766	
Address P.O. Box 910, 7105 Monache Mtn. Blvd, Inyokern CA 93527			
SECTION II HAZARDOUS INGREDIENTS		WEIGHT (grams per flare)	
Aluminum (CAS # 7429-90-5)		20 - 80	
Calcium Sulfate, dihydride (plaster of paris)		10 - 70	
Iron Oxide (CAS # 1317-61-9)		4 - 10	
Cupric Oxide (CAS # 1317-38-0)		1	
Phosphorous, Amorphous, Red (CAS#7723-14-0)		.1	
SECTION III PHYSICAL DATA FOR MATERIAL			
Boiling Point	N/A	Specific Gravity	1.43
Vapor Pressure	N/A	Physical State	Solid
Solubility in Water	Insoluble	pH	Neutral
Color	Gray	Odor Threshold	N/A
SECTION IV FIRE AND EXPLOSION HAZARD DATA			
Flash Point Self Ignites at 800 o F		UEL: N/A LEL: N/A	
MEANS OF EXTINCTION: FLOODING WITH WATER, DRY SAND, AND CARBON DIOXIDE. FLARES CAN IGNITE IF PACKAGING IS BURNING. LARGE AMOUNTS OF WATER PREVENT FLARE IGNITION IF PACKAGING IS BURNING.			
SPECIAL PROCEDURES: FIREQUICK FLARES ARE PACKAGED IN BOXES OF 10 TO 50 EACH. FLARES ARE REACTIVE PRODUCING MOLTEN MATERIALS IN EXCESS OF 4000° F AND LOCALIZED SMOKE. HEAT/FLAME IS THE ONLY KNOWN IGNITION SOURCE. FLOOD WITH WATER TO EXTINGUISH, DON'T INHALE FUMES			
EXPLOSIVE HAZARD: FLARES WILL NOT EXPLODE. DELAY FUSE IS PROTECTED BY SEAL, WHICH IS BROKEN BY THE OPERATOR BEFORE USE. FUSE LIGHTS FLARE RESULTING IN AGGRESSIVE BURNING. MAY CAUSE FLARE MOTION.		HAZARDOUS COMBUSTION PRODUCTS: REACTION PRODUCES SUPERHEATED CALCIUM SULFIDE, WHICH REACTS WITH WATER TO PRODUCE HYDROGEN SULFIDE GAS. HUMAN EXPOSURE TO H ₂ S @ 800-1000PPM FOR 30 MINUTES MAY BE FATAL.	
Last Revision 03/16/05		Page 1 of 2	





Flares and Cartridges: Orion Flares

Material Safety Data Sheets

ORION SAFETY PRODUCTS
RAILWAY & HIGHWAY FUSEES
MARINE SIGNAL PRODUCTS

MATERIAL SAFETY DATA
EMERGENCY CONTACT: CHEMTREC
1-800-424-9300

SECTION I - IDENTIFICATION

PRODUCT NAME & SYNONYMS: 12 Gauge Marine Aerial Signal (red or white)	
CHEMICAL FAMILY: Not Applicable	FORMULA: Mixture
TRADE NAME: 12 Gauge Signal	
DESCRIPTION: A shortened shotgun shell containing a star which burns red or white upon ignition.	CAS NO: Not Applicable

SECTION II - NORMAL HANDLING PROCEDURES

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: (KEEP OUT OF REACH OF CHILDREN) Store in a cool area out of direct sunlight. Do not allow long-term exposure to temperatures in excess of 180°F. Avoid long-term immersion in water. Do not disassemble signal. Do not attempt to ignite or burn this product inside a building or vehicle.	
PROTECTIVE EQUIPMENT	VENTILATION REQUIREMENTS
EYES: Goggles when handling broken containers. GLOVES: None required. OTHER: None required.	Outdoor use only.

SECTION III - HAZARDOUS INGREDIENTS

BASIC MATERIALS	OSHA PEL	LD 50	LC 50	SIGNIFICANT EFFECTS
Magnesium CAS# 7439-95-4	15 mg/m ³	230 mg/Kg (rat)	No Data	Heart beat alteration. Inflammation and local lesions on skin.
Strontium nitrate CAS# 10042-76-9 Strontium peroxide CAS# 1314-18-7	None Est. Not Known	2750mg/Kg (rat) Not Known	No Data Not Known	Irritant to skin, eyes & mucous membranes May cause irritation to eyes, mucous membranes, moist skin.
Polyvinyl chloride CAS# 9002-86-2	1 ppm	Not Known	Not Known	May contain vinyl chloride, a suspected cancer-causing agent.
Black Powder	None Est.	None Est.	None Est.	Explosive. Dust may be irritant.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Auto Ignition of Contents: >180°F	OSHA CLASSIFICATION: 1.4G Explosive	FLAMMABLE EXPLOSIVE LIMITS	LOWER: Not Known	UPPER: Not Known
EXTINGUISHING MEDIA: Water deluge. Suffocation techniques may be ineffective.				
SPECIAL FIRE HAZARD & FIRE FIGHTING PROCEDURES: Use NIOSH/MSHA approved self-contained breathing apparatus when signals are involved in a fire.				

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE:	None established.
SYMPTOMS OF OVER EXPOSURE:	Contents of star can cause skin, eye and mucous membrane irritation; dermatitis.
SKIN:	If exposed to contents, flush thoroughly with water.
EYES:	If exposed to contents, flush with water for 15 minutes, call a physician.
INGESTION:	Call a physician immediately.
INHALATION:	If star contents are inhaled, move victim to fresh air. Call a physician.



Flares and Cartridges: Orion Flares (continued)

SECTION VI - TOXICOLOGY (Contents of Signal) 12 Gauge Marine Aerial Signal (red or white)

ACUTE ORAL LD 50:	No available data.	CARCINOGENICITY:	Not known to be carcinogenic.
ACUTE DERMAL LD 50:	No available data.	MUTAGENICITY:	Not known to be mutagenic.
ACUTE INHALATION LC 50: No available data.			
PRINCIPAL ROUTES OF ABSORPTION:		Inhalation of contents.	
EFFECTS OF ACUTE EXPOSURE:		Contents can cause skin, eye and mucous membrane irritation; dermatitis.	
EFFECTS OF CHRONIC EXPOSURE:		Content dust may cause dermatitis.	

SECTION VII - SPILL AND LEAKAGE PROCEDURES (Control Procedures)

ACTION FOR MATERIAL RELEASE OR SPILL: Remove all sources of ignition. Wear NIOSH/MSHA approved dust respirator if there are dusty conditions. (Follow OSHA regulations for respirator use. See 29 CFR 1910.134.) Use non-sparking utensils to sweep or shovel up and place in an approved DOT container. Do not return material to original container. Isolate and DO NOT SEAL. Wash all contaminated clothing before re-use. In the event of a large spill, call the emergency telephone number listed below.
TRANSPORTATION EMERGENCY, CONTACT CHEMTREC 1-800-424-9300
WASTE DISPOSAL METHOD: Dispose of contaminated product and materials used in cleaning up spills or leaks in the manner approved for pyrotechnic material. Consult appropriate federal, state and local regulatory agencies to ascertain proper disposal procedures. Open burning is preferred method of disposal for pyrotechnic materials.

SECTION VIII - SHIPPING DATA

DOT CLASS: Cartridges, Signal, Packing Group II; Label: Red: 1.4G, UN0312, EX-8604108; White: 1.4S, UN0405, EX-8606151
--

SECTION IX - REACTIVITY DATA

STABLE: X UNSTABLE: AT _____°C _____°F	HAZARDOUS POLYMERIZATION	MAY OCCUR: WILL NOT OCCUR: X
CONDITIONS TO AVOID: Exposure of the signal to temperatures in excess of 150°F may cause weakening of the signal body.		
INCOMPATIBILITY (Material to avoid): None known.		
HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide, Carbon Dioxide, Nitrous oxides, Magnesium hydroxides and oxides.		

SECTION X - PHYSICAL DATA

MELTING POINT	Not Applicable	VAPOR PRESSURE	No Data	VOLATILES	No Data
BOILING POINT	Not Applicable	SOLUBILITY IN WATER	No Data	EVAPORATION RATE	No Data
SPECIFIC GRAVITY (H ₂ O=1)	No Data	pH	Not Applicable	VAPOR DENSITY (Air=1)	Not Applicable

INFORMATION FURNISHED BY: **ORION SAFETY PRODUCTS** **DATE:** August, 2006

3157 N 500 W
Peru, IN 46970
1-800-851-5260

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Flares and Cartridges: Cartridges (Industrial Loads) for FireQuick Flare Systems

Material Safety Data Sheets



CARTRIDGES POWER DEVICES - MATERIAL SAFETY DATA SHEET

PAGE 1 OF 6

I. PRODUCT AND COMPANY IDENTIFICATION

Company: Simpson Strong-Tie Company, Inc.
Address: 5956 W. Las Positas Blvd.
 Pleasanton, CA 94588

Product Name: Cartridges For Power Devices

Product Description: Powertool Loaded Round

Emergency Contact No.: 1-800-535-5053 USA
 1-352-323-3500 International

Manufacturer: Olin Brass and Winchester, Inc.
 427 North Shamrock St.
 St Alton, IL 62024-1197
 www.Winchester.com

Date Prepared or Revised: May 2008
Supercedes: 8/24/07
 For most current MSDS, please visit our web site at www.simpsonanchors.com.

II. COMPOSITION / INFORMATION ON INGREDIENTS

Components	CAS Number	% By Weight	EINECS/ELINCS #	EU Classification	
Iron	7439-89-6	0 - 97	231-096-4	None	None
Copper	7440-50-8	50 - 65	231-159-6	None	None
Zinc	7440-66-6	15 - 32	231-175-3	F(as dust or powder)	R 15-17
Nitrocellulose	9004-70-0	7 - 13	Not listed	E*	R 1-3
Nitroglycerin	55-63-0	0.5 - 2	200-240-8	E, T+, N	R 3-26/27/28-33-51-53
Dibutyl phthalate	84-74-2	0.5 - 2	201-55-74	T, N	R61-50-62
Normal Lead styphnate	15245-44-0	0.1 - 1	239-290-0	E, T, N	R61-3-20/22-33-50/53-62

* This material is not listed in Annex 1 of Directive 88/379/EEC. Olin has classified the material according to the conventional method based upon information from similar materials.

III. HAZARD IDENTIFICATION
EMERGENCY OVERVIEW

EXPLOSIVE. KEEP AWAY FROM HEAT. DO NOT SUBJECT TO MECHANICAL SHOCK. PARTICLES FROM FIRING MAY BE HARMFUL IF INHALED. DO NOT TAKE INTERNALLY.

HUMAN THRESHOLD RESPONSE DATA

Odor Threshold: Unknown
Irritation Threshold: Unknown
Immediately Dangerous to Life or Health (IDLH) value(s): The IDLH for this product is not known. The IDLH for dibutyl phthalate is 4000 mg/m³. The IDLH for copper and lead is 100 mg/m³. The IDLH for nitroglycerin is 75mg/m³.

POTENTIAL HEALTH EFFECTS

The various components of this product are completely sealed within a finished metal alloy cartridge. Under normal handling of this product, no exposure to any harmful materials will occur. However, when the product is fired, a small amount of particles may contain trace amounts of the following harmful substances which could result in:

Eye Contact: May cause slight eye irritation.
Inhalation: May cause slight irritation to the respiratory tract. Inhalation of high concentrations of the following substances could have potential health effects:

Form T-SAS-PTLDMSD08



Flares and Cartridges: Cartridges (Industrial Loads) for FireQuick Flare Systems (continued)



CARTRIDGES POWER DEVICES - MATERIAL SAFETY DATA SHEET

PAGE 2 OF 6

Copper – Dust or fumes of metallic copper may cause nasal irritation and /or nausea, vomiting and stomach pain.
Nitroglycerin - Will produce dilation of blood vessels and drop in blood pressure which may affect the heart. It has also been shown to cause methemoglobinemia (cyanosis).

Ingestion: **Lead** - Ingestion of large amount can cause abdominal pain, constipation, cramps, nausea and/or vomiting. Chronic exposure to lead can cause kidney damage, anemia, reproductive effects, developmental effects and permanent nervous systems damage in humans including changes in cognitive function.

It is unlikely that these small particles that someone would be exposed to from firing would be sufficient to cause any of these effects.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
 In its solid form, there are no medical conditions known to be aggravated. Exposure to lead can aggravate anemia, cardiovascular and respiratory disease.

POTENTIAL ENVIRONMENTAL EFFECT:
 This product has not tested for environmental properties. Lead has been shown to be toxic to aquatic species.

IV. FIRST AID MEASURES

Eye Contact:	Immediately flush eyes with plenty of cool water for at least 15 minutes while holding the eyes open. If redness, burning, blurred vision, or swelling persists, CONSULT A PHYSICIAN.
Skin Contact:	Remove product and immediately wash affected area with soap and water. Do not apply greases or ointments. Remove contaminated clothing. Wash clothing with soap and water before reuse. If redness, burning, or swelling persists, CONSULT A PHYSICIAN.
Ingestion:	DO NOT INDUCE VOMITING. Never administer anything by mouth to an unconscious person. CONSULT A PHYSICIAN immediately.
Inhalation:	Immediately remove patient to fresh air. If patient continues to experience difficulty breathing, CONSULT A PHYSICIAN.

V. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media:	Water fog, carbon dioxide or dry chemical, aqueous foam. If the fire reaches the cargo, withdraw and let fire burn.
Fire And Explosion Hazard:	If the fire reaches the cargo, do not fight. Evacuate all people, including emergency responders from the area for 1500 feet (1/3 mile) in all directions.
Fire Fighting Equipment and Procedures:	Wear full protective clothing and self-contained breathing apparatus for fire fighting. Protection concerns must also address the potential of the physical characteristic of this product as explosive.
Explosive:	Yes
Combustible:	N/A
Flash Point (°C):	N/A
Lower Explosive Limit:	N/A
Upper Explosive Limit:	N/A
Flammable Limits:	N/A
Pyrophoric:	N/A
Autoignition Temperature:	N/E
Burning Rate of Material:	N/A
Flammable Classification (29 CFR 1910.1200):	Explosive

VI. ACCIDENTAL RELEASE MEASURES

Personal Precautions:	Use cautious judgment when cleaning up spill. Do not subject materials to mechanical shock.
Clean-up Methods:	Call 1-888-289-1911 for technical assistance when large spill occurs.

Form T-SAS-PTLDMSD08



Flares and Cartridges: Cartridges (Industrial Loads) for FireQuick Flare Systems (continued)

Material Safety Data Sheets



CARTRIDGES POWER DEVICES - MATERIAL SAFETY DATA SHEET

PAGE 3 OF 6

VII. STORAGE AND HANDLING

Storage: No special requirements.
Shelf Life Limitations: Not known
Incompatible Materials For Packaging: Not known
Incompatible Materials For Storage and Transport: Acid, Class A&B explosives, strong oxidizers, and caustics.
Handling: No special requirements.

VIII. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls: Local exhaust ventilation is recommended if significant dusting occurs or fumes are generated. Otherwise, use general exhaust ventilation. Use explosion-proof ventilation. Use hearing protection.
Eye Protection: Avoid contact with eyes. Wear chemical splash goggles or safety glasses with side shields.
Skin Protection: Not normally needed.
Respirator Protection: Not normally needed.
General Hygiene: Do not eat, drink, or smoke while using this product. Wash hands thoroughly after use.
Exposure Limits:

Components	CAS Number	ACGIH (TLV)	OSHA (PEL)	International OELS
Copper	7440-50-8	0.2 mg/m ³ (fume), 1g/m ³ (dust and mists)	0.1 mg/m ³ (fume), 1g/m ³ (dust and mists)	Austria, Belgium, Canada: 0.2 mg/m ³ (fume), 1g/m ³ (dust and mists). Denmark: 1.0mg/m ³ (dust and powder). Germany (MAK): 0.1 mg/m ³ (fume), 1g/m ³ (dust and mists).
Zinc	7440-66-6	N/E	N/E	N/E
Nitrocellulose	9004-70-0	N/E	N/E	N/E
Nitroglycerin	55-63-0	0.05 ppm (0.46 mg/m ³) Skin	Ceiling - 0.2 ppm (2 mg/m ³) Skin	Denmark: 0.02 ppm (0.2 mg/m ³). Norway, Sweden: 0.03 ppm (0.3 mg/m ³). Austria, Belgium, Germany, The Netherlands, Poland, Switzerland: 0.05 ppm (0.47 mg/m ³), skin. Finland, France: 0.1 ppm (0.9 mg/m ³), skin. U.K.: 0.2 ppm (2 mg/m ³), skin.
Dibutyl phthalate	84-74-2	5 mg/m ³	5 mg/m ³	Belgium, Denmark, France, Netherlands, Switzerland, U.K.: 5 mg/m ³ Sweden: 3 mg/m ³
Lead styphnate	15245-44-0	N/E	N/E	N/E

IX. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Cylindrical brass cartridge
Form: Solid
Odor: None
Vapor Pressure: N/A
Boiling Point (°F): N/A
Melting Point: N/A
pH: N/A
Vapor Pressure (mm Hg): N/A
Vapor Density: N/A

% Volatile by volume: N/A
Solubility In Water (20°C): Insoluble
Vapor Density (air =1): N/A
Specific Gravity (g/cc): N/A
Bulk Density: N/A
Viscosity (cps): N/A
Decomposition Temperature: N/A
Evaporation Rate: N/A

X. REACTIVITY DATA

Stability: Stable under normal temperatures and pressure.
Materials To Avoid: Acid, Class A&B explosives, strong oxidizers, and caustics.
Hazardous Decomposition Products: Nitrogen oxides, carbon monoxide, lead oxides, carbon dioxide, lead dust/fume.
Hazardous Polymerization: Will not occur.
Other: Cartridge may detonate if case is punctured or severely damaged.

Form T-SAS-PTLDMSD08



Flares and Cartridges: Cartridges (Industrial Loads) for FireQuick Flare Systems (continued)



XI. TOXICOLOGICAL PROPERTIES

Potential Exposure Routes: The physical nature of this product makes absorption from any route unlikely. A small amount of inhalable particles may be created when projectile is fired.

Acute Animal Toxicity Data:

For Product		For Components					
		Copper	Nitrocellulose	Lead styphnate	Nitroglycerin	Zinc	Dibutyl phthalate
Oral LD₅₀	N/A	3.5 mg/kg (mouse, intraperitoneal)	>5 g/kg	N/E	105 mg/kg (rat)	N/E	8 g/kg (rat)
Dermal LD₅₀	N/A	375 mg/kg (rabbit, subcutaneous)	N/E	N/E	>280 mg/kg (rabbit)	N/E	>20 ml/kg (rabbit)
Inhalation LC₅₀	N/A. Particles generated from firing may be slightly toxic	N/E	N/E	N/E	N/E	N/E	4250 mg/m ³ (rat)
Irritation	Not a skin or eye irritant as a loaded round	Respiratory irritant	N/E	N/E	Mild eye and skin irritant	Eye irritant	N/A

Subchronic / Chronic Toxicity: Lead has caused blood, kidney and nervous system damage in laboratory animals. The International Agency for Research on Cancer (IARC) lists lead as possibly carcinogenic to humans, group 2B.

Carcinogenicity:

Mutagenicity: This product is not known or reported to be mutagenic. Lead has been shown to be mutagenic in several in vitro assays.

Reproductive, Teratogenicity, or Developmental Effects: This product is not known to cause reproductive or developmental effects. Lead has been shown to affect fetal development including birth defects and reduce male reproductive and developmental effects in animal studies.

Neurological Effects: This product is not known or reported to cause neurological effects. Lead has caused peripheral and central nervous system damage and behavioral effects in laboratory animals.

Interactions With Other Chemicals Which Enhance Toxicity: None known or reported.

XII. ECOLOGICAL INFORMATION

Ecotoxicity: No data is available on this product. Individual constituents are as follows:
Copper: The toxicity of copper to aquatic organisms varies significantly not only with the species, but also with the physical and chemical characteristics of the water, such as its temperature, hardness, turbidity and carbon dioxide content. Copper concentration varying from 0.1 to 1.0 mg/l has been found by various investigators to be not toxic for most fish. However, concentration of 0.015 to 3.0 mg/l have been reported as toxic, particularly in soft water to many kinds of fish, crustacean, mollusks, insects, and plankton.
Nitrocellulose: LC₅₀ > 1000 mg/l (fish, invertebrates, algae)
Nitroglycerin: Bluegill, 96 hour LC₅₀ = 1.228 mg/l (static)
Lead: LC₅₀ (48 hrs.) to bluegill (Lepomis macrochirus) is reported to be 2-5 mg/l. Lead is toxic to waterfowl.
Zinc: The following concentrations of zinc have been reported as lethal to fish:
 Rainbow trout fingerlings: 0.13 mg/l, 12-24 hours
 Blue gill sunfish: 6 hr TLM = 1.9 – 3.6 mg/l (soft water, 30°C)
 Rainbow trout: 4 mg/l (hard water) 3 days
 Sticklebacks: 1 mg/l (soft water) 24 hrs
 The presence of coppers to have a synergistic effect on the toxicity of zinc towards fish.



Flares and Cartridges: Cartridges (Industrial Loads) for FireQuick Flare Systems (continued)

Material Safety Data Sheets



CARTRIDGES POWER DEVICES - MATERIAL SAFETY DATA SHEET

PAGE 5 OF 6

Mobility: Dissolved lead from degraded bullets may migrate through soil.
Persistence/ degradability: Not biodegradable. Bullets may fragment and decompose in soil leading to accumulation of lead.
Bioaccumulation: No data.

XIII. DISPOSAL CONSIDERATIONS

Waste From Residues / Unused Products: Dispose of container and unused contents in accordance with federal, state, and local requirements.

XIII. TRANSPORTATION

US DOT (CFR): ORM-D Cartridges, Power Devices
IATA: UN 0323, Cartridges, Power Devices, 1.4S, Pkg Inst 134
Special Comments: 25 kg. per package passenger aircraft.
 100 kg. per package cargo aircraft.
IMO: UN 0323, Cartridges, Power Devices, 1.4S
Hazard Label/Placard: Explosive 1.4S/1.4 Placard over 1001 lbs. (454 kg)
Reportable Quantity: N/A

XIV. REGULATORY INFORMATION

US FEDERAL

TSCLA	The components of this product are listed on the Toxic Substance Control Act inventory.				
CERCLA	Copper, R.Q. = 5000 lbs.; Zinc, R.Q. = 1000 lbs.; Nitroglycerin, R.Q. = 10 lbs.; Dibutyl phthalate, R.Q. = 10 lbs. (No reporting is required if diameter of the pieces of metal is equal to or exceeds 100 micrometers (0.004 inches).				
SARA 313	Copper, Zinc (fume or dust), Nitroglycerin, Dibutyl phthalate, Lead and lead compound				
SARA 313 Hazard Class	Health:	Acute: No Chronic: No	Fire: No	Reactivity: None	Release of Pressure: Yes
SARA 302 EHS List	None of the components of this product are listed.				

STATE RIGHT-TO-KNOW STATUS

Component	*CA Prop. 65	New Jersey	Pennsylvania	Massachusetts	Michigan
Copper	Not Listed	X	X	X	X
Zinc	Not Listed	X	Not Listed	X	X
Nitrocellulose	Not Listed	X	X	X	Not Listed
Nitroglycerin	Not Listed	X	X	X	Not Listed
Dibutyl phthalate	Not Listed	X	X	X	X
Lead styphnate	X	Not Listed	Not Listed	X	Not Listed

EUROPEAN REGULATIONS

Hazard Classification

Danger Symbol: E Explosive
Risk Phrases: R2 Risk of explosion by shock, friction, fire or other sources of ignition
Safety Phrases: S2 Keep out of reach of children.

German WGK Classification: Not known

CANADIAN REGULATIONS

DSL List: The components of this product are on the DSL or are exempt from reporting under the New Substances Notification Regulations.

IDL: Copper, Dibutyl phthalate

WHMIS: This product is not subject to WHMIS. It is regulated as a Class 6 Explosive in Canada.



Flares and Cartridges: Cartridges (Industrial Loads) for FireQuick Flare Systems (continued)

SIMPSON
Strong-Tie
ANCHOR SYSTEMS

CARTRIDGES POWER DEVICES - MATERIAL SAFETY DATA SHEET **PAGE 6 OF 6**

XV. OTHER INFORMATION

HMIS RATING

Health	Flammability	Physical Hazard
0	0	2

N/E – Not Established
N/A – Not Applicable

This Material Safety Data Sheet (MSDS) is prepared by Simpson Strong-Tie Co. in compliance with the requirements of OSHA 29 CFR Part 1910.1200. The information it contains is offered in good faith as accurate as of the date of this MSDS. This MSDS is provided solely for the purpose of conveying health, safety, and environmental information. No warranty, expressed or implied, is given. Health and Safety precautions may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations.

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Form T-SAS-PTLDMSD08



Fuels: Diesel



MATERIAL SAFETY DATA SHEET
MSDS # F2

SINCLAIR DIESEL

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: Diesel

APPLICATIONS: Diesel – Dyed Fuel

SYNONYMS: No. 2 Diesel Fuel, Ultra Low Sulfur Diesel – Dyed and Undyed, Oil Distillate, Cycle Oil, Fuel Oil, Diesels Cycle Oil, Furnace Oil

CAS REGISTRY #: #1 Diesel 8008-20-6
#2 Diesel 68476-34-6

CHEMICAL FAMILY: Liquid Hydrocarbons

EMERGENCY PHONE: CHEMTREC – (800) 424-9300 or (703) 527-3887 (collect)

SUPPLIER: Sinclair Oil Corporation
P. O. Box 30825
Salt Lake City, Utah 84130

TELEPHONE / FAX: (888) 340-3466 / (801) 524-2740

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENTS:	CAS#	Typical wt. %
#1 Diesel	8008-20-6	100
Toluene	108-88-3	0 – 0.5
Naphthalene	91-20-3	0 – 0.5
#2 Diesel	68476-34-6	100
Toluene	108-88-3	0 – 0.5
Naphthalene	91-20-3	0 – 0.5

3. HAZARDS IDENTIFICATION

APPEARANCE: Colorless, red, blue, amber

PHYSICAL STATE: Liquid

ODOR: Kerosene odor

EMERGENCY OVERVIEW: May cause eye, skin and respiratory tract irritation. Combustible liquid and vapor. Harmful or fatal if swallowed. Toxic to aquatic organisms.

POTENTIAL HEALTH EFFECTS: Trauma and burns secondary to explosions and fires can result. In enclosed spaces, oxygen may be displaced by vapors or consumed by combustion. Incomplete combustion will produce carbon monoxide and other toxic gases.

INHALATION: Overexposure may cause weakness, headache, nausea, confusion, blurred vision, drowsiness and other central nervous system effects.

Material Safety Data Sheets



Fuels: Diesel (continued)

EYE CONTACT: Contact may cause eye irritation. Naphthalene vapor causes eye irritation.

SKIN CONTACT: Contact may irritate or burn skin. Absorption through the skin may cause symptoms of intoxication, followed by kidney damage.

INGESTION: Contact may irritate or burn skin. Absorption through the skin may cause symptoms of intoxication, followed by kidney damage.

4. FIRST AID MEASURES

GENERAL: Remove all clothing impregnated with material immediately. Consult a physician for major exposures of inhalation or skin contact.

INHALATION: Remove from further exposure. If unconsciousness occurs, seek immediate medical assistance. If breathing stops, use mouth-to-mouth resuscitation.

EYE CONTACT: Flush immediately with water for at least 15 minutes. Seek medical attention promptly.

SKIN CONTACT: Discard contaminated leather articles. Wash contact areas with soap and water. Launder contaminated clothing before reuse.

INGESTION: DO NOT INDUCE VOMITING. Get medical assistance promptly. (Note to Physician: Material, if aspirated into lungs, may cause chemical pneumonitis. Treat appropriately.)

5. FIRE FIGHTING MEASURES

FLASH POINT (°F): 100°F Minimum

FLAMMABLE LIMITS: LEL – 1.3 UEL – 6.0

AUTOIGNITION TEMPERATURE: 490°F - 545°F

FLAMMABILITY CLASSIFICATION: Combustible Liquid

GENERAL HAZARD: Incomplete burning can produce carbon monoxide. Vapors will be released above flash point and when mixed with air, can burn or explode in confined space if exposed to sources of ignition.

FIRE FIGHTING INSTRUCTIONS: Use foam, dry chemical, CO₂, water fog or vaporizing liquid (Halon). Keep personnel removed from and up-wind of fire. Cool adjacent structures and storage drums with water spray. Evacuate area. Prevent runoff from fire control dilution from entering streams or drinking water supply.

FIRE FIGHTING EQUIPMENT: Use of SCBA in enclosed or confined spaces, or as otherwise needed. Bunker gear.

HAZARDOUS COMBUSTION PRODUCTS: May produce carbon monoxide.

6. ACCIDENTAL RELEASE MEASURES

LAND SPILL: Shut off and eliminate all ignition sources. Keep people away. Remove leaking containers to a safe area. Contain and remove by mechanical means. Add sand, earth or other suitable absorbent to spill area than scrape off the ground. Guard against contamination of water supplies. Report spills to appropriate authorities. Dispose of in accordance with Federal, State and Local regulations.

WATER SPILL: Spill may be removed from water with mechanical dredges or lifts. Report spills to appropriate authorities. Dispose of in accordance with Federal, State and Local regulations.

7. HANDLING AND STORAGE

HANDLING / STORAGE: Ground and bond all transfer and storage equipment. Drums must be grounded/ bonded/ equipped with self-closing valves, pressure vacuum bungs and flame arrestors. Store away from ignition sources in a cool area. Outside or detached storage is preferred.

When handling use non-sparking tools and equipment. Do not use as a cleaner or solvent, use only as fuel. Do not siphon by mouth.



Fuels: Diesel (continued)

8. EXPOSURE CONTROLS, RESPIRATORY & PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide ventilation sufficient to prevent exceeding recommended exposure limit or build-up of explosive concentrations of vapor in air. Use explosion-proof equipment.

PERSONAL PROTECTION: If contact is likely the following protective clothing and equipment is recommended,

PROTECTIVE CLOTHING: Use full-face shield, chemical goggles, impervious gloves, boots and whole body protection.

RESPIRATOR: Approved respiratory protection must be used when vapors or mist concentrations are unknown or exceed the TLV. Avoid prolonged or repeated breathing of vapor or mists.

OCUPATIONAL EXPOSURE LIMITS

COMPONENT	LIMIT	TWA	STEL	CEILING	NOTATION	OTHER
Diesel	ACGIH_TLV	100mg/M ³			A3	Skin, Irritation
Toluene	OSHA_PEL	200ppm		300ppm		
Toluene	ACGIH_TLV	50ppm			A4	Skin, CNS
Naphthalene	OSHA_PEL	10ppm				
Naphthalene	ACGIH_TLV	10ppm	15ppm		A4	Skin
Petroleum Distillates (Naphtha)	OSHA_PEL	500ppm				

A3= Confirmed Animal Carcinogen with Unknown Relevance to Humans

A4= Not Classified as a Human Carcinogen

CNS= Central Nervous System

Skin= Absorption through the skin may contribute to overall exposure

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE: Liquid

COLOR: colorless, red, blue, or amber

DENSITY/SPECIFIC GRAVITY (g/ml): 0.75 – 0.90

VAPOR DENSITY (air=1): >1

VAPOR PRESSURE: <1 PSIA

BOILING POINT/RANGE: 550°F

SOLUBILITY IN WATER: No

VISCOSITY: N/A/F

pH : N/A

FREEZING POINT: 0°F

10. STABILITY AND REACTIVITY

GENERAL: This product is stable

INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID: Strong acids, alkalies and oxidizers. Avoid heat, sparks, flame and static electricity.

HAZARDOUS DECOMPOSITION: Incomplete burning can produce carbon monoxide.





Fuels: Diesel (continued)

11. TOXICOLOGICAL INFORMATION

SYSTEMIC: Petroleum-derived fuels and fuel oils are complex and variable mixtures of hydrocarbons. In general, the more viscous the mixture, the less toxic it will be. At high level exposures, humans experience multiple organ failures, some of which may be due to hypoxia and secondary to the failure of other organ systems. In humans kidney failure has been noted only at high, acute levels of exposures, and appears reversible. Liver enzymes may be transiently elevated. At lower level exposures, most acute health effects are reversible. People can be exposed by inhalation, ingestion and dermal contact. Frequently, people are exposed by combined dermal and inhalation exposure.

ACUTE:

Inhalation: Headaches, confusion, disorientation, blurred vision occur with inhalation. Higher exposures may cause hallucinations, CNS excitation, drowsiness, CNS depression. Seizure and coma occur from very high exposures and death may result from respiratory depression. ECG changes, cardiac arrhythmias, tachycardia, shock and cardiovascular collapse can occur. Pneumonia, pulmonary edema and hemorrhages can occur. Inhalation of 8000-16000 mg/m³ for 2 to 4 hours was lethal to rats.

Ingestion: Central nervous system, cardiovascular, and respiratory effects have been reported with acute exposures to various hydrocarbon fuels and oils similar to those reported with inhalation. Nausea, vomiting, cramping and diarrhea may occur.

Eye: Conjunctivitis and burning, watery eyes have been reported in acute exposures to various hydrocarbon fuels and oils.

Skin: Mild erythema to full thickness chemical burns have occurred after prolonged exposure to various hydrocarbon fuels and oils.

CHRONIC: Chronic dermatitis with acanthosis, inflammation, parakeratosis and hyperkeratosis have occurred with chronic exposures to various hydrocarbon fuels and oils. Occupational exposures in petroleum refining are considered Group 2A (probably carcinogenic) by IARC.

12. DISPOSAL INFORMATION

RCRA: Disposal of this product or material contaminated with this product may be regulated by RCRA due to the characteristic of ignitability.

EPA Hazard Class: Acute Hazard/Chronic Hazard/Fire Hazard

Dispose of in accordance with Federal, State, and Local regulations.

13. TRANSPORT INFORMATION

DOT (Department of Transportation):

PROPER SHIPPING NAME: Combustible Liquid nos (Diesel #1, Diesel #2)

HAZARD CLASS: Combustible Liquid

IDENTIFICATION NUMBER: UN 1993 PGIII

NAERG96 NUMBER: 128

14. REGULATORY INFORMATION

CERCLA (Comprehensive Environmental Response Compensation and Liability Act): Naphthalene and Toluene are hazardous substances under CERCLA and therefore are subject to emergency notification requirements.

SARA TITLE III (Superfund Amendments and Reauthorization Act): Naphthalene and Toluene are subject to SARA Title III, Sections 311 and 312, which require MSDS reporting and hazardous chemical inventory reporting.

Naphthalene and Toluene are also subject to SARA Title III, Section 313, which requires chemical release reporting.





Fuels: Diesel (continued)

14. REGULATORY INFORMATION CONTINUED

The following components are subject to OSHA 29CFR1910.1200 Hazard Communication Standard:

- Toluene
- Naphthalene
- Petroleum Distillates

15. OTHER INFORMATION

NFPA 704/HMIS:

Health – 0 Flammability – 2 Reactivity – 0
(0 = insignificant, 1 = slight, 2 = moderate, 3 = high, 4 = extreme)

REVISION SUMMARY:
Complete review of MSDS, January 2007.

THIS PRODUCT MATERIAL SAFETY DATA SHEET PROVIDES HEALTH AND SAFETY INFORMATION. THE PRODUCT SHOULD BE USED IN APPLICATIONS CONSISTENT WITH THIS PRODUCT LITERATURE. FOR ANY OTHER USES, EXPOSURES SHOULD BE EVALUATED SO THAT APPROPRIATE HANDLING PRACTICES AND TRAINING PROGRAMS CAN BE ESTABLISHED TO ENSURE SAFE WORKPLACE OPERATIONS.

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DATE: January 2007



Fuels: Gasoline



MATERIAL SAFETY DATA SHEET

MSDS # F1

SINCLAIR GASOLINE

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: Gasoline

APPLICATIONS: Automotive Gasoline

SYNONYMS: Regular, Premium, Subgrade, Motor Fuel, Gasohol

CAS REGISTRY #: 8006-61-9

CHEMICAL FAMILY: Liquid Hydrocarbon

EMERGENCY PHONE: CHEMTREC – (800) 424-9300 or (703) 527-3887 (collect)

SUPPLIER: Sinclair Oil Corporation
P.O. Box 30825
Salt Lake City, Utah 84130

TELEPHONE / FAX: (888) 340-3466 / (801) 524-2740.

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENTS:	CAS#	Typical wt. %
Regular Unleaded Gasoline including:	8006-61-9	100.0
Cyclohexane	110-82-7	0.5
Benzene	71-43-2	3.0
Toluene	108-88-3	10.0
Xylene	1330-20-7	6.5
Trimethyl Benzene	25551-13-7	7.0
Napthalene	91-20-3	0.2
Ethyl Alcohol	64-17-5	10.0
Premium Unleaded Gasoline including:	8006-61-9	100.0
Cyclohexane	110-82-7	0.2
Benzene	71-43-2	4.0
Toluene	108-88-3	13.7
Xylene	1330-20-7	12.7
Trimethyl Benzene	25551-13-7	11.9
Napthalene	91-20-3	0.3
Ethyl Alcohol	64-17-5	10.0

Gasoline consists of a complex blend of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons which may contain up to 5% benzene and dosages of multi-functional additives. May contain 0-10% ethanol.



Fuels: Gasoline (continued)

3. HAZARDS IDENTIFICATION

APPEARANCE: Clear, bronze, red, yellow, or purple color

PHYSICAL STATE: Liquid / Vapor

ODOR: Strong hydrocarbon odor

EMERGENCY OVERVIEW: Extremely flammable liquid and vapor. Vapors may cause flash fire. Harmful or fatal if swallowed and may cause lung damage if aspirated. Causes skin and eye irritation. Long term exposure may have caused cancer in laboratory animals. Keep away from children. Toxic to aquatic organisms.

POTENTIAL HEALTH EFFECTS: Trauma and burns secondary to explosions and fires can result. In enclosed spaces, oxygen may be displaced by vapors or consumed by combustion. Incomplete combustion will produce carbon monoxide and other toxic gases.

INHALATION: High vapor concentrations are possible and can be hazardous on single exposure. Overexposure may cause weakness, headache, nausea, confusion, blurred vision, drowsiness and other central nervous system effects. Extremely high-level exposure may result in dizziness, irregular heartbeat, coma, collapse and death.

EYE CONTACT: May cause eye irritation.

SKIN CONTACT: Contact may irritate or burn skin. Repeated contact may cause skin to become dry & scaly.

INGESTION: If aspirated (liquid enters lung) following ingestion, severe lung irritation and pulmonary edema (swelling of lung tissue) may occur. Aspiration may also result in central nervous system depression or excitement. Serious, permanent lung damage may result. Nausea, vomiting, diarrhea, or abdominal pain may occur following ingestion.

CARCINOGENICITY: Gasoline mixtures are not listed as carcinogenic by NTP, OSHA and, ACGIH. Gasoline mixtures are listed as a possible carcinogen by IARC (2B) and NIOSH. Benzene is listed as a confirmed human carcinogen by IARC, NTP, OSHA, NIOSH and, ACGIH.

4. FIRST AID MEASURES

INHALATION: Remove from further exposure. If unconsciousness occurs, seek immediate medical assistance. If breathing stops, use mouth-to-mouth resuscitation.

EYE CONTACT: Flush immediately with water for at least 15 minutes. Seek medical attention promptly.

SKIN CONTACT: Discard contaminated leather articles. Wash contact areas with soap and water. Launder contaminated clothing before reuse.

INGESTION: DO NOT INDUCE VOMITING. Get medical assistance promptly. (Note to Physician: Material, if aspirated into lungs, may cause chemical pneumonitis. Treat appropriately.)

5. FIRE FIGHTING MEASURES

FLASH POINT (°F): -45° F

FLAMMABLE LIMITS: LEL – 1.4% UEL – 7.6%

AUTOIGNITION TEMPERATURE: 530°F+

FLAMMABILITY CLASSIFICATION: Flammable Liquid

GENERAL HAZARD: Incomplete burning can produce carbon monoxide. This is an extremely flammable liquid; vapor accumulation could flash and/or explode if it comes into contact with open flame.

FIRE FIGHTING INSTRUCTIONS: Use CO₂, foam, dry chemical, Halon, or water fog. Keep personnel removed from and up-wind of fire. Cool adjacent structures and storage drums with water spray. Evacuate area. Prevent runoff from fire control dilution from entering streams or drinking water supply. A vapor suppressing foam may be used to reduce vapors.

FIRE FIGHTING EQUIPMENT: Fire fighters should use SCBA and full protective equipment (Bunker gear).

HAZARDOUS COMBUSTION PRODUCTS: May produce carbon monoxide.



Fuels: Gasoline (continued)

6. ACCIDENTAL RELEASE MEASURES

LAND SPILL: Treat spill as an oil spill. Eliminate all sources of ignition. Remove leaking containers to a safe area. Contain and remove by mechanical means. Guard against contamination of water supplies. Report spills to appropriate authorities. Dispose of in accordance with Federal, State, and Local regulations.

WATER SPILL: Treat spill as an oil spill. Report spills to appropriate authorities. Dispose of in accordance with Federal, State, and Local regulations.

7. HANDLING AND STORAGE

HANDLING / STORAGE: Ground and bond all transfer and storage equipment. Drums must be grounded / bonded / equipped with self-closing valves, pressure vacuum bungs and flame arrestors. Store away from ignition sources in a cool area. Outside or detached storage is preferred. Containers should be labeled: **FLAMMABLE. VAPOR HARMFUL.**

Improper filling of portable gasoline containers creates a danger of fire. Only dispense gasoline into approved and properly labeled gasoline containers. Always place portable containers on the ground while filling. Ensure pump nozzle is in contact with the container while filling. Do not use the nozzle's lock open device. Do not fill portable containers that are inside a vehicle or trailer / truck bed.

When handling, use non-sparking tools and equipment. Do not use as a cleaner or solvent. Use only as motor fuel. **DO NOT SIPHON BY MOUTH.**

8. EXPOSURE CONTROLS, RESPIRATORY & PERSONAL PROTECTION

ENGINEERING CONTROLS: Assure adequate natural or mechanical ventilation. Eliminate all sources of ignition.

PERSONAL PROTECTION: If contact is likely, the following protective clothing and equipment is recommended.

PROTECTIVE CLOTHING: Use full-face shield, chemical goggles, impervious gloves, boots, and whole-body protection.

RESPIRATOR: Approved respiratory protection must be used when vapors or mist concentrations are unknown or exceed the TLV. Avoid prolonged or repeated breathing of vapor or mists.

OCUPATIONAL EXPOSURE LIMITS

COMPONENT	LIMIT	TWA	STEL	CEILING	NOTATION	OTHER
Gasoline	ACGIH_TLV	300ppm	500ppm		A3	
Cyclohexane	OSHA_PEL	300ppm				
Cyclohexane	ACGIH_TLV	100ppm				CNS
Benzene	OSHA_PEL	1ppm	5ppm			
Benzene	OSHA_Z2	10ppm		25ppm		
Benzene	ACGIH_TLV	0.5ppm	2.5ppm		A1	Skin
Toluene	OSHA_PEL	200ppm		300ppm		
Toluene	ACGIH_TLV	50ppm			A4	Skin, CNS
Xylene	OSHA_PEL	100ppm				
Xylene	ACGIH_TLV	100ppm	150ppm		A4	Irritation
Trimethyl Benzene	ACGIH_TLV	25ppm				Irritation, CNS
Naphthalene	OSHA_PEL	10ppm				
Naphthalene	ACGIH_TLV	10ppm	15ppm		A4	Skin
Ethyl Alcohol	OSHA_PEL	1000ppm				
Ethyl Alcohol	ACGIH_PEL	1000ppm			A4	Irritation

A1= Confirmed Human Carcinogen
 A3= Confirmed Animal Carcinogen with Unknown Relevance to Humans
 A4= Not Classified as a Human Carcinogen
 CNS= Central Nervous System
 Skin= Absorption through the skin may contribute to overall exposure





Fuels: Gasoline (continued)

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE: Liquid
COLOR: Clear/bronze/red/yellow/purple
DENSITY/SPECIFIC GRAVITY (g/ml): 0.65 – 0.75
VAPOR DENSITY (air=1): >1
VAPOR PRESSURE: 7-15 PSI/A
BOILING POINT/RANGE: 230°F
SOLUBILITY IN WATER: Negligible
VISCOSITY: N/A/F
pH : N/A
FREEZING POINT: -76°F

10. STABILITY AND REACTIVITY

GENERAL: This product is stable
INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID: Avoid Halogens, strong acids, alkalis, and oxidizers. Also keep away from heat, sparks, flame and static electricity.
HAZARDOUS DECOMPOSITION: Incomplete burning can produce carbon monoxide

11. TOXICOLOGICAL INFORMATION

SYSTEMIC: Petroleum-derived fuels and fuel oils are complex and variable mixtures of hydrocarbons. In general, the more viscous the mixture, the less toxic it will be. At high-level exposures, humans experience multiple organ failures, some of which may be due to hypoxia and secondary to the failure of other organ systems. In humans, kidney failure has been noted only at high, acute levels of exposures and appears reversible. Liver enzymes may be transiently elevated. At lower level exposures, most acute health effects are reversible. People can be exposed by inhalation, ingestion and dermal contact. Frequently, people are exposed by combined and inhalation exposure.

ACUTE: Inhalation: Headaches, confusion, disorientation, blurred vision occur with inhalation. Higher exposures may cause hallucinations, CNS excitation, drowsiness, CNS depression. Seizure and coma occur from very high exposures and death may result from respiratory depression. ECG changes, cardiac arrhythmias, tachycardia, shock and cardiovascular collapse can occur. Pneumonia, pulmonary edema and hemorrhages can occur.

Ingestion: Central nervous system, cardiovascular, and respiratory effects have been reported with acute exposures to various hydrocarbon fuels and oils similar to those reported with inhalation. Nausea, vomiting, cramping and diarrhea may occur.

Eye: Eye irritation to atomized gasoline has been noted at 200, 500 and 1000 mg/m³ for 30 minutes and after an 8-hour exposure to 140 ppm. Atomized gasoline has the same composition as liquefied gasoline while gasoline vapors are different. Conjunctivitis has been reported after 1 hour of exposure to 900 ppm.

Skin: Mild erythema to full thickness chemical burns have occurred after prolonged exposure to various hydrocarbon fuels and oils.

CHRONIC: Chronic exposure results in kidney damage in male rats. However, this damage appears to be related to a protein produced in large amounts in male rats, but not in humans or female rats. Occupational exposures in petroleum refining are considered Group 2A (probably carcinogenic) by IARC.

Liver and kidney tumors have been noted in animals. Data is less clear in humans because of confounding factors in epidemiological studies. Some components (e.g. benzene) are known carcinogens.

Contains benzene, a known human carcinogen, which can be toxic to the blood and blood-forming organs.



Fuels: Gasoline (continued)

12. DISPOSAL INFORMATION

RCRA: Disposal of this product or material contaminated with this product may be regulated by RCRA due to the characteristic of ignitability or due to the toxicity characteristic of benzene (D018).

EPA Hazard Class: Acute Hazard/Chronic Hazard/Fire Hazard

Dispose of in accordance with Federal, State, and Local regulations.

13. TRANSPORT INFORMATION

DOT (Department of Transportation):

PROPER SHIPPING NAME: Gasoline
HAZARD CLASS: 3 Flammable Liquid
IDENTIFICATION NUMBER: UN 1203 PG II
NAERG96 NUMBER: 128

14. REGULATORY INFORMATION

CERCLA (Comprehensive Environmental Response Compensation and Liability Act): The following components are hazardous substances in CERCLA and therefore are subject to emergency notification requirements:

Benzene
Cyclohexane
Naphthalene
Toluene
Xylene

SARA TITLE III (Superfund Amendments and Reauthorization Act): The following components are subject to SARA Title III, Sections 311 and 312, which require MSDS reporting and hazardous chemical inventory reporting:

Benzene
Cyclohexane
Ethyl Alcohol
Naphthalene
Toluene
Trimethyl Benzene
Xylene

The following components are subject to SARA Title III, Section 313, which requires chemical release reporting:

Benzene
Cyclohexane
Methy-tert-butyl ether
Naphthalene
Toluene
Trimethyl Benzene
Xylene

14. REGULATORY INFORMATION CONTINUED

The following components are subject to OSHA 29CFR1910.1200 Hazard Communication Standard:

Benzene* 1
Cyclohexane 2
Ethyl Alcohol 2
Naphthalene 2
Toluene 2
Trimethyl Benzene 2
Xylene 2

(1)* Benzene has been identified by NIOSH, IARC, NTP as a human carcinogen. Refer to 29CFR1910.1000 Table Z-2 and 29CFR1910.1028 for information.

(2) Consult MSDS or NIOSH Occupational Guidelines for more information.



Fuels: Gasoline (continued)

15. OTHER INFORMATION

NFPA 704/HMIS:

Health – 1 Flammability – 3 Reactivity – 0
(0 = insignificant, 1 = slight, 2 = moderate, 3 = high, 4 = extreme)

REVISION SUMMARY:

Complete review of MSDS, December 2002.

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DATE: December 2005



Fusees: Orion Fusees

STANDARD FUSEE CORP/ORION SAFETY PRODUCTS		GS-07F-78760		
MATERIAL SAFETY DATA		NSN#: 1370-00-294-1279		
- RAILWAY & HIGHWAY FUSEES - ORION MARINE SIGNAL PRODUCTS		EMERGENCY CONTACT: CHEMTREC 1-800-424-9300		
SECTION I - IDENTIFICATION				
CHEMICAL NAMES & SYNONYMS: FUSEE, BACKFIRING				
CHEMICAL FAMILY: PYROTECHNIC DEVICE	FORMULA: MIXTURE	TRADE NAME: FUSEE/FLARE		
DESCRIPTION: RED CARDBOARD TUBE CONTAINING YELLOWISH-TAN SOLID MIXTURE.		CAS NO.: NONE ASSIGNED/MIXTURE		
SECTION II - HAZARDOUS INGREDIENTS				
BASIC MATERIAL	OSHA P.E.L	LD 50	LC 50	SIGNIFICANT EFFECTS
STRONTIUM NITRATE C.A.S.# 10042769	NONE EST.	2750 mg/Kg (RAT)	NO DATA	Irritant to skin, eyes and mucous membranes.
POTASSIUM PERCHLORATE C.A.S.# 7778747	NONE EST.	NO DATA	NO DATA	Irritant to skin, eyes and mucous membranes. Absorption can cause methemoglobinemia and kidney injury. Ingestion may cause gastroenteritis. Reactive oxidizer- keep away from fuels.
SULFUR C.A.S.# 7704349	NONE EST.	NO DATA	NO DATA	May cause eye and mucous membrane irritation.
SAWDUST/OIL BINDER C.A.S.# MIXTURE	NONE EST.	NO DATA	NO DATA	N/A
SECTION III - NORMAL HANDLING PROCEDURES				
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: KEEP ITEMS OUT OF THE REACH OF CHILDREN!!				
Store in a cool, dry place away from all sources of ignition. Do not dismantle. Do not allow contents to touch eyes, skin or clothing. Do not ingest contents. Avoid breathing dust. Contents may be harmful if swallowed. Flush areas contacted with large amount of water. Flares should be allowed to burn to completion. Unburned and partially burned flares contain potassium perchlorate which should not be allowed to come into contact with surface and ground water. For outdoor use only. Do not attempt to ignite or burn this product inside a building or vehicle. Exercise caution when using this product since molten flecks may be emitted. Do not use product near any flammable or combustible materials. Avoid contact with strong oxidizers. Avoid open flames and temperatures >167°F. Perchlorate Material – special handling may apply. See www.dtsc.ca.gov/hazardouswaste/perchlorate				
PROTECTIVE EQUIPMENT		VENTILATION REQUIREMENTS		
FOLLOW DIRECTIONS ON PACKAGE. ALWAYS POINT FUSEE AWAY FROM FACE AND BODY WHILE IGNITING AND AFTERWARDS.		THIS PRODUCT SHOULD ONLY BE USED OUTDOORS.		
SECTION IV - FIRE AND EXPLOSION DATA				
FLASH POINT/METHOD: N/A CONTENTS: >167°F (OVEN)	OSHA CLASSIFICATION: FLAMMABLE SOLID		FLAMMABLE EXPLOSIVE LIMITS: UPPER: NONE ESTAB. LOWER: NONE ESTAB.	
EXTINGUISHING MEDIA: USE WATER DELUGE/FLOODING METHODS; COLLECT WATER AND SAND FOR APPROVED DISPOSAL. KEEP FROM ENTERING SURFACE OR GROUND WATER.				
SUFFOCATION TECHNIQUES WILL NOT BE EFFECTIVE. NO THREAT OF MASS EXPLOSION.				
SPECIAL FIRE HAZARD & FIRE FIGHTING PROCEDURES: USE NIOSH/MSHA APPROVED POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS WHEN ANY MATERIAL IS INVOLVED IN FIRE.				
SECTION V - HEALTH HAZARD DATA				
THRESHOLD LIMIT VALUE: NONE ESTABLISHED FOR THE MIXTURE.				
SYMPTOMS OF OVER EXPOSURE: TUBE CONTENTS ARE CORROSIVE TO THE EYES AND IRRITATING TO THE RESPIRATORY TRACT AND SKIN.				
SKIN: IMMEDIATELY FLUSH WITH WATER FOR 15 MINUTES, CALL A PHYSICIAN IF IRRITATION OCCURS.				
EYES: IMMEDIATELY FLUSH WITH WATER FOR 15 MINUTES, CALL A PHYSICIAN.				
INGESTION: CALL A PHYSICIAN IMMEDIATELY.				
INHALATION: IMMEDIATELY REMOVE VICTIM TO FRESH AIR. CALL A PHYSICIAN.				

Material Safety Data Sheets



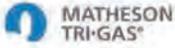
Fusees: Orion Fusees (continued)

Material Safety Data Sheets

CHEMICAL NAME: FUSEE, BACKFIRING		
SECTION VI - TOXICOLOGY (PRODUCT)		
ALL CHEMICAL IS CONTAINED IN CARDBOARD TUBE - NONE IS EXPOSED		
ACUTE ORAL LD 50: APPROXIMATELY 3 GRAMS/kg (RAT)	CARCINOGENICITY: NOT KNOWN TO BE CARCINOGENIC	MUTAGENICITY: NOT KNOWN TO BE MUTAGENIC
ACUTE DERMAL LD 50: APPROX. 2 GRAMS/kg (RABBIT)	EYE IRRITATION: CORROSIVE	PRIMARY SKIN EFFECT: IRRITANT
ACUTE INHALATION LD 50: NOT ESTABLISHED	PRINCIPLE ROUTES OF ABSORPTION: INHALATION; DERMAL CONTENT	
EFFECTS OF ACUTE EXPOSURE: Tube contents are corrosive to eyes and irritating to respiratory tract and skin. Inhalation of combustion products will irritate eyes, lungs, and mucous membranes.		
EFFECTS OF CHRONIC EXPOSURE: Content dust - dermatitis, gradual cyanosis. Ingestion of potassium perchlorate may disrupt the proper functioning of the thyroid gland. See Health Implications of Perchlorate Ingestion, Committee to Assess the Health Implications of Perchlorate Ingestion, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies, National Research Council of The National Academies (2005).		
SECTION VII - SPILL AND LEAKAGE PROCEDURES (Control Procedures)		
ACTION FOR MATERIAL RELEASE OR SPILL: For large amounts, remove all sources of ignition. If tubes are broken, wear NIOSH/MSHA approved dust respirator, goggles, impervious coveralls, gloves and boots. Follow OSHA regulations for respirator use (See 29 C.F.R. 1910.134). Shovel or sweep up and place in an approved DOT container using non-sparking utensils. Minimize contamination with organic material. Do not return material to original container. Place swept material into fresh container, isolate and DO NOT SEAL. Wash all contaminated clothing before reuse. In the event of a large spill, call the emergency number listed below. If spill area is washed with water, collect wash water for approved disposal. Keep from entering water sources and sewers. TRANSPORTATION EMERGENCY, CALL CHEMTREC 1-800-424-9300		
WASTE DISPOSAL METHOD: Dispose of contaminated product and materials used in cleaning up spills or leaks in a manner approved for this material. Consult appropriate federal, state and local regulatory agencies to ascertain proper disposal procedures. Open burning in a lined pit is the preferred method of disposal of pyrotechnic materials, in accordance with federal, state and local regulations. Fusees should be allowed to burn to completion. Partially burned, unburned flares, and ash from burned flares should be disposed of in accordance with federal, state, and local requirements. See also the Best Management Practices for flares found at the California Code of Regulations, Title 33, Sections 67384.1 - 67384.10. Refer to 40 C.F.R. 261.20 - .24 to determine at time of disposal whether the product should be classified as hazardous waste. Do not store partially burned fusees in a vehicle, close container, warehouse, or any other building.		
SECTION VIII - SHIPPING DATA		
D.O.T. CLASS (DOMESTIC): FUSEE, 4.1, NA1325, PG II (GROUND ONLY) LABEL REQ: FLAMMABLE SOLID		
INTERNATIONAL CLASS & DOMESTIC AIR: SIGNAL DEVICES, HAND, 1.4S, UN0373, PG II LABEL REQ: 1.4S		
SECTION IX - REACTIVITY DATA		
STABLE X UNSTABLE @ _____ °C _____ °F	HAZARDOUS POLYMERIZATION	MAY OCCUR WILL NOT OCCUR X
CONDITIONS TO AVOID: Keep all sources of ignition away from the signal and ingredients. Do not expose to temperatures above 160°F. Do not remain in an area where the ingredients have become airborne as a dust without wearing an approved respirator.		
INCOMPATIBILITY (MATERIAL TO AVOID): Strong oxidizers; strong acids; chlorate salts, gasoline or other fuels.		
HAZARDOUS DECOMPOSITION PRODUCTS: Sulfur oxides, nitrogen oxides, carbon dioxide / carbon monoxide.		
SECTION X - PHYSICAL DATA		
MELTING POINT: NO DATA	VAPOR PRESSURE: NO DATA	VOLATILES: NO DATA
BOILING POINT: NO DATA	SOLUBILITY IN WATER: >300 g/l powder	EVAPORATION RATE: NO DATA
SPECIFIC GRAVITY (H ₂ O = 1): NO DATA	pH: NO DATA	VAPOR DENSITY (AIR = 1): NO DATA
INFORMATION FURNISHED BY: ORION SAFETY PRODUCTS DATE: January 2008		
28320 St Michaels Rd Easton, MD 21601 1-800-637-7807		
<p><i>This information is accurate to the best knowledge of Orion Safety Products, ORION SAFETY PRODUCTS MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, ORION SAFETY PRODUCTS WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION. Any person utilizing this document should seek competent professional advice to verify and assume responsibility for the suitability of this information to their particular situation.</i></p>		
Page 2 of 2		



Gases: Nitrogen



MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MATHESON TRI-GAS, INC.
959 ROUTE 46 EAST
PARSIPPANY, NEW JERSEY 07054-0624

EMERGENCY CONTACT:
CHEMTREC 1-800-424-9300
INFORMATION CONTACT:
973-257-1100

SUBSTANCE: NITROGEN, COMPRESSED GAS

TRADE NAMES/SYNONYMS:
MTG MSDS 67; DIATOMIC NITROGEN; DINITROGEN; NITROGEN; NITROGEN-14; NITROGEN GAS; UN 1066; N2; MAT16625; RTECS QW9700000

CHEMICAL FAMILY: inorganic, gas

CREATION DATE: Jan 24 1989
REVISION DATE: Dec 15 2003

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: NITROGEN, COMPRESSED GAS
CAS NUMBER: 7727-37-9
PERCENTAGE: 100.0

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=0 REACTIVITY=0



EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: gas
ODOR: odorless
MAJOR HEALTH HAZARDS: difficulty breathing
PHYSICAL HAZARDS: Containers may rupture or explode if exposed to heat.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: nausea, vomiting, headache, drowsiness, dizziness, tingling sensation, loss of coordination, suffocation, convulsions, coma





Gases: Nitrogen (continued)



LONG TERM EXPOSURE: no information on significant adverse effects

SKIN CONTACT:

SHORT TERM EXPOSURE: no information on significant adverse effects

LONG TERM EXPOSURE: no information on significant adverse effects

EYE CONTACT:

SHORT TERM EXPOSURE: irritation

LONG TERM EXPOSURE: no information on significant adverse effects

INGESTION:

SHORT TERM EXPOSURE: ingestion of a gas is unlikely

LONG TERM EXPOSURE: no information is available

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: Wash exposed skin with soap and water.

EYE CONTACT: Flush eyes with plenty of water.

INGESTION: If a large amount is swallowed, get medical attention.

NOTE TO PHYSICIAN: For inhalation, consider oxygen.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Negligible fire hazard. Pressurized containers may rupture or explode if exposed to sufficient heat.

EXTINGUISHING MEDIA: carbon dioxide, regular dry chemical

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck, evacuation radius: 800 meters (1/2 mile).

6. ACCIDENTAL RELEASE MEASURES



Gases: Nitrogen (continued)



OCCUPATIONAL RELEASE:

Stop leak if possible without personal risk. Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind and keep out of low areas.

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

NITROGEN, COMPRESSED GAS:

NITROGEN:

ACGIH (simple asphyxiant)

VENTILATION: Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Eye protection not required, but recommended.

CLOTHING: Protective clothing is not required.

GLOVES: Protective gloves are not required.

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: gas

COLOR: colorless

ODOR: odorless

TASTE: tasteless

MOLECULAR WEIGHT: 28.0134

MOLECULAR FORMULA: N₂

BOILING POINT: -321 F (-196 C)

FREEZING POINT: -346 F (-210 C)





Gases: Nitrogen (continued)

Material Safety Data Sheets



VAPOR PRESSURE: 760 mmHg @ -196 C
VAPOR DENSITY (air=1): 0.967
SPECIFIC GRAVITY: Not applicable
DENSITY: 1.2506 g/L
WATER SOLUBILITY: 1.6% @ 20 C
PH: Not applicable
VOLATILITY: 100%
ODOR THRESHOLD: Not available
EVAPORATION RATE: Not applicable
VISCOSITY: 0.01787 cP @ 27 C
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not applicable
SOLVENT SOLUBILITY:
Soluble: liquid ammonia
Slightly Soluble: alcohol

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Protect from physical damage and heat. Containers may rupture or explode if exposed to heat.

INCOMPATIBILITIES: metals, oxidizing materials

HAZARDOUS DECOMPOSITION:
Thermal decomposition products: oxides of nitrogen

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

Not available

12. ECOLOGICAL INFORMATION

Not available

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations.





Gases: Nitrogen (continued)

 Page 5 of 6

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: Nitrogen, compressed
ID NUMBER: UN1066
HAZARD CLASS OR DIVISION: 2.2
LABELING REQUIREMENTS: 2.2

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:
SHIPPING NAME: Nitrogen, compressed
UN NUMBER: UN1066
CLASS: 2.2



15. REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4): Not regulated.
SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.
SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.
SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):
ACUTE: Yes
CHRONIC: No
FIRE: No
REACTIVE: No
SUDDEN RELEASE: Yes
SARA TITLE III SECTION 313 (40 CFR 372.65): Not regulated.
OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:
California Proposition 65: Not regulated.

CANADIAN REGULATIONS:
WHMIS CLASSIFICATION: A.

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.





Gases: Nitrogen (continued)



TSCA 12(b) EXPORT NOTIFICATION: Not listed.

CANADA INVENTORY (DSL/NDSL): Listed on inventory.

16. OTHER INFORMATION

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Gases: Propane

JMB - 1		OSHA 174, Sept. 1985	
Material Safety Data Sheet		U.S. Department of Labor	
May be used to comply with OSHA's Hazard Communication Standard 29 CFR 1910.1200. Standard must be consulted for specific requirements.		Occupational Safety and Health Administration (Non-Mandatory Form) Form Approved OMB No. 1218-0072	
Identity (As Used on Label and List)		<i>Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.</i>	
PROPANE			
SECTION I			
Supplier's Name		Emergency Telephone Number	
Bernz-O-matic		800-424-9300	
Address		Telephone Number for Information	
<i>Number, Street, City, State and ZIP Code</i>		800-654-9011	
One BernzOmatic Drive Medina, NY 14103		Date Prepared	
		June 11, 2008	
Signature of Preparer (Optional)			
SECTION II - Hazardous Ingredients / Identity Information			
Hazardous Components		OSHA PEL	ACGIH TLV
<i>Specific Chemical Identity, Common Name(s)</i>		1000PPM	1000PPM
PROPANE CAS #74-98-6		Other Limits Recommended	% (optional)
		NA	100
NFPA HAZARD RATINGS		HMIS RATINGS	
Health -1		Health -0	
Flammability -4		Flammability -4	
Reactivity -0		Reactivity -0	
<i>Note: When propane fuel is burned efficiently, the normal by-products of combustion are CO₂ and H₂O. Inefficient burning may add CO to the by-products of combustion.</i>			
SECTION III - Physical / Chemical Characteristics			
Boiling Point		Specific Gravity (H ₂ O - 1)	
-44° F		Liquid @ 60° F .51	
Vapor Pressure (mm Hg)		Melting Point	
@ 100° F		N/A	
197 psig			
Vapor Density (AIR=1)		Evaporation Rate	
@ 1 ATM @ 60° F		Butyl Acetate -1)	
1.56		N/A	
Solubility in Water			
Not Soluble			
Appearance and Odor			
Colorless - Rotten Egg Odor			
SECTION IV - Fire and Explosion Hazard Data			
Flash Point (Method Used)		Flammable Limits	LEL UEL
-156° F Closed Cup			2.1 9.5
Extinguishing Media			
Stop flow of gas or oxygen			
Special Fire Fighting Procedures			
Use water to cool tanks			
Unusual Fire and Explosion Hazards			
Auto Ignition temp. 842° F Heavier than air (vapor density 1.5). May travel a considerable distance to a source of ignition and flashback.			
SECTION V - Reactivity Data			
Stability →		Conditions to Avoid	
Unstable			
Stable X		N/A	
Incompatibility (Materials to Avoid)			
N/A			
Hazardous Decomposition or Byproducts			
None			
Hazardous Polymerization →		Conditions to Avoid	
May Occur			
Will Not Occur X		N/A	

Material Safety Data Sheets



Gases: Propane (continued)

Material Safety Data Sheets

SECTION VI - Health Hazard Data				
Routes of Entry →	Inhalation?	Skin?	Ingestion?	
	YES	YES	NO	
Health Hazards (Acute and Chronic)				
Contact with liquid propane may cause frost burns.				
Carcinogenicity →	NTP?	IARC Monographs?	OSHA Regulated?	
	N/A	N/A	N/A	
Signs and Symptoms of Exposure				
High concentrations may cause headaches and drowsiness.				
Medical Conditions Generally Aggravated by Exposure				
N/A				
Emergency and First Aid Procedures				
Remove exposed person from contaminated area.				
Warning				
This fuel, and byproducts of combustion of this fuel, contain chemicals known to the State of California to cause cancer, birth defects, and other reproductive harm.				
SECTION VII - Precautions for Safe Handling and Use				
Steps to be Taken in Case Material is Released or Spilled				
Remove ignition sources and ventilate area.				
Waste Disposal Method				
Vent gas to atmosphere in flame free, spark free area outdoors.				
Precautions to be Taken in Handling and Storing				
Store at temperatures below 120° F in well ventilated, spark free, flame free area.				
Other Precautions				
None				
SECTION VIII - Control Measures				
Respiratory Protection (Specify Type)				
Not required with normal use.				
Ventilation →	Local Exhaust	Mechanical (General)	Special	Other
	N/A	N/A	N/A	N/A
Protective Gloves		Eye Protection		
Not required		Not required		
Other Protective Clothing or Equipment				
Not required				
Work / Hygienic Practices				
N/A				
SECTION IX - Shipping Information				
WHMIS Classification: A - Compressed Gas & B1 - Flammable Gas		Class: 2.1		
DOT	Proper Shipping Name	Hazard Classification	UN. No.	
	Petroleum Gas, Liquefied	Flammable Gas	1075	



Gelling Agents: Fire-Trol Firegel/SureFire

H.L. Blachford Ltd. SUREFIRE WHMIS Material Safety Data Sheet		1
Section 1 - Hazardous Ingredients		
None / Aucun		
Section 2 - Preparation Information		
Item Code	708320	
Prepared By	Derek J. Wisdom	
Date Issued	19-JAN-2005	
Supersede Date	14-MAY-2002	
Section 3 - Product Information		
Supplier Address	H.L. Blachford Ltd 2323 Royal Windsor Dr. Mississauga, ON CA L5J 1K5 Phone: 905-823-3200 Health: 514-938-9775 Emergency: 514-938-9775	
CASRN	NOT APPLICABLE	
WHMIS Classes	NR	
Product Name	SUREFIRE	
Chemical Name	MIXTURE BASED ON ALUMINUM SOAP	
General Use	GELLING AGENT	
Section 4 - Physical Data		
Physical State (@25°C)	Solid	
Specific Gravity	1.02	
Boiling Point	Not applicable	
Freezing / Melting Point	>200°C	
Vapour Pressure	Not applicable	
Vapour Density	Not applicable	
Odour Threshold	Not available	
pH Level	5-6 (for a 5% aqueous dispersion)	
Water Solubility	Slight	
% Volatile by Weight	1.5 (Moisture)	
Evaporation Rate	Not applicable	
Appearance/Odour	Off-white powder with slight odour.	
Coefficient of Water/Oil Distribution	Not available	
Section 5 - Fire and Explosion Data		
Flash Point (Method)	Not applicable	
Explosive Limits (LEL, UEL)	Not available	
Auto Ignition Temperature	Not available	
Extinguishing Media	Foam, dry chemical, carbon dioxide, water (fog, or mist)	
Special Fire Fighting Procedures	Fire fighters should wear self-contained breathing apparatus.	



Gelling Agents: Fire-Trol Firegel/SureFire (continued)

Material Safety Data Sheets

H.L. Blachford Ltd. FIRE-TROL FIREGEL WHMIS Material Safety Data Sheet	
	2
	dlamoreau
Section 5 - Fire and Explosion Data	
Unusual Fire and Explosion Hazards	High concentrations of airborne dust may present an explosion hazard.
Conditions of Flammability	This product is not defined as flammable nor as combustible although it can be made to burn.
Hazardous Combustion Products	Oxides of carbon, metal oxide fumes.
Section 6 - Reactivity Data	
Stability	Product is stable.
Conditions to Avoid (Stability)	Open flames, sparks, etc, if there is a high concentration of this product in the air.
Materials to Avoid (Incompatibility)	Strong oxidizers. Strong acids.
Hazardous Decomposition Products	Only on combustion or high temperature thermal decomposition. See Section 5 Hazardous Combustion Products.
Hazardous Polymerization	Hazardous polymerization will not occur.
Conditions to Avoid (Hazardous Polymerization)	None known.
Section 7 - Health Hazard Data	
Threshold Limit Value	Not established.
Effects of Acute Exposure (Eyes)	Contact with eyes may cause irritation.
Effects of Acute Exposure (Skin)	Could be mild irritant to the skin.
Effects of Acute Exposure (Inhalation)	Aspiration of large amount of dust may cause congestion and irritation of respiratory system.
Effects of Acute Exposure (Ingestion)	Not determined. Expected to be of low toxicity. LD50 for a similar product is >5 g/kg (Rat, Oral).
Effects of Chronic Exposure	Grossly excessive and chronic inhalation of dust may cause pulmonary damage.
Other Data	No evidence that this product is a carcinogen, teratogen or reproductive toxin.
Section 8 - Preventive Measures	
Respiratory Protection	For dust producing operations, wear a NIOSH-approved respirator.
Ventilation (Local, Exhaust)	Recommended if fumes, vapors or dust are generated during use.



Gelling Agents: Fire-Trol Firegel/SureFire (continued)

<p>H.L. Blachford Ltd FIRE-TROL FIREGEL WHMIS Material Safety Data Sheet</p>		<p>3 dlamorea</p>
Section 8 - Preventive Measures		
Ventilation (General, Mechanical)	Recommended during handling and use.	
Protective Gloves	Rubber or plastic.	
Eye Protection	Wear safety glasses or chemical goggles.	
Other Protection	Eye wash facility.	
Precautions for Handling and Storing	Avoid contact with skin and eyes. Avoid breathing dust. Use with adequate ventilation.	
Spill Remediation Measures	Vacuum, sweep or scoop up. Avoid producing airborne dust.	
Waste Disposal Method	Consult federal, state/provincial and local authorities for proper disposal procedures.	
Other Precautions	High concentration of dust may create dust explosion hazard. Avoid sparks and other sources of ignition.	
Section 9 - First Aid Treatment		
First Aid - Skin	Wash with soap and water.	
First Aid - Eyes	Flush eyes well with water for at least 15 minutes. Seek medical attention if any irritation persists.	
First Aid - Ingestion	Drink several glasses of water to dilute. Seek immediate medical advice.	
First Aid - Inhalation	If overcome by large amount of dust, remove person to fresh air. Give artificial respiration if necessary. Seek medical help if there are breathing difficulties.	
Section 10 - Regulatory Information (TDG)		
NR		
<p>The opinions expressed in this document are those of H.L. Blachford Limited's qualified experts. We believe that the information contained herein is the latest available at the date of preparation of the Material Safety Data Sheet. Since H.L. Blachford Limited cannot control the use of the information, the use of the opinions and the conditions of use, the user is obliged to determine the conditions permitting the safe use of the material.</p>		

Material Safety Data Sheets



Gelling Agents: Fire-Trol Flash 21A

Material Safety Data Sheets

FLASH 21A Page 1 of 2

SECTION I: IDENTIFICATION OF PRODUCT	
Product Identifier	FLASH 21A
Supplier	ICL Performance Products Canada Ltd. 3060 Airport Rd Kamloops, BC V2B 7X2 Phone: (250) 554-3530
Emergency Contact (24/7)	403-203-1481
Chemical Family / Formula	Phosphate ester
Product Use	Hydrocarbon gelling agent

SECTION II: HAZARDOUS AND/OR INGREDIENT DISCLOSURE COMPONENTS					
Name	Percent (w/v%)	CAS#	LD ₅₀ (oral rat)	LD ₅₀ (dermal rabbit)	LC ₅₀ (inhalation rat)
Phosphoric Acid, mixed decyl, octyl and ethyl esters	60 - 100	68412-60-2	Not Available	Not Available	Not determined
Decanol	3 - 7	112-30-1	Not Available	Not Available	Not Available
Octanol	3 - 7	111-87-5	Not Available	Not Available	Not Available

SECTION III: HEALTH HAZARDS	
Routes of Entry	[XX] SKIN [XX] EYE CONTACT [XX] INHALATION [XX] INGESTION
Threshold Limit Value	Not determined
Skin Contact	Severe irritant. Corrosive to the skin. Can cause smarting and burning sensations, inflammation, burns and painful blisters.
Eye Contact	Severe irritant. Can cause redness, irritation, inflammation, tearing, and tissue destruction.
Ingestion	Low oral toxicity. Can cause burns to oesophagus and throat.
Inhalation	Mists may cause respiratory tract irritation.
Carcinogenicity	Not determined
Reproductive Toxicity	Not determined
Teratogenicity	Not determined
Mutagenicity	Not determined
Developmental Toxicity	Not determined

SECTION IV: FIRST AID MEASURES	
Skin Contact	Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before re-use. Destroy contaminated shoes.
Eye Contact	Immediately flush eyes with water for 15 minutes and call a physician. Contact lenses should not be worn when working with this material.
Ingestion	Do not induce vomiting. If conscious, dilute by giving two glasses of water. Call a physician immediately.
Inhalation	Remove to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. If breathing is difficult, give oxygen. Call a physician.

SECTION V: PHYSICAL DATA	
Appearance	Yellow liquid
Odour	Slight odour
Specific Gravity	1.01
Boiling Point (°C)	Not determined
Melting Point (°C)	Not determined

Protective Equipment	Transportation of Dangerous Goods	WHMIS
 <p>Chemical goggles, chemically resistant gloves, rubber apron recommended.</p>	<p>Shipping Name: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.(DECYL/OCTYL ALCOHOL, PHOSPHATE ESTER) Class: 8 UN Number: UN3265 Packing Group: III</p>	 <p>E Corrosive</p>



Gelling Agents: Fire-Trol Flash 21A (continued)

FLASH 21A Page 2 of 2

SECTION V: PHYSICAL DATA (continued)	
Solubility in Water	Not determined
Percent Volatile by Volume	12
Evaporation Rate	Not determined
Vapour Pressure (mm Hg)	Not determined
Vapour Density (Air = 1)	Not determined
pH	1.7 (10 %wt/wt)

SECTION VI: FIRE AND EXPLOSION HAZARD DATA	
Flash Point	>100°C (TCC)
Flammable Limits	Not determined
Extinguishing Media	CO2; Foam; Dry Chemical; Water Spray
Special Fire Fighting Procedures	Use full protective equipment and self-contained breathing apparatus.
Unusual Fire and Explosion Hazards	Though the product is not flammable, evaporation of sufficient quantities of material will render the product combustible.

SECTION VII: REACTIVITY DATA	
Stability	<input checked="" type="checkbox"/> STABLE <input type="checkbox"/> UNSTABLE
Incompatibility (Conditions to Avoid)	Strong oxidizers, strong bases, strong reducers
Conditions of Reactivity	Not known
Hazardous Decomposition Products	COx, POx
Hazardous Polymerization	<input checked="" type="checkbox"/> WILL NOT OCCUR <input type="checkbox"/> MAY OCCUR

SECTION VIII: PREVENTIVE MEASURES	
Special Protection Information	
Respiratory Protection	Use NIOSH approved organic vapour cartridge respirator when TLV's are exceeded.
Ventilation	General mechanical
Protective Gloves	Chemically resistant
Eye Protection	Chemical goggles
Other Protective Equipment (Specify)	Suggest rubber apron
Accidental Release Measures	
Steps to be taken in case the Material is Spilled or Released	Use full protective equipment and breathing apparatus. Eliminate all ignition sources. Contain spill. Absorb with inert absorbent. Place absorbent in closed metal containers for disposal. Do not flush in to sewer.
Handling and Storage	
Precautions to be taken in Handling and Storing	Store in cool, well-ventilated area. Practice reasonable caution and personal cleanliness. Avoid skin contact and inhalation.
Disposal	
Waste Disposal Method	Incinerate/dispose to conform to local disposal regulations.

SECTION IX: PREPARATION	
Date Issued	April 2008
Supersedes	January 2008
Prepared by	Product safety committee
Phone	403-279-8545

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Gelling Agents: Fire-Trol Flash 21B

Material Safety Data Sheets

FLASH 21B Page 1 of 2

SECTION I: IDENTIFICATION OF PRODUCT	
Product Identifier	FLASH 21B
Supplier	ICL Performance Products Ltd. 3060 Airport Rd. Kamloops, BC V2B 7X2 Phone: (250) 554-3530
Emergency Contact (24/7)	403-203-1481
Chemical Family / Formula	Iron Solution
Product Use	Hydrocarbon Gellant

SECTION II: HAZARDOUS AND/OR INGREDIENT DISCLOSURE COMPONENTS					
Name	Percent (w/v%)	CAS#	LD ₅₀ (oral rat)	LD ₅₀ (dermal rabbit)	LC ₅₀ (inhalation rat)
Ferric sulfate	30 - 60	10028-22-5	Not available	Not available	Not available
Monoethanolamine	1 - 5	141-43-5	Not available	Not available	Not available
n-alkyldimethyl benzyl ammonium chloride	0.5 - 1.5	68424-85-1	Not available	Not available	Not available
Ethylene Glycol	5 - 10	107-21-1	Not available	Not available	Not available

SECTION III: HEALTH HAZARDS	
Routes of Entry	[XX] SKIN [XX] EYE CONTACT [XX] INHALATION [XX] INGESTION
Threshold Limit Value	Monoethanolamine: OSHA PEL: TWA 3 ppm; STEL 6 ppm ACGIH TLV: TWA 3 ppm; STEL 6 ppm Ethylene Glycol: OSHA PEL: CL 50 ppm ACGIH TLV: CL 50 ppm (vapour)
Skin Contact	Severe irritant. Corrosive to the skin. Can cause smarting and burning sensations, inflammation, burns and painful blisters.
Eye Contact	Severe irritant. Corrosive. Can cause redness, irritation, inflammation, tearing, and tissue destruction.
Ingestion	Low oral toxicity. Can cause burns to oesophagus and throat.
Inhalation	Mists may cause respiratory tract irritation.
Carcinogenicity	Not determined
Reproductive Toxicity	Not determined
Teratogenicity	Ethylene glycol: Very toxic. Embryotoxicity and teratogenicity observed in animal studies. Doses were not toxic to the mother.
Mutagenicity	Not determined
Developmental Toxicity	Not determined

SECTION IV: FIRST AID MEASURES	
Skin Contact	Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before re-use. Destroy contaminated shoes.
Eye Contact	Immediately flush eyes with water for 15 minutes and call a physician. Contact lenses should not be worn when working with this material.
Ingestion	Do not induce vomiting. If conscious, dilute by giving two glasses of water. Call a physician immediately.
Inhalation	Remove to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. If breathing is difficult, give oxygen. Call a physician.

Protective Equipment	Transportation of Dangerous Goods	WHMIS
 Chemical Goggles, chemically resistant gloves, rubber apron recommended.	Shipping Name: CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S (FERRIC SULFATE) Class: 8 UN Number: UN3264 Packing Group: III	 E, D2A Corrosive, Teratogen



Gelling Agents: Fire-Trol Flash 21B (continued)

FLASH 21B Page 2 of 2

SECTION V: PHYSICAL DATA	
Appearance	Liquid
Odour	Slight odour
Specific Gravity	1.373
Boiling Point (°C)	Not determined
Melting Point (°C)	Not determined
Solubility in Water	Not determined
Percent Volatile by Volume	Not determined
Evaporation Rate	Not determined
Vapour Pressure (mm Hg)	Not determined
Vapour Density (Air = 1)	Not determined
pH	1.0

SECTION VI: FIRE AND EXPLOSION HAZARD DATA	
Flash Point	>100°C (TCC)
Flammable Limits	Not determined
Extinguishing Media	CO2; Foam; Dry Chemical; Water Spray
Special Fire Fighting Procedures	Use full protective equipment and self-contained breathing apparatus.
Unusual Fire and Explosion Hazards	Though the product is not flammable, evaporation of sufficient quantities of material will render the product combustible.

SECTION VII: REACTIVITY DATA	
Stability	<input checked="" type="checkbox"/> STABLE <input type="checkbox"/> UNSTABLE
Incompatibility (Conditions to Avoid)	Strong oxidizers, strong bases, strong reducers
Conditions of Reactivity	Not known
Hazardous Decomposition Products	COx
Hazardous Polymerization	<input checked="" type="checkbox"/> WILL NOT OCCUR <input type="checkbox"/> MAY OCCUR

SECTION VIII: PREVENTIVE MEASURES	
Special Protection Information	
Respiratory Protection	Use NIOSH approved organic vapour cartridge respirator when TLV's are exceeded.
Ventilation	General mechanical
Protective Gloves	Chemically resistant
Eye Protection	Chemical goggles
Other Protective Equipment (Specify)	Suggest rubber apron
Accidental Release Measures	
Steps to be taken in case the Material is Spilled or Released	Use full protective equipment and breathing apparatus. Eliminate all ignition sources. Contain spill. Absorb with inert absorbent. Place absorbent in closed metal containers for disposal. Do not flush in to sewer.
Handling and Storage	
Precautions to be taken in Handling and Storing	Store in cool, well-ventilated area. Practice reasonable caution and personal cleanliness. Avoid skin contact and inhalation.
Disposal	
Waste Disposal Method	Incinerate/dispose to conform to local disposal regulations.

SECTION IX: PREPARATION	
Date Issued	April 2008
Supersedes	January 2008
Prepared by	Product safety committee
Phone	403-279-8545

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Gelling Agents: Fire-Trol Petrol Jel



Fire-Trol Canada Company

www.firetrolcanada.com

MATERIAL SAFETY DATA FICHE SIGNALÉTIQUE

SECTION 1: PRODUCT IDENTIFICATION AND USE

Product Identifier: **PETROL JEL™**

Product use: Petrol Jel™ is a liquid thickener for gelling petroleum fuels for use in prescribed burning or wildfires.

Manufacturers name: **CIRCLE PARK HOLDINGS LTD
P.O. BOX 464
CLEARWATER BC
V0E 1N0**

Suppliers name: **FIRE-TROL CANADA COMPANY
455 DENE DRIVE
KAMLOOPS BC
V2H 1J1**

Emergency Telephone Numbers: (24 Hours)

[250] 374-0379: FIRE-TROL CANADA COMPANY: KAMLOOPS, B.C.

[530] 865-4932: FIRE-TROL HOLDINGS L.L.C.: ORLAND, CALIFORNIA

GENERAL INFORMATION

WHMIS CLASSIFICATION: B3 and D1
DANGEROUS GOODS CLASS: 3 (6.1)

WARNING STATEMENT

Danger. Methanol solution. May be fatal if swallowed. May cause blindness. Cannot be made non-poisonous. Can be absorbed through the skin. Harmful if inhaled. Use only in a well ventilated area. Flammable. Keep away from heat and open flame.

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Gelling Agents: Fire-Trol Petrol Jel (continued)

PETROL JEL™
Page 2 of 5

SECTION 2: HAZARDOUS INGREDIENTS

Petrol Jel™ is a proprietary mixture of a powdered gelling agent and carrying agents and has no CAS number. The principal ingredients are Methyl Alcohol (CAS #67-56-1) and a powdered metal stearate.

SECTION 3: PHYSICAL DATA:

1. Physical State: Low viscosity slurry.
2. Odour and Appearance: Slight perfume. Blue/yellow liquid
3. Odour Threshold (ppm): No data available.
4. Vapor Pressure (mm Hg): 92 at 20 degrees C.
5. Vapor Density (Air = 1): 1.11
6. Evaporation Rate:(Butyl Acet=1): 3.5 Evaporates Readily
7. Boiling Point: 64.5C (148F)
8. Freezing point: -97.8C (-144F)
9. pH: 6.5
10. Specific Gravity: 1.035
11. Coeff. Water/Oil Dist.: No data available.

SECTION 4: FIRE AND EXPLOSION DATA:

1. Flammability: Very Flammable. Class 3.2
 2. Extinguishing Media: Carbon dioxide, dry chemical, foam, or water spray. Class A, BC, or ABC fire extinguishers. Sand/earth.
 3. Special Firefighting Procedures in Enclosed Areas:

In case of accident or fire involving Petrol Jel™ use chemical extinguishers or water to keep fire-exposed containers cool and to flush non-ignited spills or vapors away from fire. Vapors can flow along surfaces to distant ignition sources and flash back. Wear an approved self-contained breathing apparatus and protective clothing.
 4. Flashpoint: 12.2C (54F): Open Cup
 5. Upper Flammable Limit (%): 36
 6. Lower Flammable Limit (%): 6.7
 7. Autoignition Temp.: 464C (867F)
 8. Hazardous Combustion Products: When Petrol Jel™ is heated to point of combustion, carbon dioxide (CO₂) and carbon monoxide (CO) will be formed.
 9. Explosion Data: Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames.
- Sensitivity to Impact: Not Applicable



Gelling Agents: Fire-Trol Petrol Jel (continued)

PETROL JEL™
Page 3 of 5

Sensitivity to Static Discharge: Not Applicable

SECTION 5: REACTIVITY DATA:

1. Stability: Excellent long term stability. Petrol Jel™ will settle out but can be easily put back into suspension through agitation. Hazardous polymerization will not occur.
2. Incompatibility: Avoid strong oxidizers such as hydrogen peroxide, bromine, chromic acid, perchlorates or sulfuric acid. Will attack some forms of plastics, rubber and coatings. May react with metallic aluminum and generate hydrogen gas.
3. Reactivity: Not Applicable.
4. Hazardous Decomposition Products: Carbon dioxide, carbon monoxide and formaldehyde.
5. Storage: Store in original container until used. Protect against physical damage. Outside or detached storage is preferred. Store in a cool well ventilated area. Inside storage should be in standard flammable liquids storage room or cabinet. Storage and use must be in "No Smoking" areas. Spark proof tools and explosion proof equipment must be used in storage areas.

SECTION 6: TOXICOLOGICAL PROPERTIES:

1. Routes of Entry: Vapors can be expected to be the most likely source of exposure to Petrol Jel™. Slight irritant to mucous membranes. Toxic effects if excessive amounts inhaled. Toxic effects if excessive amounts absorbed through the skin.
2. Toxicological Data estimated from the Methyl Alcohol carrying agent.

Oral LD50 (Rat):	> 5000 mg/kg
Dermal LD50 (Rabbit):	2000 mg/kg
3. Effects of Acute Exposure: Affects central nervous system, especially the optic nerve. Causes dizziness, nausea, muscle weakness, narcosis and respiratory failure. Ingestion can produce blindness. (100 ml can be fatal.)
4. Effects of Chronic Exposure: Marked impairment of vision and enlargement of liver. Skin irritation from prolonged exposure.
5. Carcinogenicity: Not listed by NTP or IARC.
6. Teratogenicity: Not listed by NTP or IARC.
7. Mutagenicity: Not listed by NTP or IARC.
8. Reproductive toxicity: Not listed by NTP or IARC.
9. Synergistic Products: Not applicable.



Gelling Agents: Fire-Trol Petrol Jel (continued)

PETROL JEL™
Page 4 of 5

SECTION 7: PREVENTIVE MEASURES:

1. Protective clothing and equipment must be utilized when handling Petrol Jel™.
 - (i) Gloves: Avoid skin contact. Use rubber or plastic gloves when handling.
 - (ii) Eye: Avoid eye contact. Use safety goggles offering a full seal around the eyes. Do not wear contact lenses. Keep eye wash bottle in work area.
 - (iii) Clothing: Wear cotton coveralls to minimize exposure to Petrol Jel™.
 - (iv) Respirator: Avoid excessive inhalation of vapors. Use in a well ventilated area. OSHA permissible exposure limit 200 ppm (TIME WEIGHTED AVERAGE), 250 ppm (STEL) skin. If the exposure limit is exceeded, use an air supplied, full-face respirator or self contained breathing apparatus.
2. Ventilation Type Required: Mechanical
3. Leak and Spill Procedure: Ventilate area of leak or spill. Remove all sources of ignition. Clean up personnel require protective clothing and respiratory protection from vapors. Contain and remove liquid where possible. ABSORB WITH SAWDUST OR VERMICULITE FOR DISPOSAL AS A HAZARDOUS WASTE IN A RCRA APPROVED FACILITY. Do not flush to sewer.
4. Waste Disposal: Dispose of in accordance with all Federal, Provincial and Local regulations.
5. Transportation Information:
 - Transport Canada: Dangerous Good
 - Freight class: Class 3 (6.1) Packing Group II
 - UN 1992 Flammable Liquid, Toxic, N.O.S.
 - Packing Group II

SECTION 8: ENVIRONMENTAL EFFECTS:

1. Do not dispose to sewer.
2. Relatively low toxicity to aquatic life
 - 96 hr. LC50 Juvenile Rainbow Trout: >1000 mg/litre.
3. Use and disposal employing proper environmental control practices should not cause significant environmental impact.



Gelling Agents: Fire-Trol Petrol Jel (continued)

PETROL JEL™
Page 5 of 5

SECTION 9: FIRST AID PROCEDURES:

1. Inhalation: Remove to fresh air and give oxygen if breathing is difficult. If not breathing, give artificial respiration. Get medical attention.
2. Ingestion: If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down the throat. Never give anything by mouth to an unconscious person. Get medical attention immediately.
3. Skin Contact: Remove contaminated clothing. Wash with soap and water for at least 15 minutes. Get medical attention if irritation develops.
4. Eye Contact: Flush eyes immediately with large amounts of water for at least 15 minutes, lifting upper and lower lids occasionally. Get medical attention immediately.

SECTION 10: PREPARATION DATE

Prepared By: FIRE-TROL CANADA COMPANY [250] 374-0379

Effective Date: January 16, 2008 Supersedes: January 18, 2005

NOTICE OF WARRANTY

FIRE-TROL CANADA COMPANY warrants that Petrol Jel™ is reasonably fit for the purpose for which it was developed only when used in accordance with manufacturers recommended use practices and when used under normal conditions. The liability of Fire-Trol Canada Company with respect to the use and handling of this product is limited to the amount of the purchase price of the product to the user and Fire-Trol Canada Company will not be liable for consequential, special, or indirect damages resulting from such use or handling. **WARNING: Petrol Jel™ is flammable; is harmful and potentially fatal if swallowed; contact with the skin and eyes is to be avoided. Fire-Trol Canada Company will not be responsible for injury or deaths which occur as a result of the use or handling of this product.**

Petrol Jel™ is a trademark of Circle Park Holdings Ltd.

FIRE-TROL CANADA COMPANY MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE NOR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.



Gelled Fuel Blivets: FireSnakes/Heat Source Slash Burners

<u>M A T E R I A L S A F E T Y D A T A S H E E T</u>				
80M010		Page: 1		
PRODUCT CODE: 80M010		HMIS CODES: H F R P		
PRODUCT NAME: FIRESNAKE - BLACK		1*3 0 H		
SECTION I - MANUFACTURER IDENTIFICATION				
MANUFACTURER'S NAME: FORREST PAINT CO.				
ADDRESS : 1011 MCKINLEY ST.				
EUGENE, OR 97402				
EMERGENCY PHONE : 1(800)424-9300				
INFORMATION PHONE : 1(541)342-1821				
DATE ISSUED : 9/27/2005				
INFORMATION CONTACT: T. BOLLENBAUGH				
SECTION II - REPORTABLE COMPONENTS				
REPORTABLE COMPONENTS	CAS NUMBER	mm Hg	@ TEMP	WEIGHT PERCENT
ISOPROPANOL	67-63-0	33	68	85 - 95
<small>PEL-TWA: 400 ppm, PEL-STEL: 500 ppm, ACGIH-TLV: 400 ppm</small>				
SEE SECTION 9 FOR SARA AND HAPS INFORMATION.				
SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS				
BOILING RANGE: 180 deg F				
DENSITY : 6.75 lb/gl				
SPECIFIC GRAVITY (H2O=1): .81				
VAPOR DENSITY : Heavier than air.				
EVAPORATION RATE: Slower than ether.				
VOC AS SUPPLIED: 6.29 lb/gl 754 g/l				
VOC EXCLUDING EPA EXEMPT SOLVENTS/WATER: 6.29 lb/gl 754 g/l				
NOTE: Check with your state/local Air Quality regulatory agency to determine which VOC calculation you should use.				
SOLUBILITY IN WATER: Insoluble.				
APPEARANCE AND ODOR: Gel with alcohol odor in a plastic sheath.				
SECTION IV - FIRE AND EXPLOSION HAZARD DATA				
FLASH POINT: 54 deg F				
FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: 2.5 UPPER: 12				
EXTINGUISHING MEDIA: Foam, Alcohol foam, CO2, Dry chemical, Water fog.				
SPECIAL FIREFIGHTING PROCEDURES: None known.				
UNUSUAL FIRE AND EXPLOSION HAZARDS: None known.				
SECTION V - REACTIVITY DATA				
STABILITY: Stable.				
CONDITIONS TO AVOID: Do not use indoors or in confined spaces.				

Material Safety Data Sheets



Gelled Fuel Blivets: FireSnakes/Heat Source Slash Burners (continued)

M A T E R I A L S A F E T Y D A T A S H E E T

80M010

Page: 1

INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS: Carbon, carbon monoxide, carbon dioxide, oxides of nitrogen.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION VI - HEALTH HAZARD DATA

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE:

ISOPROPANOL: Exposure can cause irritation of the eyes, nose, mouth and throat. IPA is of low toxicity by any route and the TLV is set on the basis of eye, nose and throat irritation. Exposure to the vapors and smoke can cause irritation of the eyes, nose, mouth and throat. Avoid breathing the vapors that may collect in pails during storage.

EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE:

ISOPROPANOL: Contact can cause eye irritation. Contact can cause eye irritation.

SKIN CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE:

ISOPROPANOL: Can irritate the skin on contact, causing a rash or burning feeling. Exposure to the gel contained inside the plastic sheathing can irritate the skin on contact. May cause rash.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE:

ISOPROPANOL: Can absorbed through the skin. Not expected to be a significant source of exposure. Can be absorbed through the skin if not cleaned off. Has low toxicity.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE:

ISOPROPANOL: Ingestion gives rise to symptoms of alcoholic intoxication. Other symptoms may include vomiting, depression, headache, coma and shock. Not expected to be a significant source of exposure given the nature of the product. This product contains materials that will cause a bad taste in the mouth and cause vomiting if product is swallowed. Ingestion of large amounts may cause abdominal pains, headache, depression, coma and shock.

CHRONIC HEALTH RISKS:

ISOPROPANOL: Skin exposure can cause itching, redness and rashes in some people. Repeated or prolonged exposure can cause dryness and cracking of skin. This chemical has not been adequately evaluated to determine whether brain or nerve damage could occur with repeated exposure. However, many solvents and other petroleum based chemicals have been shown to cause such damage. ***Prolonged or repeated exposure to solvents may cause permanent



Gelled Fuel Blivets: FireSnakes/Heat Source Slash Burners (continued)

M A T E R I A L S A F E T Y D A T A S H E E T

80M010 Page: 2

brain and nervous system damage, including memory loss and impairment of coordination and reaction time. May cause toxic brain disease (encephalopathy), associated with brain tissue death. May cause liver and kidney damage. Inhaling concentrated vapors is harmful and may be fatal.***
When used properly, chronic overexposure to this product should not be significant. Skin exposure to gel can cause itching, redness and rashes in some people. Repeated or prolonged exposure can cause dryness and cracking of skin. Repeated and prolonged exposure to vapors may cause brain or nervous system damage.

CARCINOGENICITY:
NTP CARCINOGEN: No IARC MONOGRAPHS: No OSHA REGULATED: No
Not known to contain any ingredients recognized as carcinogens by the National Toxicology Program (NTP), the International Agency for Cancer Research (IARC) or the Occupational Safety and Health Administration (OSHA).

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:
ISOPROPANOL: Skin (dermal) reactions due to hypersensitivity.
Skin (dermal) reactions due to hypersensitivity. Smoke from the burning FireSnake may aggravate pre-existing asthma and other respiratory ailments.

EMERGENCY AND FIRST AID PROCEDURES:
EYES: Flush with large quantities of water for 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention if irritation persists.
SKIN: Wash thoroughly with soap and water. Remove and wash contaminated clothing if heavily splashed or soaked.
INGESTION: If swallowed, do not induce vomiting. Get medical attention immediately.
INHALATION: If affected by inhalation of vapor or smoke, get some fresh air.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Not expected to be a large problem due to nature of product and packaging.
In case of leaks, remove all sources of ignition. Ventilate area if possible. Avoid breathing vapors. Avoid getting FireSnake gel on clothing (fire hazard). Put damaged FireSnake in secure container for disposal.

WASTE DISPOSAL METHOD: If spilled, contain spilled material and remove any liquid with inert absorbent. Unused material is considered an ignitable hazardous waste. After burning, the residue is not a hazardous waste. Dispose of in accordance to Federal, state and local waste disposal regulations.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: FLAMMABLE LIQUID AND VAPORS. Store only in areas approved for flammable liquids. Keep clear of all sources of ignition. Storage temperature should be kept below 120 degrees F. KEEP CONTAINER TIGHTLY CLOSED WHEN NOT IN USE.



Gelled Fuel Blivets: FireSnakes/Heat Source Slash Burners (continued)

Material Safety Data Sheets

M A T E R I A L S A F E T Y D A T A S H E E T

80M010 Page: 4

DO NOT TRANSFER TO UNLABELED CONTAINER.

OTHER PRECAUTIONS: None known.

SECTION VIII - CONTROL MEASURES

RESPIRATORY PROTECTION: FireSnake is designed for outdoor use only. When used as directed, respiratory protection is not necessary.

VENTILATION: FireSnake is designed for outdoor use only.

PROTECTIVE GLOVES: Wear gloves when handling FireSnake to prevent accidental exposure to skin.

EYE PROTECTION: Approved safety glasses.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT: As necessary to keep FireSnake gel off skin.

WORK/HYGIENIC PRACTICES: In handling any chemicals, personal hygiene is extremely important. Always wash your hands and face before eating or when done handling or using this product. Keep food and drink out of work areas.

SECTION IX - REGULATORY INFORMATION

SARA 313 / 40 CFR 372: % / WT

. This product contains no reportable materials at or above normal reporting levels.

CLEAN AIR ACT AMENDMENT SECTION 112 (HAPS): % / WT

. This product contains no reportable materials at or above normal reporting levels.

DOT SHIPPING INFORMATION (GROUND): Flammable Liquid, n.o.s., (Isopropanol), 3, UN1993, PGII.

DOT SHIPPING INFORMATION (LIMITED QUANTITIES/GROUND): Inner packaging 1 gallon or less each net capacity in strong outer packaging:
Consumer Commodity, ORM-D

IATA SHIPPING DESCRIPTION (AIR SHIPMENTS): Flammable Liquid, n.o.s., (Isopropanol), Class 3, UN1993, PGII

IMDG SHIPPING DESCRIPTION (WATERWAYS SHIPMENTS): Flammable Liquid, n.o.s. (Isopropanol), Flammable Liquid, Class 3, UN1993, PG II.
Flashpoint -18 C

OSHA CLASSIFICATION: Flammable Liquid - Class IB.

CLEAN AIR ACT - OZONE DEPLETING CHEMICALS: Not known to contain or be manufactured with Class 1 or Class 2 Ozone Depleting Chemicals (ODC's).





Gelled Fuel Blivets: FireSnakes/Heat Source Slash Burners (continued)

<u>M A T E R I A L S A F E T Y D A T A S H E E T</u>	
80M010	Page: 5
<hr/>	
SECTION X - DISCLAIMER	
<hr/>	
The above information is based on current information available to Forrest Paint Co. and is believed to be accurate but is not warranted.	

Material Safety Data Sheets



Plastic Spheres: Ethylene Glycol Antifreeze

Material Safety Data Sheets

Initial Preparation Date: 10/09/1990
Last Revision Date: 9/16/2003
Effective Date: 8/1/2005

MATERIAL SAFETY DATA SHEET

PRODUCT IDENTITY: PEAK ANTIFREEZE & COOLANT

1. CHEMICAL PRODUCT & COMPANY INFORMATION

OLD WORLD INDUSTRIES, INC.
4065 COMMERCIAL AVENUE
NORTHBROOK, ILLINOIS 60062
PHONE: 847-559-2000
EMERGENCY PHONE: 1-800-424-9300 (CHEMTREC)

2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>Material</u>	<u>CAS#</u>	<u>% by Wt</u>	<u>PEL (OSHA)</u>	<u>TLV (ACGIH)</u>
Ethylene Glycol	107-21-1	90 - 95	50 ppm	50 ppm
Diethylene Glycol	111-46-6	0 - 5	None	None
Dipotassium Phosphate	7758-11-4	1 - 2	None	None

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

<i>Slight odor.</i>	<i>May be fatal if swallowed.</i>	<i>Vapors can cause eye irritation.</i>
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Lowest Known LD50 (Oral)	107-21-1	5840 mg/kg (Rats)
Lowest Known LD50 (Skin)	107-21-1	9530 mg/kg (Rabbits)

HAZARD RATING SYSTEM

NFPA: HEALTH: 1 FLAMMABILITY: 1 REACTIVITY: 0
HMIS: HEALTH: 2 FLAMMABILITY: 1 REACTIVITY: 0

KEY: 0 - Minimal 1 - Slight 2 - Moderate 3 - Serious 4 - Severe



Plastic Spheres: Ethylene Glycol Antifreeze (continued)

POTENTIAL HEALTH EFFECTS

Routes of Exposure: Inhalation, Ingestion, Skin Contact/Absorption, Eye Contact

Eye: May cause slight transient (temporary) eye irritation. Corneal injury is unlikely. Vapors or mists may cause eye irritation.

Skin: Prolonged or repeated exposure not likely to cause significant skin irritation. A single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts. Repeated skin exposure may result in absorption of harmful amounts. Massive contact with damaged skin or of material sufficiently hot to burn skin may result in absorption of potential lethal amounts.

Ingestion: Single dose oral toxicity is considered to be moderate. Excessive exposure may cause central nervous system effects, cardiopulmonary effects (metabolic acidosis), and kidney failure. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; however, swallowing amounts larger than that may cause serious injury, even death.

Inhalation: At room temperature, exposures to vapors are minimal due to physical properties; higher temperatures may generate vapor levels sufficient to cause adverse effects.

Systemic (Other Target Organ) Effects: Repeated excessive exposures may cause severe kidney and also liver and gastrointestinal effects. Signs and symptoms of excessive exposure may be central nervous system effects. Signs and symptoms of excessive exposure may be nausea and/or vomiting. Signs and symptoms of excessive exposure may be anesthetic or narcotic effects. Observations in animals include formation of bladder stones after repeated oral doses of ethylene glycol. Reports of kidney failure and death in burn patients suggest the ethylene glycol may have been a factor. The use of topical applications containing this material may not be appropriate in severely burned patients or individuals with impaired renal function.

Cancer Information: Based on data from long-term animal studies, ethylene glycol is not believed to pose a carcinogenic risk to man.

Teratology (Birth Defects): Exposure to ethylene glycol has caused birth defects in laboratory animals only at doses toxic to the mother.

Reproductive Effects: Ethylene glycol has not interfered with reproduction in animal studies except at very high doses.

CHRONIC, PROLONGED OR REPEATED OVEREXPOSURE

Effects of Repeated Overexposure: Repeated inhalation of ethylene glycol mist may produce signs of central nervous system involvement, particularly dizziness and nystagmus.

Other Effects of Overexposure: repeated skin contact with ethylene glycol may, in a very small proportion of cases, cause sensitization with the development of allergic contact dermatitis. The incidence is significantly less than 1% with the undiluted material.



Plastic Spheres: Ethylene Glycol Antifreeze (continued)

4. FIRST AID MEASURES
Ensure physician has access to this MSDS.

TREATMENT

Eyes: Immediately flush eyes with large amounts of water for 15 minutes, lifting lower and upper lids. Get medical attention as soon as possible. Contact lenses should never be worn when working with this chemical.

Skin: Flush area of skin contact immediately with large amounts of water for at least 15 minutes while removing contaminated clothing. If irritation persists after flushing, get medical attention promptly. Wash clothing before re-use.

Inhalation: If inhaled, immediately remove victim to fresh air and call *emergency medical care*. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Ingestion: Obtain medical attention immediately. If patient is fully conscious, give two glasses of water. Do not induce vomiting. If medical advice is delayed, and if the person has swallowed a moderate volume of material (a few ounces), then give three to four ounces of hard liquor, such as whisky. For children, give proportionally less liquor, according to weight.

Notes to Physician:

It is estimated that the lethal oral dose to adults is of the order of 1.0 ml/kg. Ethylene glycol is metabolized by alcohol dehydrogenase to various metabolites including glycerinaldehydes, glycolic acid and oxalic acid which cause an elevated anion-gap metabolic acidosis and renal tubular injury. The signs and symptoms in ethylene glycol poisoning are those of metabolic acidosis, CNS depression, and kidney injury. Urinalysis may show albuminuria, hematuria and oxaluria. Clinical chemistry may reveal anion-gap metabolic acidosis and uremia. The currently recommended medical management of ethylene glycol poisoning includes elimination of ethylene glycol and metabolites, correction of metabolic acidosis and prevention of kidney injury. It is essential to have immediate and follow up urinalysis and clinical chemistry. There should be particular emphasis on acid-base balance and renal function tests. A continuous infusion of 5% sodium bicarbonate with frequent monitoring of electrolytes and fluid balance is used to achieve correction of metabolic acidosis and forced diuresis. As a competitive substrate for alcohol dehydrogenase, ethanol is antidotal. Given in the early stages of intoxication, it blocks the formulation of nephrotoxic metabolites. A therapeutically effective blood concentration of ethanol is in the range 100-150 mg/dl, and should be achieved by a rapid loading dose and maintained by intravenous infusion. For severe and/or deteriorating cases, hemodialysis may be required. Dialysis should be considered for patients who are symptomatic, have severe metabolic acidosis, a blood ethylene glycol concentration greater than 25 mg/dl, or compromise of renal functions.

A more effective intravenous antidote for physician use is 4-methylpyrazole, a potent inhibitor of alcohol dehydrogenases, which effectively blocks the formation of toxic metabolites of ethylene glycol. It has been used to decrease the metabolic consequences of ethylene glycol poisoning before metabolic acidosis coma, seizures, and renal failure have occurred. A generally recommended protocol is a loading dose of 15 mg/kg followed by 10 mg/kg every 12 hours for 4 doses and then 15 mg/kg every 12 hours until ethylene glycol concentrations are below 20 mg/100 ml. Slow intravenous infusion is required. Since 4-methylpyrazole is dialyzable, increased dosage may be necessary during hemodialysis. Additional therapeutic measures may include the administration of cofactors involved in the metabolism of ethylene glycol. Thiamine (100 mg) and pyridoxine (50 mg) should be given every six hours.

**Plastic Spheres: Ethylene Glycol Antifreeze (continued)**

Pulmonary edema with hypoxemia has been described in a number of patients following poisoning with ethylene glycol. The mechanism of production has not been elucidated, but it appears to be non-cardiogenic in origin in several cases. Respiratory support with mechanical ventilation and positive end expiratory pressure may be required. There may be cranial nerve involvement in the late stages of toxicity from swallowed ethylene glycol. In particular, effects have been reported involving the seventh, eighth and ninth cranial nerves, presenting with bilateral facial paralysis, diminished hearing and dysphasia.

5. FIRE FIGHTING MEASURES**Flammable Properties**

Flash Point: 119°C (247°F)

Method Used: Setaflash

Autoignition Temperature: Autoignition temperature for ethylene glycol is 398°C (748°F).

Flammability Limits - % of vapor concentration at which product can ignite in presence of spark.

Lower Flammability Limit: 3.2%

Upper Flammability Limit: 15.3%

Hazardous Combustion Products: Hazardous combustion products may include and are not limited to carbon monoxide, carbon dioxide and trace amounts of aldehydes and organic acids. When available oxygen is limited, as in a fire or when heated to very high temperatures by a hot wire or plate, carbon monoxide and other hazardous compounds such as aldehydes might be generated.

Extinguishing Media: Water fog or fine spray. Alcohol resistant foams (ATC type) are preferred if available. General purpose synthetic foams (including AFFF) or protein foams may function, but much less effectively. Carbon dioxide. Dry chemical. Do not use direct water stream. May spread fire.

Fire Fighting Instructions: No fire and explosion hazards expected under normal storage and handling conditions (i.e. ambient temperatures). However, ethylene glycol or solutions of ethylene glycol and water can form flammable vapors with air if heated sufficiently. Keep people away. Isolate fire area and deny unnecessary entry.

Protective Equipment for Fire Fighters: Wear positive-pressure, self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire-fighting helmet, coat, pants, boots and gloves).

6. ACCIDENTAL RELEASE MEASURES

Protect People: Material is moderately toxic when ingested. Take adequate precautions to keep people, especially children away from spill site. PVC-coated rubber gloves and monogoggles or face shield can be used during cleanup of spill site. Product on surfaces can cause slippery conditions. Practice reasonable care and cleanliness. Avoid breathing spray mists if generated. Keep out of reach of children. Product may become a solid at temperatures below -18°C (0°F). Do not store near food, foodstuffs, drugs or potable water supplies.

Protect the Environment: Do not dump used product or diluted material into sewers, on the ground, or into any body of water.

Cleanup: Small spills: Soak up with absorbent material. Large spills: Dike and pump into suitable containers for disposal. Ensure compliance with all applicable statutes that require notification of appropriate government officials.



Plastic Spheres: Ethylene Glycol Antifreeze (continued)

7. HANDLING AND STORAGE

Steps to be Taken in Case Material is Released or Spilled: Eliminate all sources of ignition in vicinity of the spilled or released fluid.

Other Precautions: Use normal precautions in handling any combustible liquid. Keep container closed when not in use. Store away from heat or open flame. Product on surfaces can cause slippery conditions. Practice reasonable care and cleanliness. Avoid breathing spray mists if generated. Keep out of reach of children. Product may become a solid at temperatures below -18°C (0°F). Do not store near food, foodstuffs, drugs or potable water supplies.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Respiratory Protection: Respiratory protection is required if airborne concentration exceeds TLV. At any detectable concentration any self-contained breathing apparatus with a full face piece and operated in a pressure-demand or other positive pressure mode or any supplied-air respirator with a full face piece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

Escape: Any air-purifying full face piece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister or any appropriate escape-type self-contained breathing apparatus.

Skin Protection: Protective gloves recommended when prolonged skin contact cannot be avoided. Polyethylene; Neoprene; Nitrile; Polyvinyl alcohol; Natural Rubber, Butyl Rubber. Safety shower should be available.

Eye Protection: Safety goggles and face shield. Emergency eyewash should be available. Contact lenses should not be worn when working with this chemical.

Engineering Controls: Use general or local exhaust ventilation to meet TLV requirements.

EXPOSURE LIMITS

<u>Component</u>	<u>Exposure Limits</u>	<u>Skin Form</u>
Ethylene glycol	100 mg/m ³ CEILING ACGIH	Aerosol
Ethylene glycol	125 mg/m ³ CEILING OSHA-vacated	
	50 ppm CEILING OSHA - vacated	
	100 mg/m ³ CEILING UCC	Aerosol and Vapor
Diethylene glycol	50 ppm TWAS AIHA WEEL	Aerosol and Vapor
Diethylene glycol	10 mg/m ³ TWAS AIHA WEEL	Aerosol

In the Exposure Limits Chart above, if there is no specific qualifier (i.e., Aerosol) listed in the Form Column for a particular limit, the listed limit includes all airborne forms of the substance that can be inhaled.

A "blank" in the Skin column indicates that exposure by the cutaneous (skin) route is not a potential significant contributor to overall exposure.



Plastic Spheres: Ethylene Glycol Antifreeze (continued)

9. PHYSICAL / CHEMICAL PROPERTIES

Boiling Range:	171 - 175°C (339 - 348°F)
Freeze Point:	-18°C (0°F)
Specific Gravity (Water =1):	1.12
Pounds/Gallons:	9.3
Vapor Pressure (mm of Hg) @ 20°C:	<0.1
Vapor Density (air=1):	2.1
Water Solubility:	Complete
Evaporation Rate (BuAc = 1):	Nil
% Volatile By Volume:	97.0
Appearance:	Green
Odor:	Mild
pH (50% Water Solution):	10.5-11.0

10. STABILITY & REACTIVITY DATA

Stability:	Stable
Conditions to Avoid:	Keep away from flame
Incompatibility (Materials to Avoid):	Strong acid or oxidizing agents
Hazardous Decomposition Products:	Incomplete combustion may produce CO gas
Hazardous Polymerization:	Will not occur

11. TOXICOLOGICAL INFORMATION

Skin: The dermal LD50 has not been determined.

Ingestion: The lethal dose in humans is estimated to be 100 ml (3 ozs.). The oral LD50 for rats is in the 6000-13,000-mg/kg range.

Mutagenicity (The Effects on Genetic Material): In vitro mutagenicity studies were negative. Animal mutagenicity studies were negative.

Significant Data with Possible Relevance to Humans: Ethylene glycol has been shown to produce dose-related teratogenic effects in rats and mice when given by gavage or in drinking water at high concentrations or doses. The no-effect doses for developmental toxicity for ethylene glycol given by gavage over the period of organogenesis has been shown to be 150 mg/kg/day for the mouse and 500 mg/kg/day for the rat. Also, in a preliminary study to assess the effects of exposure of pregnant rats and made to aerosols at concentrations of 150, 1000 and 25000 mg/m³ for 6 hours a day throughout the period of organogenesis, teratogenic effects were produced at the highest concentration, but only in mice. The conditions of these latter experiments did not allow a conclusion as to whether the developmental toxicity was mediated by inhalation of aerosol percutaneous absorption of ethylene glycol from contaminated skin, or swallowing ethylene glycol as a result of grooming the wetted coat. In a further study, comparing effects from high aerosol concentration by whole-body or nose-only exposure, it was shown that nose-only exposure resulted in maternal toxicity (1000 and 25000 mg/m³) and developmental toxicity with minimal evidence of teratogenicity (2500 mg/m³). The no-effects concentration (based on maternal toxicity) was 500 mg/m³. In a further study in mice, no teratogenic effects could be produced when ethylene glycol was applied to skin of pregnant mice over the period of organogenesis. The above observations suggest that ethylene glycol is to be regarded as an animal teratogen. There is currently no available information to suggest that ethylene glycol has caused birth defects in humans. Cutaneous application of ethylene glycol is ineffective in producing developmental

PEAK Antifreeze



Plastic Spheres: Ethylene Glycol Antifreeze (continued)

toxicity. Exposure to high aerosol concentrations is only minimally effective in producing developmental toxicity. The major route for producing developmental toxicity is perorally. Two chronic feeding studies, using rats and mice, have not produced any evidence that ethylene glycol causes dose-related increases in tumor incidence or a different pattern of tumors compared with untreated controls. The absence of carcinogenic potential for ethylene glycol has been supported by numerous in vitro genotoxicity studies showing that it does not produce mutagenic or clastogenic effects.

A chronic dietary feeding study of diethylene glycol with rats showed mild kidney injury at 1%, while concentrations of 2% and 4% caused more marked kidney injury. In addition, at 2% and 4% of diethylene glycol in the diet, some rats developed benign papillary tumors in the urinary bladder. These have been attributed to the presence of urinary bladder calcium oxalate stones. No evidence for carcinogenicity was found with a chronic skin-painting study with diethylene glycol in mice. The absence of a direct chemical carcinogenic effect accords with the results in vitro genotoxicity studies that show that it does not produce mutagenic or clastogenic effects. A feeding study employing up to 5.0% diethylene glycol in the diet failed to produce any teratogenic effects. In a mouse continuous breeding study with large doses of diethylene glycol in drinking water, there was evidence for reproductive toxicity at 3.5% (equivalent to 6.1 g/kg/day) as reduced number of litter, live pups per litter and live pup weight. No such effects were seen at 1.75% (approximately 3.05 g/kg/day). The relevance of these very high dosages to human health is uncertain. Pregnant rats receiving undiluted diethylene glycol by gavage over the period of organogenesis had toxic effects at 4.0 and 8.0 ml/kg/day as mortality, decreased body weight, decreased food consumption increased water consumption and increased liver and kidney weights. Fetotoxicity was seen only at these maternally toxic dosages. Decreased fetal body weight occurred at 8.0 ml/kg/day, and increased skeletal variants at 4.0 and 8.0 ml/kg/day. No embryotoxic or teratogenic effects were seen. Neither maternal toxicity nor fetotoxicity occurred at 1.0 ml/kg/day. In a study with mice also receiving undiluted diethylene glycol over the period of organogenesis, maternal toxicity occurred at 2.5 and 10.0 ml/kg/day, but not at 0.5 ml/kg/day. Definitive developmental toxicity was not seen in this species.

ACUTE TOXICITY

Peroral: The lethal dose in humans is estimated to be 3 oz. or 100 ml.
Rat: LD50 (6000 – 13000) mg/kg

Percutaneous:
Rabbit: LD50 = >22270 mg/kg; 24 h occluded

Inhalation:
Rat: 8-hour exposure, substantially saturated vapor studies, dynamic generation method

Mortality: 0/6

Inhalation: Mist/vapor study, rat, at 170°C, 8-hour exposure = 2.2 mg/l

Mortality: 0/6

Inhalation:
Rat: 8-hour exposure, fog = 10000 ppm: 65° - 70°C

Mortality: 0/6



Plastic Spheres: Ethylene Glycol Antifreeze (continued)

IRRITATION

Skin:

Rabbit: 24-hour occluded contact, 0.5 ml
Results: Minor erythema and edema

Skin:

Human: Primary irritation patch test, 48-hour occluded, 0.2 ml
Results: Evidence of irritation

Eye:

Rabbit: 0.1 ml
Results: Minor transient iritis, conjunctival irritation with discharge

REPEATED EXPOSURE

In a 7-day dietary study with rats, a significant increase in kidney weights in females was observed at 5.0 gm/kg. The NOEL was 2.5 gm/kg.

In a 24-month dietary study with rats, increased mortality in males was observed at the highest dose, 1.0 gm/kg/day. There were multiple signs: mineralization of several organs, including the cardiac vessels, cardiac muscle, vas deferens, stomach and pulmonary vessels; cellular hyperplasia of the parathyroids; hemosiderosis of the spleen, myocardial fibrosis, portal fibrosis of the liver, bile duct hyperplasia and hydronephrosis and oxylate nephrosis of the kidneys. Ethylene glycol was not oncogenic.

In a 90-day dietary study with dogs, repeated exposures to 2.5 gm/kg resulted in acute renal failure and deaths. The NOAEL was 1.0 gm/kg.

SENSITIZATION (ANIMAL AND HUMAN STUDIES)

Repeated skin contact with ethylene glycol may, in a very small proportion of cases, cause sensitization with the development of allergic contact dermatitis. The incidence is significantly less than 1% with the undiluted material.

REPRODUCTIVE TOXICITY

A three-generation study indicated that ethylene glycol did not affect reproductive parameters at dietary concentrations up to 1.0 gm/kg/day in any generation.

CHRONIC TOXICITY AND CARCINOGENICITY

Two chronic feeding studies, using rats and mice, have not produced any evidence that ethylene glycol causes dose-related increases in tumor incidence or a different pattern of tumors compared with untreated controls. The absence of a carcinogenic potential for ethylene glycol has been supported by numerous in vitro genotoxicity studies showing that it does not produce mutagenic or clastogenic effects.

GENETIC TOXICOLOGY

In Vitro: Ethylene glycol was devoid of genotoxic activity in an Ames test, forward gene mutation and sister chromatid exchange (SCE) studies in Chinese Hamster Ovary (CHO) cells and an in vitro cytogenetics study



Plastic Spheres: Ethylene Glycol Antifreeze (continued)

In Vivo: Ethylene glycol by three different routes (intravenous, peroral and percutaneous) demonstrates apparent first-order pharmacokinetic behavior for the disposition in and the elimination from the plasma. Dose-dependent changes occur for the elimination of metabolites in the urine and as $^{14}\text{CO}_2$ after single doses for the intravenous and peroral, but not the percutaneous route. The hypothesis from literature sources exists that developmental toxicity is caused by a metabolite of ethylene glycol, called glycolic acid, and not parent ethylene glycol. Under most conditions of ethylene glycol exposure, the glycolic acid metabolite is present in the blood in very low levels. However, it can become the major metabolite following large doses of ethylene glycol due to saturation of glycolic acid oxidation and/or elimination. When levels of this acidic metabolite exceed the capacity of maternal blood buffers to neutralize it, a maternal metabolic acidosis ensues, which has been hypothesized to be the true agent responsible for ethylene glycol induced developmental toxicity. Research suggests that ethylene glycol developmental toxicity is due to a dose-rate dependent toxicokinetic shift leading to glycolate accumulation and metabolic acidosis.

ADDITIONAL STUDIES

Ethylene glycol has been shown to produce dose-related teratogenic effects in rats and mice when given by gavage or in drinking water at high concentrations or doses. The no-effect doses for developmental toxicity for ethylene glycol given by gavage over the period of organogenesis has been shown to be 150 mg/kg/day for the mouse and 500 mg/kg/day for the rat. Also, in a preliminary study to assess the effects of exposure of pregnant rats and mice to aerosols at concentrations of 150, 1000 and 2500 mg/m³ for 6 hours a day throughout the period of organogenesis, teratogenic effects were produced at the highest concentration, but only in mice. The conditions of these latter experiments did not allow a conclusion as to whether the developmental toxicity was mediated by inhalation of aerosol, percutaneous absorption of ethylene glycol from contaminated skin, or swallowing of ethylene glycol as a result of grooming the wetted coat. In a further study, comparing effects from high aerosol concentration by whole-body or nose-only exposure, it was shown that nose-only exposure resulted in maternal toxicity (1000 and 2500 mg/m³) and developmental toxicity with minimal evidence of teratogenicity (2500 mg/m³). The no-effects concentration (based on maternal toxicity) was 500 mg/m³. In a further study in mice, no teratogenic effects could be produced when ethylene glycol was applied to the skin of pregnant mice over the period of organogenesis. The above observations suggest that ethylene glycol is to be regarded as an animal teratogen. There is currently no available information to suggest that ethylene glycol has caused birth defects in humans. Cutaneous application of ethylene glycol is ineffective in producing developmental toxicity. Exposure to high aerosol concentrations is only minimally effective in producing developmental toxicity.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL FATE

Movement & Partitioning: Bioconcentration potential is low (BCF less than 100 or Log Kow less than 3). Log octanol/water partition coefficient (log Kow) is -1.36. Henry's Law Constant (H) is 6.0E-08 atm-m³/mol. Bioconcentration factor (BCF) is 10 in golden orfe.

Degradation & Transformation: Biodegradation under aerobic static laboratory conditions is high (BOD₂₀ or BOD₂₈/ThOD greater than 40%). 5-Day biochemical oxygen demand (BOD₅) is 0.78 p/p. 10-Day biochemical oxygen demand (BOD₁₀) is 1.06 p/p. 20-Day biochemical oxygen demand (BOD₂₀) is 1.15 p/p. Theoretical oxygen demand (THOD) is calculated to be 1.29 p/p. Biodegradation may occur under both aerobic and anaerobic conditions (in either the presence or absence of oxygen). Inhibitory concentration (IC₅₀) in OECD "Activated Sludge, Respiration Inhibition Test" (Guideline # 209) is < 1000 mg/L. Degradation is expected in the atmospheric environment within days to weeks.



Plastic Spheres: Ethylene Glycol Antifreeze (continued)

Ecotoxicology: Material is practically non-toxic to aquatic organisms on an acute basis (LC50 greater than 100 mg/L in most sensitive species). Acute LC50 for fathead minnow (*Pimephales promelas*) is 51000 mg/L. Acute LC50 for bluegill (*Lepomis macrochirus*) is 27549 mg/L. Acute LC50 for rainbow trout (*Oncorhynchus mykiss*) is about 18000-46000 mg/L. Acute LC50 for guppy (*Poecilia reticulata*) is 49300 mg/L. Acute LC50 for water flea (*Daphnia magna*) is 46300-51100 mg/L. Acute LC50 for the cladoceran *Ceriodaphnia dubia* is 10000-25800 mg/L. Acute LC50 for crayfish is 91430 mg/L. Acute LC50 for brine shrimp (*Artemia salina*) is 20000 mg/L. Acute LC50 for golden orfe (*Leuciscus idus*) is greater than 10000 mg/L. Acute LC50 for goldfish (*Carassius auratus*) is greater than 5000 mg/L. Growth inhibition EC50 for green alga *Selenastrum capricornutum* is 9500-13000 mg/L.

BOD (% Oxygen Consumption):

Day 5	Day 10	Day 15	Day 20	Day 30
51%	80%		97%	

ECOTOXICITY

Toxicity to Micro-organisms:

Bacterial / NA: 16 h; IC50
Result Value: >10000 mg/l

Toxicity to Aquatic Invertebrates:

Daphnia: 48 h; LC50
Result Value: >100000 mg/l

Toxicity to Fish

Fathead Minnow: 94 h; LC50
Result Value: 70000 mg/l

FURTHER INFORMATION

Chemical Oxygen Demand (COD) – Measured: 1.29 mg/mg
Theoretical Oxygen Demand (THOD) – Calculated: 1.30 mg/mg

Octanol/Water Partition Coefficient – Measured: -1.36

13. DISPOSAL CONSIDERATIONS

DO NOT discharge to sewer. Wear appropriate personal protection. Take up with sand, vermiculite, or similar inert material. Dispose in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION

Non-Bulk

Not regulated by the US D.O.T. (in quantities under 5,000 lbs in any one inner package)



Plastic Spheres: Ethylene Glycol Antifreeze (continued)

Material Safety Data Sheets

Bulk

Proper Shipping Name: Environmentally Hazardous Substance, LIQUID N.O.S. (ETHYLENE GLYCOL)
Technical Name: ETHYLENE GLYCOL
ID Number: UN 3082
Hazard Class: 9
Packing Group: PG III
Reportable Quantity: 5,000 lb.

IATA

Non-Bulk

Not Regulated by IATA

IMDG

Non-Bulk

Not regulated by IMDG (in quantities under 5,000 lbs in any one inner package)

15. REGULATORY INFORMATION

THIS PRODUCT CONTAINS COMPONENT(S) CITED ON THE FOLLOWING REGULATIONS.

	<u>Chemical Name</u>	<u>Cas Number</u>
	Ethylene Glycol	107-21-1
United States - TSCA Inventory:	Listed	
Water Standards:	No data available	
Atmospheric Standards:	Clean Air Act (1990) - List of Hazardous Air Contaminants: listed	
CERCLA:	Reportable Quantity (RQ): 5,000 pounds (532 gallons)	
OSHA Hazard Communication Standard:	This product is a "hazardous chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.	
SARA Title III:	<u>Section 311/312 - Categories:</u> Acute hazard; chronic hazard	
	<u>Section 312 - Inventory Reporting:</u> Ethylene glycol is subject to Tier I and/or Tier II annual inventory reporting.	
	<u>Section 313 - Emission Reporting:</u> Ethylene glycol is subject to Form R reporting requirements.	
	<u>Section 302 - Extremely Hazardous Substances:</u> Ethylene glycol is not listed.	



Plastic Spheres: Ethylene Glycol Antifreeze (continued)

State Right-To-Know:

California - Exposure Limits - Ceilings:	vapor-50 ppm ceiling; 125 mg/m ³ ceiling
Director's List of Hazardous Substances:	listed
Florida - Hazardous Substances List:	listed
Massachusetts - Right-to-Know List:	listed
Minnesota - Haz. Subs. List:	listed (particulate and vapor)
New Jersey - Right-to-Know List (Total):	Present greater than 1.0%
Pennsylvania Right-to-Know List:	environmental hazard

Canadian Regulations: This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required.

WHMIS Information: D2A - material has potential toxic effects. Refer elsewhere in the MSDS for specific warnings and safe handling information. Refer to the employer's workplace education program.

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986): The normal consumer use of this product does not result in exposure to chemicals known to the state of California to cause Cancer and/or reproductive harm above the significant risk level for carcinogens or the maximum allowable dose levels for reproductive toxins. Warnings are not required for consumer packaging. However, industrial or other occupational use of this product at higher frequency and using larger quantities of this product may result in exposures exceeding these levels and are labeled accordingly.

California SCAQMD Rule 443.1 (South Coast Air Quality Management District Rule 443.1, Labeling of Materials Containing Organic Solvents):

VOC: Vapor pressure 0.06 mmHg at 20°C
1113.38 g/l

16. OTHER INFORMATION

Contact: Thomas Cholke

Phone: (847) 559-2225

Old World Industries, Inc. makes no warranty, representation or guarantee as to the accuracy, sufficiency or completeness of the material set forth herein. It is the user's responsibility to determine the safety, toxicity and suitability of his own use, handling and disposal of this product. Since actual use by others is beyond our control, no warranty, expressed or implied, is made by Old World Industries, Inc. as to the effects of such use, the results to be obtained or the safety and toxicity of this product, nor does Old World Industries, Inc. assume liability arising out of the use by others of this product referred to herein. The data in this MSDS relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.



Plastic Spheres: Potassium Permanganate



Health	2
Fire	0
Reactivity	0
Personal Protection	J

Material Safety Data Sheet

Potassium permanganate MSDS

Section 1: Chemical Product and Company Identification

Product Name: Potassium permanganate	Contact Information:
Catalog Codes: SLP4912, SLP3892, SLP1075	Sciencelab.com, Inc. 14025 Smith Rd. Houston, Texas 77396
CAS#: 7722-64-7	US Sales: 1-800-901-7247 International Sales: 1-281-441-4400
RTECS: SD6475000	Order Online: ScienceLab.com
TSCA: TSCA 8(b) inventory: Potassium permanganate	CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300
Cl#: Not available.	International CHEMTREC, call: 1-703-527-3887
Synonym: Potassium Permanganate, Biotech Grade	For non-emergency assistance, call: 1-281-441-4400
Chemical Name: Potassium Permanganate	
Chemical Formula: KMnO ₄	

Section 2: Composition and Information on Ingredients

Composition:		
Name	CAS #	% by Weight
Potassium permanganate	7722-64-7	100
Toxicological Data on Ingredients: Potassium permanganate, Biotech: ORAL (LD50): Acute: 1090 mg/kg [Rat], 2157 mg/kg [Mouse].		

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator). Possibly corrosive to eyes and skin. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.



Plastic Spheres: Potassium Permanganate (continued)

The substance may be toxic to kidneys, liver, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: organic materials, metals, combustible materials

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available.

Risks of explosion of the product in presence of static discharge: Not available.

Explosive in presence of organic materials, of metals.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:

Spontaneously flammable on contact with ethylene glycol.



Plastic Spheres: Potassium Permanganate (continued)

Material Safety Data Sheets

Potassium Permanganate being conveyed through propylene tube ignited the tube.
When solid hydroxylamine is brought into contact with solid potassium permanganate, there is produced immediately a with flame.
Potassium permanganate decomposes hydrogen trisulfide so rapidly that sufficient heat is liberated to ignite the trisulfide.
When Antimony or arsenic and solid potassium permanganate are ground together, the metals ignite.

Special Remarks on Explosion Hazards:

Take care in handling as explosions may occur if it is brought in contact with organic or other readily oxidizable substances, either in solution or in dry state.
Explosive in contact with sulfuric acid or hydrogen peroxide.
Potassium permanganate + acetic acid or acetic anhydride can explode if permanganate is not kept cold.
Explosions can occur when permanganates come on contact with benzene, carbon disulfide, diethyl ether, ethyl alcohol, petroleum, or organic matter.
Contact with glycerol may produce explosion.
Crystals of potassium permanganate explode vigorously when ground with phosphorous.
A mixture of .5% potassium permanganate + ammonium nitrate explosive caused an explosion 7 hrs. later.
Addition of Potassium permanganate + dimethylformamide to give a 20% solution led to an explosion after 5 min.
During a preparation of chlorine by addition of the concentrated acid (Hydrochloric acid) to solid potassium permanganate, a sharp explosion occurred on one occasion.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:

Oxidizing material. Corrosive solid.
Stop leak if without risk. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep away from heat. Keep away from sources of ignition. Keep away from combustible material. Do not ingest. Do not breathe dust. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as organic materials, metals, acids.

Storage:

Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:

Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus



Plastic Spheres: Potassium Permanganate (continued)

should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 5

Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Odorless.

Taste: Sweetish, astringent.

Molecular Weight: 158.03 g/mole

Color: Purple, (Dark.)

pH (1% soln/water): Not available.

Boiling Point: Not available.

Melting Point: Decomposes.

Critical Temperature: Not available.

Specific Gravity: 2.7 @ 15 C (Water = 1)

Vapor Pressure: Not applicable

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, acetone.

Solubility:

Easily soluble in methanol, acetone.

Partially soluble in cold water, hot water.

Soluble in Sulfuric Acid

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances:

Highly reactive with organic materials, metals, acids.

Reactive with reducing agents, combustible materials.



Plastic Spheres: Potassium Permanganate (continued)

Corrosivity: Not available.

Special Remarks on Reactivity:

It is a powerful oxidizing agent.
Incompatible with reducing agents, acids, formaldehyde, ammonium nitrate, dimethylformamide, glycerol, combustible materials, alcohols, arsenites, bromides, iodides, charcoal, organic substances, ferrous or mercurous salts, hypophosphites, hyposulfites, sulfites, peroxides, oxalates, ethylene glycol, Manganese salts in air oxidize the toxic sulfur dioxide to more toxic sulfur trioxide.
Can react violently with most metal powders, ammonia, ammonium salts, phosphorous, many finely divided organic compounds (materials), flammable liquids, acids, sulfur.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

Acute oral toxicity (LD50): 1090 mg/kg [Rat]
Lowest Published Lethal Dose:
LDL[Woman] - Route: Oral; Dose: 100 mg/kg
LDL[Human] - Route: Oral; Dose: 143 mg/kg.

Chronic Effects on Humans:

MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.
May cause damage to the following organs: kidneys, liver, skin, central nervous system (CNS).

Other Toxic Effects on Humans:

Hazardous in case of skin contact (irritant), of eye contact (corrosive), of ingestion, of inhalation.
Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects (Male and Female fertility) based on animal data.
May affect genetic material (mutagenetic) based on animal data.

Special Remarks on other Toxic Effects on Humans:

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:



Plastic Spheres: Potassium Permanganate (continued)

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 5.1: Oxidizing material.

Identification: : Potassium permanganate UNNA: 1490 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

- Connecticut carcinogen reporting list.: Potassium permanganate
- Illinois toxic substances disclosure to employee act: Potassium permanganate
- Illinois chemical safety act: Potassium permanganate
- New York release reporting list: Potassium permanganate
- Rhode Island RTK hazardous substances: Potassium permanganate
- Pennsylvania RTK: Potassium permanganate
- Massachusetts RTK: Potassium permanganate
- Massachusetts spill list: Potassium permanganate
- New Jersey: Potassium permanganate
- New Jersey spill list: Potassium permanganate
- Louisiana spill reporting: Potassium permanganate
- California Director's list of Hazardous Substances: Potassium permanganate

Other Regulations:

- OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
- EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

- CLASS C: Oxidizing material,
- CLASS E: Corrosive solid.

DSCL (EEC):

- R8- Contact with combustible material may cause fire.
- R22- Harmful if swallowed,
- R50/53- Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
- S60- This material and its container must be disposed of as hazardous waste,
- S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: j



Plastic Spheres: Potassium Permanganate (continued)

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves.

Synthetic apron.

Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.

Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Last Updated: 11/06/2008 12:00 PM

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Appendix B Ground Ignition References

This appendix is a compilation of the references found in individual chapters and additional references.

Drip Torches

- Specification 5100-614A, Drip Torch (Diesel and Gasoline Mixture), Specification 5100-614A, Drip Torch (Diesel and Gasoline Mixture), available to Forest Service and BLM employees at <<http://fsweb.mtdc wo.fs.fed.us/programs/fire/specs.htm>>. Other agency employees can contact the MTDC ignition specialist at 406-329-3900.
- Specification 5100-616, Drip Torch-Extended Spout (Diesel and Gasoline Mixture), available to Forest Service and BLM employees at <<http://fsweb.mtdc wo.fs.fed.us/programs/fire/specs.htm>>. Other agency employees can contact the MTDC ignition specialist at 406-329-3900.
- Fire Equipment Storage and Refurbishing Standards, PMS 448, available at <<http://www.nwccg.gov/>>.

Flares and Flare Launchers

- FireQuick Flare Systems User Training Workbook, available from FireQuick Products, Inc., 855-374-3473.

Fusees

- Specification 5100-360F, Fusee, Backfiring, available to Forest Service and BLM employees at <<http://fsweb.mtdc wo.fs.fed.us/programs/fire/specs.htm>>. Other agency employees can contact the MTDC ignition specialist at 406-329-3900.

Hazardous Materials

- Emergency Response Guidebook, available at <<http://www.phmsa.dot.gov/hazmat/>>. (Search for Emergency Response Guidebook.)
- Everyday Hazmat User's Training Guide, 0471-2810-MTDC, available at <http://www.fs.fed.us/eng/everyday_hazmat/users_guide.htm>.
- Interagency Aviation Transport of Hazardous Materials guide (NFES 1068), available at <<http://amd.nbc.gov/safety/library/hazmathb0105.pdf>>.

Plastic Spheres and Sphere Launchers

- PyroShot Model FBS-1 Delayed Ground Ignition Device Launcher Operator's Manual, available at <http://helifire.com/FBS-1_Ops_Manual_7_Nov_07.pdf>.

Terra Torches

- Interagency Standards for Fire and Fire Aviation Operations, NFES 2724, available at <http://www.nifc.gov/policies/red_book.htm>.
- Firecon Terra Torch Operation Manual, available from Firecon, Inc., P.O. Box 657, Ontario, OR 97914, 541-889-8630 or firecon@fmmc.com.
- 29 CFR 1910, available at <<http://www.osha.gov>>. (Search for 29 CFR 1910.)
- Forest Service Handbook FSH 7109.19, 31.3, available at <<http://www.fs.fed.us/im/directives/fsh/7109.19/7109.19,30txt>>.
- Phos-Chek Web site at <<http://phos-chek.com>>.





Transporting Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel

- Interagency Transportation Guide for Gasoline, Mixed Gas, Drip-Torch Fuel, and Diesel, PMS 442, available at <http://www.nwcg.gov/>.

Additional Useful References

- GSA Wildland Fire Equipment Catalog, available at <http://www.gsa.gov/>. Search for “Wildland Fire Equipment Catalog.”
- National Fire Equipment System Catalog, Part 1: Fire Supplies and Equipment, PMS 449-1, available at <http://www.nwcg.gov/>.
- Interagency Prescribed Fire Planning and Implementation Procedures Guide, available at <http://www.nwcg.gov/>.



Notes



References



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Ground Ignition Subcommittee of the Equipment Technology Committee, National Wildfire Coordinating Group
2011. Interagency ground ignition guide. NWCG PMS 443. Boise, ID: National Wildfire Coordinating Group, Equipment
Technology Committee, National Interagency Fire Center. 230 p.

This guide was developed to ensure that all ground ignition operations are performed in a safe and efficient manner. Organized into 10 individual chapters and 2 appendixes, the guide includes information on: types of ground ignition devices, standards/specifications for equipment, normal and emergency operating procedures for use, qualifications for operators, job hazard analyses, and material safety data sheets for the fuels used during ignition.

Keywords: antifreeze, ATVs, blivets, diesel, fire fighting, firefighting, Firegel, Fire-Trol, FireSnakes, flares, Flash 21, fuels, fusees, gasoline, gelled fuel, Heat Source Slash Burners, launchers, material safety data sheets, MSDS, nitrogen, Petrol Jel, potassium permanganate, prescribed fires, propane, safety at work, spheres, SureFire, torches, UTVs

Interagency Ground Ignition Guide