

A publication of the
National Wildfire
Coordinating Group



NWCG Standards for Aerial Ignition

PMS 501

JANUARY 2021



NWCG Standards for Aerial Ignition

January 2021
PMS 501

The *NWCG Standards for Aerial Ignition (NSAI)* establishes the standards for approved aerial ignition operations for use by all cooperating natural resource agencies. Participating agency aviation manuals contain the authority for implementing this guide. This publication:

- Defines procedures and equipment to ensure that all aerial ignition operations are performed in a safe and efficient manner.
- Provides a framework within which areas, regions, states, and local units can provide supplemental, site-specific guidance.
- Establishes a method to evaluate and approve aerial ignition devices not currently approved and outlined in this publication.
- Supplemental documents for the *NWCG Standards for Aerial Ignition (NSAI)*, PMS 501, are separate to enable the use and editing as appropriate: <https://www.nwcg.gov/publications/501>.

The National Wildfire Coordinating Group (NWCG) provides national leadership to enable interoperable wildland fire operations among federal, state, tribal, territorial, and local partners. NWCG operations standards are interagency by design; they are developed with the intent of universal adoption by the member agencies. However, the decision to adopt and utilize them is made independently by the individual member agencies and communicated through their respective directives systems.

Contents

Chapter 1 – Introduction	1
Approved Aerial Ignition Device.....	1
Agency Manufactured or Modified Devices.....	2
Manufacturer Modifications.....	2
Aerial Ignition Device Approval Process	2
Contracted Aerial Ignition Services.....	3
Organization.....	4
Chapter 2 – Aerial Ignition Position Qualifications	5
Introduction.....	5
Qualifications.....	5
Instructor Qualifications.....	5
Position Certification	5
Additional Positions in Prescribed/Wildfire Aerial Ignition.....	6
Chapter 3 – Plastic Dispenser Operations	8
Introduction.....	8
Description.....	8
Dispenser Function	8
Safety Considerations.....	8
Advantages and Disadvantages of the PSD in Relation to the Helitorch	10
PSD System Organization.....	11
Bench Testing and Cleaning	12
Preparation for Aerial Ignition.....	12
Preflight Test Procedures.....	13
In-Flight Operations.....	14
In-Flight Procedures (Using Example of FIRB as Aerial Ignition Supervisor).....	15
Emergency Procedures for PSD.....	15
Emergency Procedures for Raindance	16
Ignition Operations.....	16
Additional Information.....	16
PSD Installation Procedures (General)	17
PSD Installation Procedures for Specific Helicopter Types	17
Raindance Installation Procedures for Specific Helicopter Types.....	19
Transportation and Safety Data Sheets (SDS).....	19
Chapter 4 – Helitorch Operations	20
Introduction.....	20
Description.....	20
Function	20
Advantages and Disadvantages of the Helitorch in Relation to PSD	20
Personnel Responsibilities	21
Helitorch Mixing/Loading Area.....	24
Fuel Preparation	26
Bench Testing the Helitorch	29
Helitorch Installation to Aircraft.....	30
Testing Helitorch with Helicopter.....	31
Filling Helitorch from Mixing Unit	32

Prior to Each Takeoff (Final Check).....	32
Cleaning and Maintenance of Helitorch and Related Equipment.....	33
Helitorch Maintenance.....	33
General Mixing System Maintenance.....	33
Drum and Associated Hardware Maintenance.....	34
Vapor Hose Maintenance.....	34
Helitorch and Mix Transfer System Required Modifications and Approved Equipment Inspection Checklists.....	34
Barrel Helitorch Assembly and Setup.....	35
Chapter 5 – Unmanned Aircraft Systems (UAS) Aerial Ignition.....	39
UAS Aerial Ignition Qualifications.....	39
UAS Aerial Ignition Operations.....	39
UAS Aerial Ignition Equipment Review and Approval Process.....	41
Chapter 6 – Reference Materials.....	42
Safety Data Sheets (SDS).....	42
Aerial Ignition Equipment Modifications.....	43
Bonding Procedures.....	43

Chapter 1 – Introduction

Approved Aerial Ignition Device

All aerial ignition devices must meet Occupational Safety and Health Administration (OSHA) regulations, Department of Transportation (DOT) requirements, and National Fire Protection Association (NFPA) standards as well as the required safety modifications outlined in [Chapter 6](#) and Appendix C (<https://www.nwcg.gov/publications/501>).

The following are the only aerial ignition devices currently approved for interagency use by all cooperating natural resource agencies. Devices must be updated with current retrofits (reference [Chapter 6 – Reference Materials](#)). Interagency Aerial Ignition Unit (IAIU) recommends contacting an agency representative prior to equipment purchase:

Plastic Sphere Dispenser (PSD)

- Premo Mark III Aerial Ignition Device
- SEI Red Dragon
- Aerostat PSDS Mark V – new purchases of Aerostat PSDS Mark V equipment are not authorized
- Raindance R3 Aerial Incendiary Device
- Drone Amplified Ignis Version 2 – see [Chapter 5](#)

Helitorches and Mix Systems

- Simplex Helitorch Model 5400 and Batch Mixer
- Fire Spec Systems: Spec 2000 Helitorch and Spec 2000 Modular Mix Transfer System
- New purchases of Fire Spec equipment are not authorized
- Isolair Helitorch
- Firecon Batchmixer and Portable Mix Transfer System (Now GelFire Systems)
- Western Helicopter Helitorch (Barrel Helitorch)
- Northern (Canadian) Helitorch (Barrel Helitorch)
- T&T Helitorch (Barrel Helitorch) – new purchases of T&T equipment are not authorized
- US Forest Service Helitorch M-2015 – contact National Technology and Development Program (NTDP) for engineering specifications

Agency/bureau or vendor Mixing and Torch Systems that are in compliance with [Chapter 6 – Reference Materials](#) and Appendix C (<https://www.nwcg.gov/publications/501>) criteria, and that have been inspected and approved by a representative of the IAIU may be used. Some aerial ignition devices and procedures are still in use that can only be utilized by a specific agency.

The following aerial ignition device is only approved for specific bureaus/agencies use (non-interagency) for burning operations conducted by qualified personnel of the agency approving their use:

- California Division of Forestry (CalFire) Helitorch.

Agency Manufactured or Modified Devices

Any modifications to equipment must be approved by the IAIU. If agency personnel modify a commercially obtained device or construct their own device, the agency assumes liability for the product. See [Chapter 6 – Reference Materials](#) for current approved modifications.

Manufacturer Modifications

Periodically, manufacturers of aerial ignition equipment modify or upgrade their equipment. As an example, Simplex has made several revisions of their helitorch and accessory equipment. Modifications made by the original manufacturer may require special authorization from an agency to be installed. Bureaus and agencies are not required to install new modifications unless the agency or manufacturer requires installation of the modification for safe operation of the device. All manufacturer modifications shall be accompanied by revised operating procedures if applicable.

For approved current aerial ignition components and modifications, reference [Chapter 6 – Reference Materials](#).

Aerial Ignition Device Approval Process

An agency/bureau may wish to evaluate an aerial ignition system not covered in the *NWCG Standards for Aerial Ignition (NSAI)*, PMS 501. While all natural resource agencies are strongly encouraged to use the devices and procedures approved in this guide, the following guidelines shall be used for new proposed aerial ignition system approval:

- 1) The sponsoring unit must request, in writing, permission to evaluate the unapproved system. The written request shall be submitted through appropriate channels to their regional/state Aviation Manager.
 - a) The written request must include a project proposal, with risk assessment, which describes the user needs and justification for use of an unapproved system.
 - b) A written manufacturer operational manual must be submitted with the request package describing operating procedures, training plan, and a risk assessment.
- 2) The agency/bureau Aviation Manager shall submit the proposal to the IAIU through their representative to the group. The IAIU will then forward the proposal to the Aerial Ignition Technical Advisors at NTDP and arrange for technical review and evaluation.
 - a) If live burn operations are required as part of the evaluation, the sponsor shall submit an approved agency specific aviation plan: Project Aviation Safety Plan (PASP) or Mission Aviation Safety Plan (MASP). Provide necessary personnel that possess the aerial ignition qualifications listed in *Federal Wildland Fire Qualifications Supplement*, <https://iqcsweb.nwcg.gov/>.
- 3) After the technical review, the IAIU will submit a letter of recommendation to the Interagency Helicopter Operations Steering Committee (IHOPs) Chair. The IHOPs will forward a letter to all agencies/bureaus regarding decision of new equipment. The IAIU Chair will formally notify vendor of IHOPs decision.

Contracted Aerial Ignition Services

In the vast majority of cases, prescribed fire on government lands is conducted under the operational control of the government agency responsible for managing the public lands within their trust. In Department of Interior (DOI), all commercial aircraft services must be procured through Office of Aviation Services (OAS) Acquisition Services Directorate (AQD). It is very rare for end product contracts to be used for prescribed burns, these requirements do not apply to end product contracts.

Some geographic areas have private vendors who own and operate aerial ignition devices. When an agency opts to use aviation contract services providing aerial ignition personnel and/or equipment, the following guidelines shall be observed.

- 1) The contractor shall comply with all applicable federal, state, local laws, and the *NSAI*.
- 2) Contractors who wish to obtain approval for use of an aerial ignition system that is not listed in Chapter 1, Agency Manufactured or Modified Devices and will be used only by contract personnel shall:
 - a) Submit a request through a sponsor to the appropriate agency/bureau IAIU representative.
 - b) Make the equipment available to the IAIU for a technical review and evaluation.
 - c) Make arrangements through the IAIU for flight testing of the equipment with NTDP.
 - d) Ensure that only contract personnel operate the equipment when used for contract operations.
 - e) Ensure the approved equipment is included as a listed item on the contract.
 - f) Develop and provide a risk assessment with the vendor's proposal.
- 3) The user 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 aerial ignition services and that the equipment has been approved. The Helicopter Manager (HMGB) will assure that contracted aerial ignition services will be conducted in accordance with the procurement document.
 - a) The requesting unit will provide information to assist the contractor in planning for equipment, personnel, supply needs, location of burn, and burn objectives. This information will include approximate acreage (overall/acres per day), times and dates of proposed burn, location and directions to the burn area, supplies and equipment to be provided by the agency, agency contact names and phone numbers, and local support equipment sources and phone numbers (bulk fuel providers, motels, etc.).
 - b) The government will provide at the jobsite: pad marker(s), wind indicator(s), crash rescue kit, evacuation kit, and 40BC fire extinguisher(s) (as per the *NWCG Standards for Helicopter Operations (NSHO)*, PMS 510, <https://www.nwcg.gov/publications/510>).
 - c) A government Helitorch Manager (HTMG) is a required position and will be provided by the ordering agency unit, and be on-site, for all contract helitorch operations to perform functions listed in the *NSAI*.
 - d) The contractor shall have a written standard operating plan (SOP) outlining duties and responsibilities for contractor personnel, equipment, and mixing/operating procedures for contractor operations. The SOP and a copy of contractor employee qualifications and training documentation shall be made available for review by the government HTMG upon arrival to the jobsite and prior to the start of contract work.

- e) The HTMG will inform the contractor helitorch mixing crew of gel fuel needs, in gallons, throughout the duration of the burn.
 - f) Gelled fuel deemed unacceptable by the Burn Boss or HTMG and any residual waste product shall be disposed of at an approved hazardous waste disposal site or, with the HTMG and Burn Boss approval, by incineration within the burn area.
- 4) Any deviation from established standard operating procedures or policy requires authorization by the regional Aviation Officer or state Aviation Manager.
 - 5) The user unit must submit a written PASP or MASP to the appropriate region, state, or agency Aviation Manager in compliance with agency policy.

Organization

The chapters of the *NSAI* are used to identify the approved aerial ignition devices and best practice procedures. The appendices provide the user with operational and administrative forms, checklists, equipment modifications, and job aids.

Chapter 2 – Aerial Ignition Position Qualifications

Introduction

This chapter identifies the position prerequisites and qualifications for individuals involved in aerial ignition operations. To meet the minimum qualifications, individuals must be trained, experienced, certified for specific aerial ignition device, and current with that aerial ignition system. Position requirements apply to both incident and prescribed fire operations.

Qualifications

To be qualified in an aerial ignition position, individuals must be current with all applicable *Federal Wildland Fire Qualifications Supplement* requirements and meet all the prerequisite training and experience standards, <https://iqcsweb.nwcg.gov/>.

Instructor Qualifications

- 1) HTMG lead instructor must be qualified and current as HTMG on specific aerial ignition device and HMGB.
- 2) Plastic Sphere Dispenser Operator (PLDO) lead instructor must be qualified and current as PLDO on specific aerial ignition device and HMGB (or previously qualified as or less currency as HMGB).
- 3) Instructors must be approved by regional Helicopter Operations Specialist or state/regional Aviation Manager.

Position Certification

In the USDA-Forest Service, certification is the responsibility of the Forest Incident Qualification Certification System (IQCS) committee. For DOI bureaus, certification is accomplished through bureau/agency authority in accordance with individual agency policy.

Course leader should have the training documented per agency requirements. Contact a USDA-FS or OAS training specialist for specific information.

Initial Training:

Training for helitorch and PSD operations will utilize IAIU approved lesson plans. The approved PSD and helitorch lesson plans are available on the NWCG website at:

<https://www.nwcg.gov/committees/interagency-aerial-ignition-unit/resources>.

Initial Training Will Cover:

- 1) Organization and communication requirements.
- 2) Special safety procedures and concerns, including emergencies.
- 3) Hazardous materials shipping, storage, handling procedures, and requirements for.
- 4) Equipment testing, bench test, troubleshooting, and maintenance.
- 5) Briefing and checklist requirements.
- 6) Manufacturer manual for each device.

Additional Training:

- 1) Additional model specific training is required on devices not covered in initial training.
- 2) This training will be documented on Aerial Ignition Device Additional Training form, found in Appendix A and B (<https://www.nwcg.gov/publications/501>).
- 3) This can be done in the field, on a wildland or prescribed fire.

Certification:

- 1) A Position Task Book (PTB) must be completed and documented in IQCS or Incident Qualifications System (IQS).
- 2) The Firing Boss (FIRB) or assigned aerial ignition supervisor may also serve as the PLDO trainer, if qualified as PLDO.

Currency Requirements:

Each member of a helitorch module or PLDO must perform in the position at least once every three years in accordance with *Federal Wildland Fire Qualifications Supplement*, <https://iqcsweb.nwcg.gov/>.

Recertification:

If currency is not maintained, a recertification and trainee assignment must be completed in order to recertify in IQCS/IQS. A refresher may be used in the recertification process along with a trainee assignment.

Refresher:

An annual refresher shall be attended to update personnel with any policy equipment, or aviation changes. The format and the length of time of the refresher shall be determined by aviation management staff. Instructors must meet qualifications in Chapter 2, [Instructor Qualifications](#), of this document.

- 1) The annual refresher shall, at a minimum, consist of review of previous aerial ignition device and life support equipment issues through SAFENETs/SAFECOMS, equipment changes, policy changes, and updates to the NSAI.
- 2) RT-9012, Helitorch Manager Refresher and RT-9016, PSD refresher will be used to document refresher training in IQCS/IQS.

Additional Positions in Prescribed/Wildfire Aerial Ignition

Aerial Ignition Oversight and Supervision: Aerial ignition operations must be overseen by an appropriately qualified supervisor. For prescribed fire operations, only a FIRB, a Type 1 Burn Boss (RXB1) or Type 2 Burn Boss (RXB2) may direct aerial ignition operations. For a wildfire, a FIRB, RXB1, RXB2, Division Supervisor (DIVS), or Operations Section Chief (OSC) may direct aerial ignition operations.

Throughout the rest of this publication, the supervisor of the aerial ignition operations will be referred to simply as the “aerial ignition supervisor.”

- 1) Supervision – The PLDO, HTMG or Unmanned Aircraft Systems (UAS), Module Leader (UASL) works directly for the aerial ignition supervisor.
- 2) Qualifications – See *NWCG Standards for Wildland Fire Position Qualifications*, PMS 310-1, <https://www.nwcg.gov/publications/310-1>, and FSH 5109.17 for specific requirements.

- 3) Duties and responsibilities – Has complete authority for and directs the firing operation, develops firing plan(s), performs the initial briefing from the firing plan, covers the assignments of each boss/supervisor and pilot. Instructs the pilot on the firing sequences and keeps the pilot informed throughout the entire operation. For PSD operations, may be in a helicopter with the PLDO, in another aircraft, or at some other vantage point. For helitorch operations, may be in another aircraft, or at some other vantage point.
 - a. Additional recommended training for FIRB to includes attendance at aerial ignition initial Helitorch / PLDO training. DOI agency specific recommended training consist of A-310 CRM (Crew Resource Management). USFS agency specific recommended training S-270 Basic Air Operations and CRM 7 Skill Training and Qualified or previously qualified as HECM.
 - b. Other recommended FIRB skillsets include: Aircraft Radio Operations.

Note: “Aerial ignition supervisor” as used in this guide does not refer to a particular NWCG position, rather it is a generic term used to describe any of a number of NWCG positions that directs aerial ignition operations which may include any of the following qualified NWCG positions – FIRB, Type 1 Burn Boss (RXB1), Type 2 Burn Boss (RXB2), DIVS, or OSC.

Pilot:

The pilot works directly for the HMGB in conjunction with the aerial ignition supervisor. The *Interagency Helicopter Pilot Practical Test Standards* describes qualification standards for aerial ignition and can be found at: <https://www.doi.gov/aviation/library>.

Mission Prerequisites – Both the pilot and aircraft must be carded for the intended mission and qualified for fire suppression operations. The pilot shall be fire shelter training current and qualified. Before operations commence, the following will be briefed:

- 1) operational objectives,
- 2) burn boundaries, contingency lines, fire behavior, avoid areas, and hazards,
- 3) problems encountered with steep hillsides and the relation of convective and radiant heat,
- 4) safety and risk management plans,
- 5) ground and flight communication and procedures,
- 6) set up of flight patterns according to relative winds, terrain and smoke management,
- 7) helicopter emergencies and emergency landing sites,
- 8) helicopter doors-off limitations and/or any other configuration limitations,
- 9) altitude and airspeed considerations,
- 10) loss of tail rotor effectiveness and power settling avoidance, especially in low airspeed downwind turns,
- 11) avoidance and risk management regarding the avoid area of the height-velocity envelope,
- 12) reserve power/airspeed in the event of an emergency,
- 13) equipment emergencies, malfunctions and inadequate mixing indicators, and
- 14) fire suppression and dip site contingency plans.

Chapter 3 – Plastic Dispenser Operations

Introduction

The machines were developed to provide a method of igniting ground fuels, in a short time, on large acreage, without causing undue damage to the over story. This method was required to be cost effective, environmentally acceptable, and readily available.

Description

The spheres/capsules are made of plastic and contain a specific amount of potassium permanganate. The rate of chemical reaction is dependent on the particle size and concentration of the chemicals involved. Refer to specific manufacturer's recommendations for glycol usage. It provides a reliable ignition and a time delay.

Dispenser Function

The dispenser injects glycol into the plastic sphere/capsule, initiating an exothermic reaction, and then expels the primed sphere/capsule from the aircraft. The machine can be regulated to control the number of spheres/capsules being dispensed, establishing ignition patterns on the ground. Power to the dispenser is supplied by the aircraft's 24-volt electrical system. For additional information refer to the appropriate manufacturer's manual.

Safety Considerations

Some helicopter missions are high risk and policy requires that risks shall be mitigated to As Low As Reasonably Practical (ALARP). To obtain ALARP, continued risk mitigation must be conducted by emphasizing thorough pilot/crew briefings, by developing Crew Resource Management (CRM) and by communicating ALARP during pilot carding. Altitude, airspeed, and aircraft performance and limitations should be emphasized during training and operations for all low-level helicopter missions.

The helicopter profile used is at the discretion of the pilot and crew based on mission requirements. Nevertheless, it is highly recommended that the pilot and crew reduce their time in a low altitude environment (below 500 feet), "Slow" forward flight (less than 40 knots), and/or "Hovering Out of Ground Effect" (HOGE) profile. Pilots shall consider escape routes and have the ability to avoid additional risk potential in these flight profiles. Pilots should be prompted utilizing CRM to exit/avoid high risk Loss of Tail Rotor, Power Settling, and Height and Velocity (H/V) concerns when it is not necessary to be exposed. The crew remains explicitly empowered to manage and/or decline the remainder of the flight or the mission. It is important to note that aircraft with a "Height/Velocity diagram" located in the performance section is predicated on an engine failure over a level, hard surface that is clear of any obstacles. This chart is not intended to provide information over forested, uneven, soft surfaces, or otherwise unprepared landing sites.

Performance planning and weight and balance shall be accurately performed.

Consideration should be given to increasing the weight reduction beyond that of policy and/or contractual standards to provide excess power available in order to reduce susceptibility to power settling and loss of tail rotor effectiveness.

Reference Forest Service Aviation Accident Prevention Bulletin 16-01:

- 1) Aerial ignition operations may require helicopter flight below 500 feet above ground level (AGL) and less than 50 mph. Exposure to low airspeed, loss of tail rotor effectiveness, power

settling, and HOGE is typical of a flight profile. The pilot must keep altitude, airspeed, wind direction, and aircraft capabilities and limitations in mind during all phases of flight operations. Thorough briefings prior to operations are required.

- 2) All aerial ignition devices must have a means to jettison the flammable components in an emergency situation (i.e., the Hopper, capsule bag).
- 3) The glycol tank must be filled and tightly capped at least 25 feet away from the aircraft.
- 4) Absolutely no batteries will be carried in the cabin to power the PSD. The PSD must be powered through the aircraft's electrical system.
- 5) Provide crash rescue and evacuation equipment at helibase/helispot (reference *NSHO*).
- 6) A fire extinguisher (reference *NSHO*, Chapter 9) will be available on-site.
- 7) Extra supplies of glycol will not be carried in the cabin during burning operations.
- 8) Do not use other containers that cannot be secured inside the helicopter, i.e., Zip-Loc bags, tubs, trash cans, cardboard containers, plastic bags as sphere/capsule bags.
- 9) A metal container, and at least five gallons of water, will be available during testing for containment of plastic spheres/capsules.
- 10) Ignition lag time is recommended not to be less than 20 seconds.
- 11) CAUTION: An inadequate quantity of ethylene-glycol injected into the plastic sphere can induce a violent reaction that can cause the sphere to spin or roll and spray a hot mixture of potassium permanganate and glycol a considerable distance.
- 12) During ignition operations, adjust the aircraft speed and altitude according to existing conditions.
- 13) Do not disassemble ANY PSD components during flight.
- 14) Potassium permanganate is a strong oxidizer; it should be stored in a cool, dry place, and must be kept completely separate from glycol. While in transit spheres/capsules and glycol must be located in separate compartments to eliminate the possibility of inadvertent ignition.
- 15) The area to be ignited must be clear of people and equipment.
- 16) The terminology surrounding fall protection systems may seem complex, but it is important to understand the basic systems and terms to choose the fall protection solution best suited for operational mission needs. For example, the terms "fall arrest" and "fall restraint" may at first glance seem indistinguishable. Both fall under the rubric of "fall protection," but there are important distinctions.

The main difference between arrest and restraint is an "arrest" occurs after a person free falls through space. In other words, the system stops a worker's fall that has already occurred, preventing impact at a lower level.

In a fall restraint system, however, the worker is restrained from reaching a fall hazard. In such cases, the fall restraint would typically be provided by a fixed-length lanyard and a body harness or body belt. The lanyard acts as a leash, preventing the worker from reaching the leading edge.

The primary restraint is considered the seat belt and must be worn at all times. The secondary restraint device may consist of either an approved full body harness or gunners strap. The PLDO shall wear an approved restraint, tether, and carabiner in the aircraft and must be attached to an approved hard point during firing. The harness or gunner strap, and tether must be adjusted to

prevent the operator from extending past the plane of the door sill of the aircraft. Additional guidance can be found in the *Interagency Aviation Life Support Equipment (ALSE)*, https://www.doi.gov/sites/doi.gov/files/uploads/interagency_alse_handbook_v2.8.pdf Handbook/Guide, under Aircrew Member Secondary Restraint System. In addition to *ALSE* standards, the following are required:

- a) Carabiners shall meet requirements as described in the Interagency *ALSE* Handbook/Guide.
- b) Daily inspection of harness, gunner strap, tether, tether attachment, and carabiner shall be done. Harness, gunner strap, tether and tether attachment shall have a date stamp and will have a life cycle of 10 years after the manufacture date.

Having both feet out the door at the same time is prohibited.

17) Fire shelters for government employees during PSD operations shall be secured and accessible within the aircraft cabin. Fire shelters are not to be located in areas which would reduce the crash extenuation of any aircraft component, or restrict the ingress or egress of passengers.

Advantages and Disadvantages of the PSD in Relation to the Helitorch

Advantages:

- Logistically less complicated--plastic spheres can be safely and easily transported in bulk quantity to the burn site.
- Separate helibase is not required for PSD setup and operation.
- Essentially a self-contained operation.
- PLDO and possibly one assistant are the only personnel required.
- Safety and hazardous material handling procedures are less complicated than those for the helitorch.
- Requires little setup time apart from installation of PSD machine in helicopter.
- PLDO is able to immediately assess and/or address minor problems without returning to helipad.
- Equipment costs less than helitorch unit.
- Operator can see how many spheres/capsules are left in the dispenser and can approximate how much ignition time is left before having to return to helipad.
- Possible to lay very long-ignition lines and larger acreage with one fuel cycle.
- Less cost in support staff, setup, and demobilization time than helitorches.
- Minimum damage to tree canopy resulting from ignition procedures. Understory Burning – Plastic sphere dispensed ignition may be used in any stand that can be burned by conventional methods. The plastic sphere ignition system is an excellent tool for hazard fuel reduction in pine plantations. This system is safe, efficient, and economical and users can burn with less risk to the plantation than by using the helitorch.
- Narrow burning windows can be better utilized due to shorter setup time.
- Aerial ignition supervisor can be on board during ignition sequences. Command and control can more easily be maintained.

- Burning is possible in less accessible areas, reducing hazards to ground personnel. Burns where, due to size, poor access, safety considerations, etc., use of PSD may result in a lower cost per acre.

Disadvantages:

- Plastic spheres burn for a shorter time on the ground than do gelled fuels.
- Even a dense drop pattern of plastic spheres cannot duplicate the characteristics of the helitorch drop pattern.
- Firelines take longer to form and interact with each other.
- The pilot cannot jettison the dispenser.
- The PLDO must **manually** jettison the dispensers in the event of an emergency.
- Possibility of fires developing in the dispenser.

PSD System Organization

See the organization charts in Appendix A (<https://www.nwcg.gov/publications/501>) for required positions to be filled for both prescribed and wildland fire aerial ignition.

PLDO

Position Responsibilities:

- Serves as PLDO for the aerial ignition supervisor. PLDO may have collateral duties as the HMGB.
- Briefs pilot and identifies safety requirements at the operations briefing,
- Monitors overall operation and provides information on aerial safety procedures to be used by the aerial ignition supervisor.
- Prepares, installs, operates, maintains, and cares for the PSD.
- Verifies for the aerial ignition supervisor that prescribed spacing of ignition is occurring and makes the necessary adjustments as directed.
- Determines if malfunction occurs and acts accordingly.
- Communicates with the pilot and aerial ignition supervisor on all procedures associated with operation and/or emergencies occurring during the operation.

Helicopter Manager

Position Responsibilities– Duties and responsibilities are outlined in *NSHO*. HMGB may have collateral duties as the PLDO or FIRB.

Pilot

Position Responsibility– The pilot will follow the ignition plan under the direction of the aerial ignition supervisor. The pilot-in-Command is responsible for all matters related to aircraft operations and safety, weight and balance and performance planning, PSD installation oversight, and helicopter load calculation.

Helibase/Helispot Support

As needed, reference Appendix A (<https://www.nwcg.gov/publications/501>), Organization Chart

- a) Helibase/Helispot Fire Protection. (reference *NSHO*, Chapter 9)
 - i. At a minimum, one fire extinguisher and five gallons of water will be positioned at the helibase/helispot.
 - ii. Provide crash rescue and evacuation equipment at helibase/helispot.
- b) Radio Operator.
 - i. Will be positioned at the helibase/helispot.
 - ii. Will initiate radio communications with Burn Boss and dispatch.
- c) Helibase/Helispot Manager (HECM) – Depending on operational complexity, a Helibase Manager (HEBM) may be advisable in addition to the required HMGB.

Bench Testing and Cleaning

Bench tests should be performed prior to actual burn.

- 1) Review manufacturers manual and procedures for bench testing.
 - a) Bench testing shall occur in an appropriate safe area.
 - b) Place metal container under chute/tube without water.
 - c) Water in the container has been known to increase the chance of spheres to launch out of the container.
 - d) Temperature and humidity may affect ignition delay, causing delays to be greater than 20 seconds. Colder temperatures will cause longer ignitions, often as long as 40 to 60 seconds. This is an appropriate ignition timeframe if all spheres are igniting.
 - e) Calibration instructions are contained in manufacturer's manual, if applicable.
 - f) Promote priming of the machine prior to adding spheres/capsules for testing purposes.
- 2) Cleaning should follow the bench test in accordance with manufacturer's specifications.

Preparation for Aerial Ignition

Preparation of Helicopter

- 1) Remove appropriate door/doors or open and pin sliding door.
- 2) Remove all loose cushions and other loose materials.
- 3) Locate and assure proper electrical connections.
- 4) Utilize approved aircraft anchor or install tether attachments to hard points per instructions on MTDC-993 drawing, found in the current *ALSE Handbook/Guide*, https://www.doi.gov/sites/doi.gov/files/uploads/interagency_alse_handbook_v2.8.pdf.
- 5) Install secondary restraint using approved carabiner and adjust tether length. A properly adjusted tether shall insure that the operator is restrained inside the aircraft if the seat belt should become unbuckled during flight.

Preparation of Aerial Ignition Device

- 1) Fill glycol tank at least 25 feet from aircraft.
- 2) Fill emergency water tank.
- 3) Ensure adequate supply of spheres/capsules are available to complete project.
- 4) Ensure one-gallon container of water and seatbelt cutter is on board, secured, and are readily accessible.
- 5) Fire shelters for each occupant must be secured in the cabin of the aircraft and in a singular identified location.

Common Installation Procedures

The dispensing devices are designed to be operated from the right rear of a Bell 206 series Jet/Long Ranger/407 helicopter but can be used in most helicopter makes and models.

- 1) Install in doorway with exit chute/tube attached and overhanging.
- 2) Attach tie-down strap.
 - a) Y-end attached to PSD beside exit chute, fasten from the inside out.
 - b) Connect and tighten the belly hold-down strap ensuring it is secured and does not interfere with any external fittings, wiring, or release cables.
 - c) All helicopters may use belly strap or approved model specific hard points, all other methods of securing the device must be approved by an aviation maintenance inspector.
 - d) Return through the opposite door.
 - e) Fasten to buckle attached to machine.
 - f) Cinch tight and secure loose ends.
- 3) Connect power supply cord.
- 4) For PSD operations, perform electrical power check by turning on drive switch and hopper feed switch. Manual assist must rotate in direction of arrow. For the Raindance system, perform electrical power check by turning on the ensuring the carousel turns counterclockwise.
- 5) Recheck the installation.
- 6) Ensure a seat belt cutter is available and accessible to the PLDO.
- 7) A visual check of PLDO and equipment shall be performed by another member of the crew.

Preflight Test Procedures

Sphere/capsule ignition delay time need not be checked in the preflight test if bench test has been performed.

CAUTION: Do not conduct this test near refueling area or in flashy ground fuels.

Test Procedures Are as Follows:

- 1) Place metal container under the exit chute/tube.
- 2) Connect power leads.

- 3) Power on – A/C.
- 4) Start up the dispenser.
- 5) For PSD, deposit one sphere in a slipper block/shuttle block to track calibration.
- 6) Once the sphere/capsule has dropped into the metal container, remove it from the vicinity of the aircraft.
- 7) Time ignition delay by measuring time of injection to ignition.
- 8) Repeat as necessary.
- 9) Check system for leaks.
- 10) Test PSD emergency water system.
- 11) Secure machine and equipment.
- 12) For PSD, fill hopper with spheres.
- 13) Check intercom communications and air-to-ground communications.

Pre-mission briefing discussing the risk assessment and mitigations that includes the *ALSE* Handbook/Guide, emergency procedures, HOGE power required, weight and balance, etc.

Prior to any burn mission, the HMGB must brief all personnel involved as to the nature of the mission and its objectives, through the use of PASP or MASP. The information should include environmental concerns such as weather and fire behavior if known, individual responsibilities, incident specific information such as location (e.g., division assignment), radio frequencies, name of communication center, and any other incident specific information. Prior to any burn operation, the pilot and manager will identify any performance limitations for the aircraft and determine excess performance required for the mission. Consideration should be given to increasing the weight reduction beyond that of policy and/or contractual weight reduction standards to reduce susceptibility to loss of tail rotor effectiveness and power settling. Performance should be planned so that the mission is performed within the maximum continuous of the helicopter.

Weight and balance (W&B) calculations will be performed for standard burn configurations and emergency scenarios prior to the commencement of burn operations. The purpose is to ensure the center of gravity (CG) will remain within limits.

In-Flight Operations

Dry Run over Burn Area Procedures

Before starting burn operations, a HOGE power check is accomplished at an altitude comparable to the burn area or greater. A positive rate of climb must be established without exceeding aircraft limitations. The pilot is responsible to ensure sufficient power is available by performing a hover-out-of-ground 24 (HOGE) power check prior to any landing site approach/departure. Refer to the Interagency Aviation Tech Bulletin (IATB) 17-01 25, https://www.doi.gov/sites/doi.gov/files/uploads/iatb_2017-01.pdf.

- 1) Check ignition area is clear of personnel.
- 2) Identify burn area boundaries.
- 3) Ensure communication with ground personnel.
- 4) Make practice run of the first firing sequence.

- 5) Coordinate machine speed and sphere/capsule spacing to be used on first run with FIRB.
- 6) Identify helispots and emergency landing areas.
- 7) After a dry run and prior to aerial firing the crew will evaluate the risk assessment mitigations and readjust as necessary (this does not require formal documentation). The aerial ignition supervisor will confirm that all ground personnel are clear of the area and that firing may commence.

In-Flight Procedures (Using Example of FIRB as Aerial Ignition Supervisor)

FIRB Communicates to PLDO, “Prepare to Fire; Activate Machine.”

- 1) Operator actions:
 - a) Activate machine
 - b) PLDO communicates to FIRB, “Ready to fire.”
- 2) FIRB communicates to PLDO to “Start firing/number of chutes or machine speed.”
- 3) PLDO replies, “Firing/Number of chutes or machine speed.”
- 4) Operator monitors machine operation and refills as needed. Operator observes spheres/capsules after they have made contact with the ground to confirm ignition.
- 5) When appropriate, FIRB communicates, “Prepare to stop firing.”
- 6) PLDO places hand on controls and communicates, “Ready to stop.”
- 7) FIRB gives the order, “Stop firing.”
- 8) Operator closes chutes on PSD or presses stop button on Raindance and responds, “Firing stopped.”
- 9) Operator observes last sphere/capsule clear of the device and relays, “machine cleared.”
- 10) FIRB gives order to PLDO to “secure machine” or “prepare to fire.”
- 11) Operator gives appropriate response.
- 12) Conduct a post mission debriefing that includes a review and update of hazards and risk mitigations.

Emergency Procedures for PSD

Operator Notifies Pilot of Problem and Gives Brief Description.

- 1) Pilot maintains aircraft flight in burn area until emergency is resolved.
- 2) Operator closes chute feed handles.
- 3) If problem is a jammed machine, operator pulls manual assist wheel outward and rotates forward then backward. If obstruction clears, turn on drive motor, check circuit breaker, and notify Pilot and FIRB before resuming operations.
- 4) If a fire starts, operator activates emergency water system for up to 30 seconds. If necessary, uses additional container of water to extinguish fire by pouring down feed chutes in hopper. If a problem persists, land as soon as possible.

- 5) Notify pilot of problem status and take appropriate actions.

Emergency Procedures for Raindance

Operator Notifies Pilot of Problem and Gives Brief Description.

- 1) Pilot maintains aircraft flight in burn area until emergency is resolved.
- 2) Operator presses the stop button on the remote pendant.
- 3) Press the glycol shutdown button.
- 4) Press the unload button until the capsules are fully retracted.
- 5) Return master power switch to the off position.
- 6) Activate the fire pump until fire is extinguished, if needed.
- 7) Have the pilot land to evaluate if there is any damage. Clean and clear the machine.

Ignition Operations

The aerial ignition supervisor gives the location where spheres are to be placed in the burn area. This should be made clear during the dry run before any firing begins. It is important that all parties (aerial ignition supervisor/pilot and PLDO) understand where the firing is to be performed. This includes starting points, ending points, and desired placement, and spacing.

During ignition operations, adjust the aircraft speed and altitude according to existing conditions. The pilot and aerial ignition supervisor must keep altitude, airspeed, wind direction, and aircraft capabilities and limitations in mind during all phases of flight operations. Thorough briefings prior to operations are required.

The aerial ignition supervisor gives direction to the pilot once the firing run has begun and during the dry run to assure correct placement of the injected spheres.

Occupants of the helicopter shall be limited to essential personnel. Additional occupants may include instructor or trainees if essential to the mission.

The switches on the PSD are not required to be turned off when the PSD helicopter stays within the burn area boundary or crosses a fire control line with the intent of returning for another live firing run. The operator's right hand must remain on the feed control levers in the closed position. If leaving the burn area the machine will be completely shut off and deactivated.

Power requirements are based on manufacturers' recommendations.

Additional Information

- Reference for Premo Mark III: <https://www.sei-ind.com/products/premo-fire-ignition/>
- Reference for Aerostat Mark V: <http://www.aerostatinc.com/index.asp>
- Reference for Raindance Systems R3: <http://www.raindancesystems.com.au/r3/>

All information listed below can be found in manufacturer's manuals.

- Ignition spacing.
- Maintenance and service.

- Troubleshooting PSDs.
- Equipment specifications.
- Tool kits.

PSD Installation Procedures (General)

Installation of the PSD will be specific to individual helicopter models. Model specific [procedures](#) are outlined later in Chapter 3. Consult the manufacturer installation procedures for those helicopters not listed in this guide.

All helicopters may use belly strap or approved model specific hard points. If not using manufacturer's belly strap systems, all other methods of securing the PSD device must be approved by an aviation maintenance inspector.

The Following Applies to All PSD Installations:

- 1) The PLDO must read the operator's manual before installation.
- 2) The PLDO and the pilot must read the limitations section of the flight manual and be familiar with the limitation of flight with the door(s) removed.
- 3) Helicopters shall be equipped with a power source for PSD.
- 4) A MS 3112E-12 3S, 3-pin connector shall be provided. Pin B shall be airframe ground. Pin A shall be +28 Volts D.C. for a 28-volt aircraft system. Pin C shall be +14 for a 14-volt aircraft system. The circuit shall be protected by a 5-amp circuit breaker. The mating connector for the government-furnished PSD shall be an MS 3116E-12-3P wired with the same pin assignments. Reference a wiring diagram in the aircraft procurement document.
- 5) Unit weights can be found in manufacturer specifications.
- 6) The mounting area must be cleaned, which includes vacuuming if there is powder from broken spheres and cleaning any glycol that may have spilled on the floor from previous installation. All carpet and porous floor coverings must be removed.
- 7) A one-gallon container of water and a seat belt cutter must be carried on board and be secured and readily accessible to the PLDO.
- 8) Fire shelters for each occupant must be secured in the cabin of the aircraft and in a singular identified location.

PSD Installation Procedures for Specific Helicopter Types

Listed below are installation procedures for some common aircraft utilized for PSD operations. Any helicopter may be utilized if it is carded and agency approved for PSD operations. Alternative mounting and securing procedures not identified in this section shall be approved prior to use at regional/state level. Refer to aircraft flight manual for door removal and limitations. Adapter plate and chute extension may be used but are not required.

Aircraft with a Doorsill such as: Bell 206 and 407 Series Helicopters

- 1) Remove right rear door of helicopter.
- 2) Use duct tape or other means to protect the paint finish around the right rear doorsill (consult with pilot/vendor before doing this).

- 3) Place the PSD mainframe over the doorsill and connect the Y-end buckles of the hold-down strap to the slots in the mainframe. Do not tighten the hold-down strap.
- 4) Install exit chute. Tighten and lock nuts.
- 5) Install hopper on the mainframe and make electrical hookup between units.
- 6) Slide the assembled PSD as far forward as possible to provide legroom between machine and rear seat. Some helicopters have a cabin fire extinguisher mounted on the rear of the pilot's seat and it may interfere with the opening of the hopper lid. The machine must be slid far enough aft to allow the hopper lid to open, ensure there is enough room for access to the PSD control panel.
- 7) Connect and tighten the belly hold-down strap making sure the strap is secure and does not interfere with any external fittings, wiring, or release cables.
- 8) Make sure the PSD switches are in the OFF position and connect the power supply plug from the helicopter to the PSD.
- 9) Turn the PSD on and watch the rotation of the hand wheel. Rotation in the direction of the arrow indicates correct polarity. To change the direction of rotation, reverse the plug wiring on the PSD (black wire is positive, and the white wire grounds the chassis).
- 10) Proceed with ignition timing tests, briefings, etc.
- 11) Manufacturers' safety precautions must be adhered to during operation of the PSD.

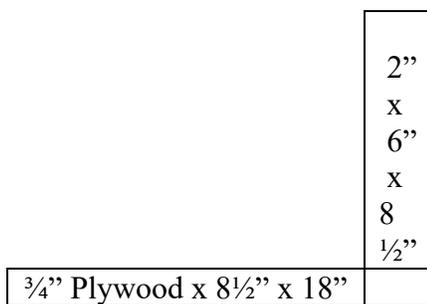
Flat or Level Cabin Floors such as: Hughes/MD 500 Series, AS-350, and UH-1H Helicopters

- 1) An extension may need to be added to the hold-down strap when using this type of helicopter (AS-350, UH-1H). The extension must be added to the short buckle portion that is attached to the PSD. The smooth, flat portion of the hold-down strap must pass through the doorframe without hanging up.
- 2) An approved, hard point secured, attachment system may be used for all aircraft.
- 3) An adapter board may need to be constructed to mount the PSD in flat or level cabin floor helicopters (see Figure 3.1).
- 4) Remove or slide open and lock the right rear door of helicopter.
- 5) Use duct tape or other means to protect the paint finish around the right rear doorsill (consult with pilot).
- 6) Place the adapter on the floor and the PSD mainframe on the adapter and connect the Y-end clips of the hold-down strap to the slots in the mainframe. Do not tighten the hold-down strap.
- 7) Install exit chute. Tighten and lock nuts.
- 8) Install the hopper on the mainframe and make electrical hookup between the two units.
- 9) Slide the assembled PSD as far forward as possible to provide legroom between machine and rear seat. The fire extinguisher may need to be removed from its holder and secured on the floor, or the machine must be slid far enough aft to allow the hopper lid to open. Either option must ensure enough room for access to the PSD control panel on the side of the mainframe.
- 10) Connect and tighten the belly hold-down strap or approved, hard point secured, attachment system ensuring it is secured and does not interfere with any external fittings, wiring, or release cables.

- 11) Make sure the PSD switches are in the OFF position and connect the power supply plug from the helicopter to the PSD.
- 12) A metal container shall be placed under the exit chute at this time to catch any spheres that may be triggered from the PSD during the polarity check.
- 13) Turn the PSD on and watch the rotation of the wheel. Rotation in the direction of the arrow indicates correct polarity. To change the direction of rotation, reverse the plug wiring on the PSD (black wire is positive and the white wire grounds the chassis).
- 14) Proceed with ignition timing tests, briefings, etc.
- 15) Manufacturer's safety precautions must be adhered to during operation of the PSD.

Adapter plate example: construction is of 1/8-inch welded aluminum or on a 3/4-inch plywood base.

Figure 3.1: Adapter Plate



Raindance Installation Procedures for Specific Helicopter Types

See manufacturer manual.

Transportation and Safety Data Sheets (SDS)

See manufacture documentation and [Safety Data Sheets \(SDS\)](#) in Chapter 6.

Manufacturer states that the spheres have an indefinite shelf life; they have tested spheres that have been in storage for 20 years with favorable results. The main environmental effects that can cause problems are humidity, extreme temperature variations, and exposure to ultraviolet light. Discoloration of the sphere is a sign of exposure to moisture, which causes the potassium permanganate to cling to the sides. This does not necessarily mean that the spheres won't function properly. Old spheres that are brittle may still be ok for use. Anticipate a dirty machine. The more brittle the spheres become the more apt the machine is to jam. Poor ignition of spheres is generally caused by over injection of glycol. Bench testing prior to use will give indications of sphere condition (brittleness).

The manufacture recommends following local hazardous materials protocol for disposal of spheres. There is not a manufacture sponsored recycling program for spheres.

STORAGE PROCEDURES: Follow manufacturer's recommendations or local agency/bureau procedures.

Chapter 4 – Helitorch Operations

Introduction

The helitorch is a gelled fuel aerial ignition device that is attached to a helicopter's external cargo hook. The ignition and fuel feed are controlled by the pilot through a simple electrical connector on the belly of the helicopter, usually the water bucket plug. The complete system is jettisonable by the pilot in case of emergency.

Description

Adding fuel-thickening compounds to raw fuel reduces the volatility and is therefore more manageable for dispersal. This increases the safety of handling the fuel, improves its drop characteristics, puts more fuel onto the ground (rather than burning off in the air), and increases residual burning time allowing the aircraft to be flown higher and faster than some other aerial ignition systems.

Function

This aerial ignition device is a tool used in backfiring and burnout operations for wildfires and is also a mainstay to the prescribed fire arena for reduction of hazard fuels. It is a very effective tool but must be used by very skilled, qualified pilots, and trained qualified field personnel for a safe operation.

Advantages and Disadvantages of the Helitorch in Relation to PSD

Advantages

- Sites where burn areas have sparse or patchy fuel distribution and high fuel moisture content, the pattern of fire laid down by the torch can provide a greater chance of ignition and, under some conditions, reduce emissions.
- Convection column can be developed quicker, increasing control over the fire.
- Thickened fuel provides a longer residual burning time on the ground.
- Helitorch has the potential of laying a more continuous line of fire. The type of fire pattern laid by the torch and the fuel's residual burning time on the ground can aid in developing a continuous line of fire and achieving better consumption.
- Helitorch can be easily jettisoned by the pilot in the event of an emergency.
- Helitorch can be more effective under marginal weather, site, or fuel conditions.
- Burning is possible in less accessible areas, reducing hazards to ground personnel. Where wildland fire burnout is the best option for safety and control, the helitorch can expedite the operation without compromising personnel safety.
- More acres can be burned in less time.
- Emissions may be reduced due to widening of prescription window.
- Can ignite more than one fuel layer. Can be more effective in the ignition of aerial fuels, such as standing timber, blow down, and/or poorly compacted fuels.

Advantages When Using Barrel Helitorches

- The small size of the torch allows it to be transported to remote areas inside any medium and most light helicopters.
- No need to transport large amounts of mixing equipment and supplies.
- Requires a smaller ground crew to mix gel, operate, and maintain.

Disadvantages

- The use of gasoline is hazardous since it is highly flammable in its un-gelled state.
- There is substantial resource outlay: three- to five-person crew, with one or two vehicle and/or trailer units for most burning operations.
- Crew requires extensive training and a commitment to the program for the duration of the burning season.
- Bulk fuel and chemicals must be hauled to the site; the DOT and OSHA requirements must be known, understood, and complied with.
- Costs can be significant.
- Helicopter must return frequently to refill with gel.
- Operation requires considerable planning and setup time to organize the mixing/loading site and helipad.
- Rigorous safety procedures must be followed. Hazardous material removal and storage may be a problem.
- It is easier to establish a convection column because of helitorch mass ignition; it is as easy to lose control of the column with a break in ignition.
- Helitorch does not lend itself to under-burning operation. The burning fuel globules can ignite tree crowns.
- Commercial driver's license (CDL) with hazardous materials endorsement maybe required for transportation of mixing equipment.
- Requires special pilot and ground crew techniques in order to operate effectively.

Personnel Responsibilities

See the organization charts in Appendix B (<https://www.nwcg.gov/publications/501>) for required positions to be filled for both prescribed and wildland fire aerial ignition.

Helitorch Manager (HTMG)

- 1) Supervises and monitors the overall helitorch operations on the helibase.
- 2) Supervises all helitorch/helibase operation and assigns qualified personnel to positions and identifies trainees.
- 3) Ensures Aerial Ignition PASP or MASP and checklists are completed, approved, posted, and followed.

- 4) Maintains Helitorch Maintenance Log and ensures proper cleanup of equipment prior to storage (reference maintenance in Appendix B, <https://www.nwcg.gov/publications/501>).
- 5) Provides technical assistance to aerial ignition supervisor on helibase location and operation.
- 6) Ensures all required equipment is on-site and operational.
- 7) Ensures communications link between helitorch base/helibase, dispatch, aerial ignition supervisor, and designated personnel is operational.
- 8) Conducts briefing and provides technical advice and information to involved parties.
- 9) Conducts and documents a risk assessment. Identifies hazards and safety requirements at operations briefing.
- 10) Ensures safety precautions have been completed prior to mixing.
- 11) Fire shelters for each occupant must be secured in the cabin of the aircraft and in a singular identified location.

Helicopter Manager (HMGB)

Duties and responsibilities are outlined in the *NSHO*. On operations utilizing only one helitorch helicopter, the HMGB may have collateral duties as the HTMG or Helitorch Parking Tender (HTPT).

Helitorch Mixmaster (HTMM)

- 1) Reports to the HTMG.
- 2) Attends helibase briefings.
- 3) Supervises mixing/filling operation, manages time frames to maintain availability of gel, assuring bonding procedures are followed.
- 4) Determines quantities of fuel, gelling agent, etc., needed and manages time frames between mixing systems.
- 5) Oversees hookup of helitorch to helicopter and preflight tests of helitorch with pilot.
- 6) Supervises the helitorch fire protection organization.
- 7) Places equipment and ensures it is operational; conducts drills prior to operations to ensure mixing and filling operations are coordinated between all personnel.
- 8) Performs maintenance and cleaning of all helitorch equipment.

Helitorch Parking Tender (HTPT)

- 1) Reports to the HTMG.
- 2) Attends briefings.
- 3) Directs all movements of personnel and equipment around the helicopter.
- 4) Checks hookup of helitorch to helicopter; accomplishes checkout procedures.
- 5) Must have a radio equipped with headset and hardhat or *ALSE* approved flight helmet with a remote transmit switch during takeoffs and landings during helitorch operations at the landing pad.

- 6) Has fire protection/crash rescue responsibility for the primary helitorch helipad (ensures fire extinguisher is staffed during all fueling, reloading/filling operations, and during takeoffs and landings).
- 7) Ensures electrical switches are “on” prior to takeoff and “off” after landing and inspects discharge valve, propane pressure, camlock, drum hardware, and suspension cables prior to takeoff.
- 8) Ensures all personnel/equipment are clear of safety circle during takeoff/landing.
- 9) Maintains communications with helicopter while within the area of helitorch base, turns communication over to aerial ignition supervisor when helicopter departs helitorch base area.
- 10) If the cables become tangled over the helicopter’s skids, UNDER NO CIRCUMSTANCES will any individual walk underneath the hovering helicopter to untangle the lines. The parking tender must direct the pilot to place the helitorch on the ground and release it before re-hooking.

Helitorch Mixing Personnel (Optional)

- 1) Report to HTMM.
- 2) Perform any other miscellaneous tasks during helitorch operation.

Aircraft Base Radio Operator (Optional)

- 1) Reports to HTMG.
- 2) Attends helibase briefings.
- 3) Receives orders from aerial ignition supervisor and relays to HTMG.
- 4) Maintains communication with appropriate aircraft.
- 5) Provides communication between HTMG, HTPT, pilot, aerial ignition supervisor, and dispatch and/or operations.
- 6) Maintains a flight-following log.

Pilot

Pilot is responsible for all helicopter operations and flight safety.

- 1) Must be carded for helitorch operations and fire suppression activities.
- 2) Attends helibase briefing.
- 3) Understands helitorch commands. Communicates and coordinates with aerial ignition supervisor and HTPT.
- 4) Has been briefed on helitorch operation and installation procedures.
- 5) Maintains appropriate airspeed and elevation above the ground while staying within the burn area.
- 6) Maintains reserve power/airspeed in the event of an emergency.
- 7) Discuss how winds and topography may affect flight patterns with aerial ignition supervisor.
- 8) Must be fire shelter trained and current.

- 9) Avoids slip-turns, which could result in erratic helitorch movements that may throw burning fuel across fire lines or cause inconsistent drop patterns.
- 10) Understands that helitorch must be turned off an adequate distance inside the boundary of the burn to avoid dropping ignited gel outside the desired burn area.
- 11) Understands that residual gel may continue to drip and ignite after the pilot has stopped ignition. The pilot must ensure that the flame on the gel nozzle is extinguished before leaving the burn area. Persistent flame can be extinguished by increasing airspeed.
- 12) Whenever possible, keeps the pilot's side of the helicopter toward the previously ignited area. This way the pilot can monitor heat buildup from the ignited burn area and avoid possible heat damage to the helicopter from extreme temperatures.
- 13) Sufficient altitude must be maintained.
- 14) Maintains a safe departure path from the burn at all times in case of erratic fire behavior.
- 15) Slowly descends until the helitorch contacts the ground. Helitorch should be in front of the aircraft upon landing.
- 16) Follows emergency procedures in helicopter flight manual. Jettison helitorch by electrical or manual release if necessary. Avoids flying over personnel, vehicles, or congested areas.
- 17) Removes pilot's door prior to burning operations unless the aircraft is equipped with a bubble door.
- 18) Removes external cargo racks if necessary, to provide a better view of the helitorch.
- 19) Checks the electrical and manual cargo hook releases prior to operation.
- 20) Ensures the helitorch tip clears the ground before forward flight.
- 21) Ensures that sufficient reserve power is available to hover and maneuver the helitorch.
- 22) Does not check for helitorch ignition unless over the burn area or other designated test area.
- 23) Takes off into the wind, allowing sufficient clearance over obstacles.
- 24) Maintains airspeed within limits for adequate controllability of the helicopter and the helitorch combination.
- 25) Monitors aircraft limitations when operating in burn areas, as flying through preheated air may result in erratic engine performance.
- 26) Completes load calculations and ensures that HOGE-J is available. Consideration may be given to weight reduction.

Additional Aerial Ignition Positions (Wildland or Prescribed Fire) May Be Added Depending Upon Complexity of Operation.

Based on the complexity of the operation, additional fire protection capabilities may be necessary. Additional aviation supervision may be necessary for complex operations.

Helitorch Mixing/Loading Area

CAUTION: All handheld electronic devices such as radios, pagers, cell phones, satellite phones, etc. shall be turned off within 50' of any fuel preparations/vapor removal area. This prohibition will be emphasized as part of each daily briefing and each risk assessment. Warning signs should be posted.

Safety

- 1) The location and layout of the fuel mixing and helitorch loading site is critical to reducing the risk of accidents with flammable materials, helicopter, and mixing/loading personnel. The fuel mixing/loading area is used for the purpose of blending fuel and gelling agent, exchanging drums on helitorches, or refilling drums from the mixing units.
- 2) The helitorch base should be separated from the primary helibase and other helicopter operations. No smoking is permitted within the mixing/loading area. Precautions must be taken to eliminate sources of ignition where fuel vapors may be present.
- 3) Each helipad requires a fire extinguisher, per *NSHO*, Chapter 9.
- 4) Fire Protection for helitorch operations must have one of the following (in addition to the fire extinguisher per pad, required per *NSHO*, Chapter 9) :
 - a) A minimum of four extinguishers.
 - b) Two 3-gallon compressed air foam system extinguishers capable of using Class B foam.
 - c) Staffed 30-gallon Class B foam capable system.
 - d) Staffed engine with Class B foam on-site.

Emergency Procedures per OSHA 1910.38

“Emergency escape route, meeting point, emergency shutdown of operations, procedures to account for all employees, rescue and medical duties, means of reporting fires, and emergencies should be covered. The alarm system to be utilized for employee notification should be outlined.”

Elements of an Emergency Contingency Plan:

- 1) Establish and follow approved Crash Rescue Plan located in the PASP or MASP.
- 2) Establish and maintain a communication link to dispatch/Incident Command Post (ICP).
- 3) Establish emergency contact procedure via radio notification.
- 4) Establish escape routes and an emergency meeting point where personnel could congregate to identify everyone for accountability.
- 5) Identify and brief helitorch operations, suppression, fire protection, and first aid personnel.

Location

The helitorch mixing/loading area should meet the following criteria:

- 1) The helitorch site should be large enough to accommodate and provide a safe working distance between all the required pieces of equipment.
- 2) The site should have an established takeoff and landing corridor that has no equipment placed within that zone.
- 3) A safety circle shall be maintained around the landing pad.
- 4) There should be an alternate loading area in case the mixing/loading site becomes unusable.
- 5) The site should be located in close proximity to the burn site to minimize turnaround times.
- 6) Choose a site that will not be impacted by the smoke column or embers from the burn.

- 7) Consider the prevailing and forecasted wind direction. Keep location upwind of the burn.
- 8) Helicopter flight paths must not pass over any personnel, structures, or areas of human occupancy. When over-flights of traveled roads occur, traffic control must be mitigated.
- 9) The helitorch operation site should be reserved for authorized personnel only.
- 10) Establish alternate landing areas.
- 11) During wildland incidents, helitorch base operations should be separated from the primary helibase.
- 12) Choose a site that has no, or a minimal, need for dust abatement.
- 13) Mixing equipment must be located outside the helicopter safety circle.

Fuel Preparation

For all fuel preparation activities, refer to [Chapter 6 – Reference Materials](#).

Safety

- 1) The HTMG must be aware of the procedures for safe storage, handling, and mixing of fuel according to agency or bureau policies.
- 2) The mixing area should be large enough to accommodate and provide a safe working distance between all required equipment.
- 3) Nonferrous mixing equipment must be used and all bonding procedures must be followed.
- 4) Ensure precautions are exercised to eliminate direct exposure of skin to gelling agent or fuel.
- 5) When dispensing or handling powdered gelling agent, if dust masks are provided for voluntary use (as defined by OSHA in 29 CFR 1910.134 <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.134>), ensure the following:
 - a) An N-95 dust mask is supplied.
 - b) Prevent contamination of N-95 dust masks by storing in a chemical and dust free sealed container to ensure their use does not present a health hazard.
 - c) Wearing the N-95 dust mask does not interfere with employees' ability to work safely.
 - d) Instruct employees that the N-95 masks are for one-time use and a new one should be used each day.
 - e) Supply, and ensure each employee reads a copy of, Appendix D of 29 CFR 1910.134, which instructs employees on N-95 dust mask limitations such as warning them that wearing a dust mask does not protect them from organic vapors.
 - f) For employees using respirators, refer to Appendix D of OSHA regulation, Sec. 1910.134.
- 6) If gelled fuel is spilled, burning of the gelled fuel on-site is the preferred method of clean up if possible.
- 7) Consult with local Safety Officer prior to performing cleaning or maintenance on the interior of batch or modular mixers or the cleaning up of spills to determine the appropriate respiratory protection and other personal protective equipment (PPE).

- 8) Personal protective equipment: Personnel must be equipped with eye protection, hardhat, fire resistant clothing labeled as non-static or 100 percent cotton (clothing must be labeled with Nomex IIIA or 2% Carbon Core or 3% Conductive Fiber), and Nitrile Chemical Resistant gloves. Testing performed at the University of Alberta has shown clothing consisting of these fabrics to have better anti-static properties than cotton.
- 9) “NO SMOKING” and “NO CELL PHONES OR RADIO” signs conspicuously posted around mixing area, to include all vapor removal outlets.

When Not Required to Wear a Respirator Under the OSHA 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 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 wearer. 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 an employer provides respirators for voluntary use, or if individuals own their respirator, the individual needs to take certain precautions to be sure that the respirator itself does not present a hazard.

Personnel should do the following:

- 1) Read and follow all instructions provided by the manufacturer on use, maintenance, clean, care, and warnings regarding the respirators limitations.
- 2) Choose respirators certified for use to protect against the contaminant of concern. The National Institute for Occupational Safety (NIOSH) 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 what the respirator is designed for and how much it will protect a person.
- 3) Do not wear a respirator into atmospheres containing contaminants for which the respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect 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. Reference 63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998.

Hazards

- 1) Gasoline vapors are a depressant to the nervous system and a known carcinogen; prolonged and direct exposure to these vapors must be avoided.
- 2) Personnel should 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.
- 3) Dust created in fuel mixing should be avoided. Mixing can only take place when all personnel involved in the operation are adequately trained and equipped.
- 4) Hazards to the mixing personnel include vapors and flammability of gasoline, skin contact with fuel, and dust from the gelling agent. Review Chapter 6, [Safety Data Sheets \(SDS\)](#).

Handling Gelling Agent and Fuel

- 1) Bulk transportation of fuel is recommended whenever possible using a fuel truck with its own pumping system.
- 2) When bulk fuel transportation is unavailable, a portable refueling system may be used that complies with requirements in Chapter 6.
- 3) The powdered gelling agent must be kept dry.
- 4) All gelling agents shall be disposed of in accordance with applicable state and federal regulations.
- 5) DOT requirements are outlined in Chapter 6.
- 6) Only gelling agents with a current SDS are approved for use. Current approved brand names for thickeners are: Firetrol Firegel (also known as Sure Fire), Firetrol Petro Gel, Flash 21, and Halliburton MO85 and MO86.
- 7) Portable eyewash station required on-site OSHA 1910.151 and 1926.5 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. The American National Standards Institute (ANSI) defines 15-minute continuous flow.

Mixing Procedures

- 1) Correct mixing is essential and clean fuel results in the best gelling and ignition. The optimum fuel temperature for gelling is 21°C or 70°F. Colder fuel takes longer to gel and requires more gelling agent for a proper mix.
- 2) Cleanliness of fuel, gelling agent, and equipment must be ensured. It is desirable to set up the mixing area well ahead of the desired ignition time to ensure all components of the setup are operational.
- 3) HTMG checks to ensure all personnel are properly equipped and that all safety gear is in place.
- 4) HTMM ensures all mixing systems, helitorches, and bulk fuel sources are properly bonded. Reference Chapter 6.
- 5) All drums and associated equipment must be clean.
- 6) Mix-crew attaches the bonding cable and fuel nozzle to the mixing unit and adds fuel.
- 7) After fueling, the HTMM adds the measured amount of gelling agent to the mixing unit while the fuel is being agitated. Gelling agent must be added slowly or improper gelling may occur.
- 8) Mixing of fuel and gelling agent continues until required amounts have been added (reference manufacture's mixing guidelines). Agitation continues until complete mixing has occurred and the mixture shows signs of gelling (waxy surface and thickening).
- 9) The HTMM determines if the gel is of the desired consistency.
- 10) Powdered gelling agent added to partially gelled fuel will not totally dissolve and may cause lumping.
- 11) Ensure proper gel consistency before pumping to helitorch. Gel color may vary with different grades and brands of fuel. Gelling quality may be affected by additives such as ethanol and detergents.

- 12) The use of liquid gelling agents will have different procedures, follow manufacturer's instructions.
- 13) No plastics of any kind shall be used in the powdered gel mixing operations. All dispensing equipment must be made of metal capable of being bonded. Do not pour powder gelling agent directly from the bag into the drum/tank (NFPA 77, 8-11).
- 14) Fuel that has been gelled with powder should not be mixed unless its use is likely. This mix, which has been gelled for more than 2 hours, will begin to lose viscosity and may cause flaring during use.

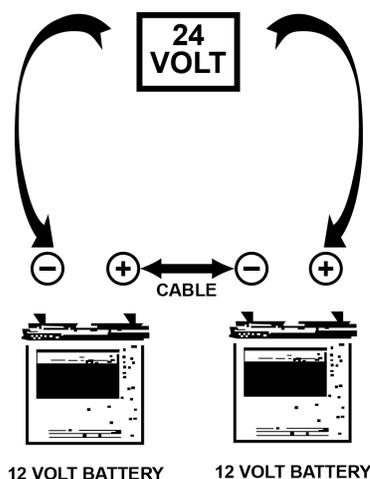
Bench Testing the Helitorch

Helitorches will be kept clean and maintained to avoid operational delays. Once the helitorch has been cleaned and reassembled, it can be tested for serviceability on the ground. A fire extinguisher (per *NSHO*, Chapter 9) must be readily available for use by a trained person during helitorch testing procedure. The helitorch will not be loaded with jelled fuel for bench testing.

Bench Test Steps

- 1) Connect two 12-volt batteries in series to produce 24 volts. See Figure 4.1 or utilize power converter.
- 2) Ensure that both pumps and ignition switches are in the off position. Attach the power cord to the battery and the 9-pin plug to the helitorch.
- 3) With the ignition switch on and the pump switch off, check to see that the igniter is producing a spark.
- 4) With the pump switch on and the igniter switch off, check to see that the motor and pump operate normally and the pulley rotates in the proper direction, clockwise when viewed from the control switch side of the helitorch.
- 5) Turn both switches off and disconnect the plug from the battery adapter cord.
- 6) Check all nuts, bolts, and connectors for tightness and serviceability.

Figure 4.1: Batteries in Series to Produce 24 Volts



BATTERIES IN SERIES TO PRODUCE 24 VOLTS

Helitorch Installation to Aircraft

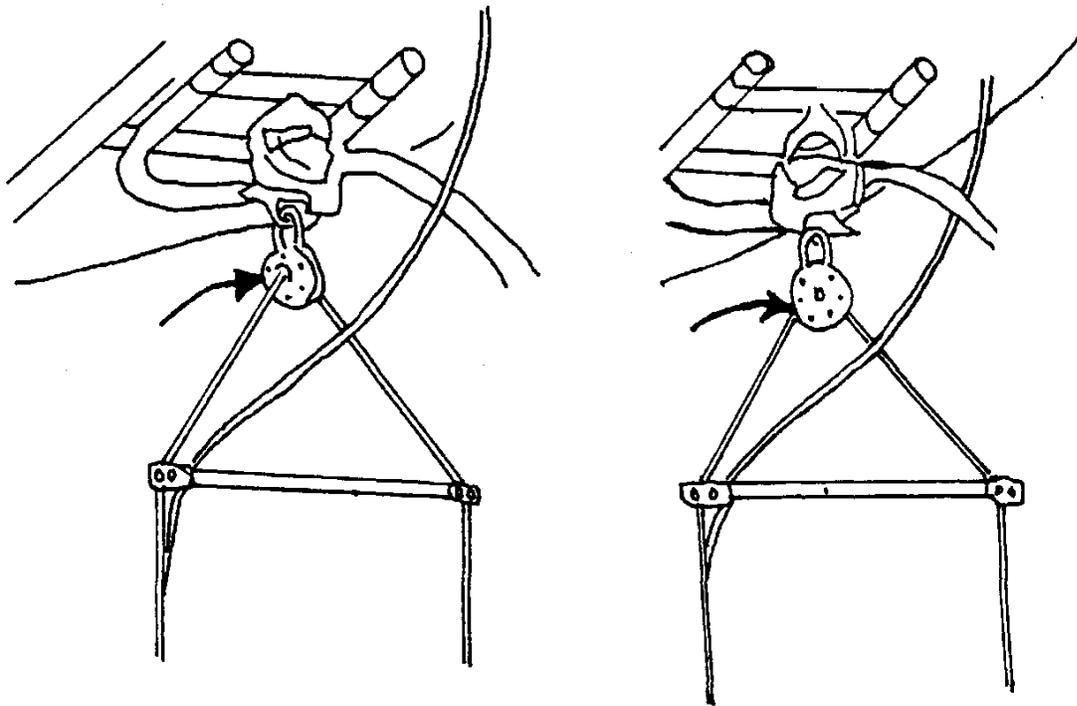
- 1) Have the pilot door removed.
- 2) Ensure that the suspension cables are correctly installed to the helitorch (See Figure 4.2). Inspect cables and connectors for security.
- 3) Place the helitorch on the ground in front of the helicopter with the nozzle end to the pilot's side of the aircraft and make sure the switches are off. Ensure lines are not over or under landing gear.

Figure 4.2: Location of Attachment Points of Single Point Cable Assembly



- 4) Ensure that the pear link adapter is correctly configured for the cargo hook on the helicopter. (See Figure 4.3) Make sure that the cables are between the skids and will not become entangled during takeoff. Attach the pear link to the cargo hook. At this time conduct a safety check of the cargo hook, both manual, and electrical releases. After insuring that both switches are in the off position, secure the electrical cannon plug to the plug on the helicopter.
- 5) Due to the length of the cables, care must be taken when landing medium helicopters.
- 6) For use with medium helicopters, ensure hook is secured/pinned to trolley so the helitorch is not able to rotate or discharge static electricity that may arc by touching the side of the trolley.

Figure 4.3: Laterally Oriented Cargo Hook and Longitudinally Oriented Cargo Hook



LATERALLY ORIENTED CARGO HOOK

LONGITUDINALLY ORIENTED CARGO HOOK

(NOTE THE CABLE ATTACHMENT LOCATIONS ON THE PEARLINK)

- 7) Before testing helitorch with the helicopter, disconnect pear link from the aircraft cargo hook. Failure to follow this procedure can result in damage to the helicopter wiring if polarity is incorrect.
- 8) The helitorch suspension system shall be hooked directly to the helicopter cargo hook. Tag/Lead lines or longlines are prohibited.

Testing Helitorch with Helicopter

After the helitorch has been bench tested, it shall be tested with the helicopter while both are on the ground. At this point it is essential that you have conducted a pre-operational briefing with the pilot and crew. This briefing must include communications, any identified hazards, and associated mitigations, aircraft performance, and emergency procedures. Ensure the desired nozzle tip is installed on the helitorch, that there are no cables over the skids, and have a fire extinguisher staffed with a trained person.

Ignition Test

- 1) Disconnect pear link.
- 2) Ensure the pump switch is off and turn the ignitor switch on.
- 3) Have pilot activate the helitorch control switch to test for proper ignition.
- 4) Have pilot release helitorch control switch and turn ignitor switch off.
- 5) Allow tip to cool prior to pump test.

Pump Test

- 1) Check dry-break connection and open hose valve.
- 2) Ensure ignition switch is off and turn pump switch on.
- 3) Have pilot activate the helitorch control switch after having placed fuel catch vessel under fuel nozzle. Gelled fuel should flow through the nozzle tip. At this time all lines should be bled to insure fuel flow. If you hear the motor turning and no fuel flows, check for clogging, vapor lock, or polarity reversal. If the polarity is reversed, simply reverse the input wires or use a “backward wired pigtail.” When polarity is correct, reconnect pear link to the aircraft cargo hook.
- 4) Check that the positive shutoff valve does not allow fuel to leak from the nozzle and that it operates freely.
- 5) Make sure both switches are off.
- 6) The torch is ready for operation.

Filling Helitorch from Mixing Unit

- 1) Ensure all mixing systems, helitorches, and bulk fuel sources are properly bonded. Reference Chapter 6, [Bonding Procedures](#).
- 2) The helicopter returns with an empty drum. The HTPT directs the helicopter to its landing position.
- 3) Once the helicopter is on the ground, the pilot signals to the HTMM or designee to approach.
- 4) The HTMM or designee turns the switches off. HTMM or designee now connects the vapor recovery and filler hoses on the helitorch drums. The HTMM or designee signals to the mixing plant to pump gel. When the drum is full, the HTMM or designee signals to shut off the mixing plant pump. Then the HTMM or designee closes the valve, removes fuel and vapor hoses, turns the switches on, and exits. After fueling is complete, change propane bottle if applicable and test ignition.
- 5) The HTPT performs visual final checks that ensures switches are on, cables are correct, dry-break handle is in the open position, check the propane gauge, and nozzle tip is clean. The HTPT then exits.

Prior to Each Takeoff (Final Check)

- 1) Ensure that the pear link adapter is correctly configured for the cargo hook on the helicopter and attached to the cargo hook. Check helitorch structural integrity.
- 2) Igniter is clean.

- 3) Helitorch and suspension system is positioned in front of the helicopter with the nozzle end toward the pilot's side of the aircraft.
- 4) The HTMM or HTPT will inform the pilot prior to activating switches. Activate pump and ignition switches and exit the area toward the HTPT.
- 5) At no time should there be anyone underneath or in close proximity of the helicopter with the helitorch attached while in flight.
- 6) HTPT directs takeoff.

Cleaning and Maintenance of Helitorch and Related Equipment

The helitorch, drums, and mixing unit must have proper maintenance to be dependable. Thoroughly flush all equipment with diesel fuel and run through all nozzles, hoses, etc. Keep all equipment indoors or cover well. Routine inspection of equipment should occur even during times of non-use to prevent corrosive damage.

Helitorch Maintenance

It is important to properly service and store the helitorch to maintain dependability. Obtain major component service/maintenance publications from manufacturers and distributors.

- 1) Flush the helitorch plumbing with diesel fuel or Jet A after each operational period.
- 2) Clean ignitor system.
- 3) Clean and inspect discharge nozzle assembly.
- 4) Inspect hoses and electrical wiring.
- 5) Complete required maintenance checklist and Helitorch Use Record as indicated in Appendix B (<https://www.nwcg.gov/publications/501>).

General Mixing System Maintenance

- 1) Mixing systems that meet MC 306 or DOT 406 design specifications must comply with DOT regulations. This includes an annual (VK) external visual inspection (V) and leakage test (K). An (IP) internal inspection (I) and pressure test (P) must be performed every 5 years. The tests must be performed by a DOT licensed inspector.
- 2) Inspect and maintain the mixing system trailer brakes, wheel bearings, electrical system, engine oil, air filter, spark arrester, etc., and the general integrity of the unit on an annual basis. Record and log all work performed.
- 3) Reference maintenance publications for the major components of the mixing system (e.g., engine, pump, valves, etc.), to maintain the equipment and to help remedy any problems (troubleshoot). Report any problems to your agency representative of the IAIU.
- 4) Clean and purge the mixing system tank, plumbing, suction line, and discharge lines of gel/fuel when the unit is not operated for a prolonged period of time.
 - a) Pump as much of the remaining gel out of the plumbing and tank. Use a nonferrous metal or wood paddle to scrape gel toward outlet valve if needed.
 - b) Put several gallons of diesel into the tank and recirculate. Flush all hoses with diesel.
 - c) Purge the entire system of diesel.

- d) Fuel remaining in the system can absorb moisture and could jeopardize the life span of the tank by pitting and rusting the internal walls. Also, moisture can degrade gel consistency rendering it unsafe.
- 5) Care must always be taken not to introduce foreign matter (i.e., rocks, grit, debris, etc.) from getting into the system and perhaps damaging the pump or valves.
- 6) Prevent rust from forming on the tank. Paint the unit when necessary.
- 7) Keep the mixing system clean and store in a dry place.

Drum and Associated Hardware Maintenance

- 1) Keep the drum purged of gel/fuel when not in use.
- 2) Prevent rust from forming on the drum. Paint if necessary.
- 3) Keep the drums clean and store in a dry environment.
- 4) Keep the dry breaks clean of dirt, debris, and gel residue.
- 5) Keep Clay & Bailey relief valve, site glasses, and vapor removal/recovery camlock free of gel residue.
- 6) Clean and lubricate all components with a minimal amount of diesel prior to storage.

Vapor Hose Maintenance

- 1) Store hoses in dry location away from sunlight.
- 2) Ensure that debris does not enter the hose by keeping the camlock caps on during storage.
- 3) Perform continuity test prior to use.
- 4) Replace brittle/dry cracked hoses.

Helitorch and Mix Transfer System Required Modifications and Approved Equipment Inspection Checklists

See Appendix C (<https://www.nwcg.gov/publications/501>).

Barrel Helitorch Assembly and Setup

Figure 4.4: Barrel Helitorch



Helitorch Assembly

- 1) Unwind the cables for the spreader bar assembly.
- 2) Straighten and check the suspension lines for damage and entanglements.
- 3) Check all connections to ensure that they are secure and properly wired for safety.
- 4) Remove the two bolts from the sleeve portion of the bent leg frame.
- 5) Install the straight frame into the sleeve portion of the bent leg and secure it with the bolts, nuts, and safety pins.

Gelled Fuel Helitorch Setup Procedure

Mixing helitorch components between kits may cause compatibility problems due to differences in hose and/or nozzle length. If 1½ inch hose lengths are too long, the drum clamp may disconnect in flight.

- 1) The pump-fin assembly is quick-pinned into place in the slot on the down facing side of the straight leg frame, below the ignition box.
- 2) One end of the ¾-inch hose fitting is connected to the outlet of the fuel pump. The other end is connected to the fuel nozzle inlet on the bent leg frame.
- 3) The 1½-inch fitting will attach to the 1½-inch coupler installed on the fuel drum.
- 4) The cannon plug on the pump assembly presses onto the receptacle on the ignition box.

Adjusting the Igniter Tip

- 1) Igniter wire and nozzle terminus should be free of carbon deposits. Remove carbon deposits with sandpaper or a wire brush.
- 2) When properly adjusted, the igniter wire bends at the nozzle tip and parallels the nozzle terminus so that a gap of approximately 1/4 to 3/8 inch exists between the two. This will allow multiple points for arcing to occur and prevent ignition failure.

Fuel Drum Valve Assembly

Figure 4.5: Fuel Drum Valve



The Barrel Helitorch uses unmodified standard 55-gallon fuel drums. The ground crew must check the drums for fuel leaks and bent rims. Drums with bent rims on the vent bung side of the drum, or large dents in the side of the drum near drum rims, cannot be used since this is the area where the drum attaches to the helitorch. Any drum with damaged threads should not be used because it may leak or damage the threads of the helitorch vent or helitorch coupler.

- 1) Install small brass bleed-vent in the drum bung.
- 2) Ensure drum rim height and rim thickness is compatible with torch frame to maintain positive lock with torch.
- 3) Check the bleed-vent for proper operation before installing by gently blowing on the brass end of the vent. If air does not go through the vent, or the vent is too loose, adjust the vent by tightening or loosening the vent's inset screw, which is located inside the vent.
- 4) The bleed-vent also serves as a check valve. If it is adjusted too loosely, fuel will leak from the vent during flight. Use a bung plug gasket on the air vent and finger-tighten to the drum.
- 5) The 1½ inch coupler is used for gelled fuels.
- 6) Fuel must be gelled before inserting drum coupler.
- 7) Put Polytetrafluoroethylene (PTFE) tape (yellow petroleum Teflon tape) on the coupling valve to seal threads. Do not use the bung gasket with the coupler.
- 8) Close the coupler valve before inserting into the drum.
- 9) Use a pipe wrench attached to large bung adapter to tighten the coupler to the drum. **DO NOT USE THE COUPLER HANDLE.**
- 10) The coupler closure handle should face up toward the center of the drum after the coupler is tightened.
- 11) Keep drums upright until ready for use.

Attachment of Fuel Drum to Helitorch

See Figure 4.

Initial Helitorch Hookup

- 1) Ensure the fuel drum coupler valve is closed, place the drum on its side so that the small bung valve is in the upper most position and the fuel coupler is in the lowest position.
- 2) Place the helitorch on the ground in front of the helicopter.
- 3) Orient nozzle terminus toward the pilot's side.
- 4) Helitorch should be placed close enough so that it can be hooked to the aircraft by a person crawling underneath the aircraft, and far enough away to minimize cable slack.
- 5) Attach the pear link to the aircraft cargo hook.
- 6) Attach the helitorch electrical connection to the helicopter's external electrical plug.
- 7) Check the aircraft manual and electrical hook release to ensure that the helitorch can be jettisoned during an emergency.
- 8) Open fuel valve on drum to half open.
- 9) Turn on both ignition and fuel switches on the helitorch as well as the manual valves for the Mapp/propane gas.
- 10) During lift-off, ensure that suspension lines do not become entangled with the helitorch and are not draped over the helicopter skid.

Drum Exchanges for Barrel Helitorches

- 1) A full fuel drum with coupler and bleed air vent attached is elevated to facilitate drum exchanges.
- 2) The parking tender directs the helicopter to lower the helitorch onto the downwind side next to the full drum, ensuring that the helitorch tip does not touch the ground.
- 3) As the helicopter is landing, the parking tender will direct the pilot back so the cables on the torch remain slack free. The HTMM turns off the ignition and pump switches, closes the inline Mapp/propane gas valve, and turns off the fuel valve on the 1½-inch drum coupler. Both the HTMM and HTPT disconnect the helitorch from the empty drum. The HTMM disconnects the fuel coupling.
- 4) Both HTMM and HTPT move the helitorch to the full drum. The HTMM connects the fuel coupling. The HTMM attaches the helitorch to the drum. The HTMM turns on the fuel valve (half open for gelled fuel), turns on the pump and the two ignition switches, and opens inline Mapp/propane gas valve.
- 5) The HTMM remains at the exchange area to ensure that the cables do not get caught on the helitorch, and the helitorch tip does not contact the ground as the helicopter lifts the helitorch.
- 6) The HTMM double checks to make sure that the pump and ignition switches are turned on. When the helitorch begins to lift, the HTMM exits toward the parking tender.
- 7) The HTPT signals the pilot when the helitorch crew is clear.

- 8) The HTPT signals the pilot to exit into the wind, and observes the helitorch until it is clear of the area.
- 9) The pilot avoids flying over personnel and equipment.
- 10) The HTMM and HTPT monitor the helitorch until it is out of the helitorch base area.

Chapter 5 – Unmanned Aircraft Systems (UAS) Aerial Ignition

The IAIU will work with Interagency Fire Unmanned Aircraft Systems Subcommittee (UASSC), OAS, and NTDP to develop, coordinate, and implement strategic and tactical UAS operations, and associated personnel in conjunction with Aviation Managers, geographic area coordination groups, and interagency partners/cooperators.

UAS Aerial Ignition Qualifications

The qualifications, training, position descriptions and certification requirements for UAS personnel, along with operations standards and approved equipment, are found in *NWCG Standards for Fire Unmanned Aircraft Systems Operations*, PMS 515, <https://www.nwcg.gov/publications/515>.

UAS Aerial Ignition Operations

UAS operations may require one or more pilots/operators and support staff referred to collectively as a UAS module. This module consists of a Module Leader (UASL), Manager (UASM), Pilot (UASP) and Data Specialist (UASD). The exact number and configuration may vary by UAS type, but each module will have a designated module leader. The UASL typically coordinates with personnel such as the local unit managers, state/regional aviation officers, or Air Support Group Supervisor (ASGS) to gain general familiarity regarding the request. Once a specific work assignment is made and the UAS pilot/operator is preparing to initiate aerial ignition activities, at that time they will work under the direct supervision of the assigned aerial ignition supervisor.

UAS aerial ignition operations hold many similarities to helicopter-based PSD operations in that the ignition devices (sometimes referred to as payload) utilize similar systems that use plastic spheres containing potassium permanganate with an ethylene-glycol injector to pierce the balls that are then dropped and ignite on the ground.

Operational Considerations

While UAS aerial ignition operations are relatively new and much remains to be learned, the following are some operational considerations gleaned from the recent experience gained using UAS for aerial ignition on both wildfire and prescribed fires.

- 1) Duration and Capacity: UAS platforms typically have a maximum payload (i.e. number of balls it can carry) and battery life. A typical operation will require the aircraft to land several times to change batteries and reload the ignition device.
- 2) Flight Times: Generally speaking UAS ignition is faster than ground ignition but slower than traditional helicopter-based aerial ignition.
- 3) Operational Tempo: Field units noted that the operational tempo of the Rx burn and aerial ignition can feel more at ease or relax” with UAS as compared to occasionally experiencing a more stressful tempo while utilizing manned aircraft.
- 4) Operational Functionality: It was noted that UAS aerial ignition operations functioned similar to helicopter ignitions with respect to firing patterns, communication, ignition time frames and organizational structure.
 - a. The aerial ignition supervisor coordinates and communicates similar to flying in the front seat of a helicopter for, while standing on the ground in a less stressful atmosphere.

- b. The aerial ignition supervisor (e.g., FIRB) stands shoulder to shoulder with the UAS pilot who controls the aircraft through use of a tablet or similar device that shows the location and activity (i.e. ignition points) of the aircraft. The aerial ignition supervisor can point to specific locations on the screen to direct the pilot(s) as to the desired timing and location of ignitions.
 - c. The normal communication sequence used for PSD operations (i.e., prepare to fire, start firing, prepare to stop, stop firing) may be used, but many aerial ignition supervisors and pilots have noted that it is often easier to just describe the pattern the supervisor wants flown to the pilot on the screen and that the pilot simply confirm with the supervisor if they are clear to start ignition once the aircraft is in position.
- 5) Connectivity: Most UAS are controlled by a ground control unit that must be constantly connected via radio signal with the UAS. Terrain, vegetation, power lines or other factors can interfere with the quality of the signal or connectivity, which may limit the effective operational distance of the UAS.
 - 6) Firing Patterns: As noted above, firing patterns can be executed similar to helicopter firing.
 - 7) Advantage of Infrared (IR): With advanced thermal imagery on many platforms, the UAS can see through smoke clearly. This alleviates smoking-out the aircraft, making it essentially a non-issue. Firing patterns can then be based off the aerial ignition supervisor's needs even if that means flying directly into smoked out areas.
 - 8) Spacing of Ignition Spheres: UAS aerial ignition devices will usually have the ability to dial-in the drop spacing of ignition spheres on the fly to a specific distance, (50 feet, 100 feet, 300 feet, etc.).
 - 9) Multiple Aircraft: Large burns (1,000+ acres) have been done with both a single UAS aircraft and multiple UAS aircraft. Having the ability to use multiple UAS with aerial ignition on the same burn presents a significant advantage. Ignition time frames are reduced, which can aid in smoke management. Larger burns can be difficult to reach the "far corners" with a single UAS. Having multiple aircraft operating from different locations can more easily cover the areas of larger burns. Fatigue on a single UAS pilot is reduced, as well as wear-and-tear on a single aircraft.
 - 10) Integration: Field units noted that integration of UAS technology into the Rx fire operation was fairly straightforward and manageable, once local units were briefed on UAS operations by qualified UAS personnel.
 - 11) Communications: On large incidents such as Type I wildfire, UAS operations would typically utilize an air-to-ground frequency as well as monitor the tactical channel(s) on the Divisions they are assigned to. For prescribed fire operations it may be more practical to stay on the local tactical channel used for normal Rx burn operations which allow all personnel the ability to listen and communicate with the aerial ignition supervisor who is with the UAS pilot directing the flight/firing patterns.
 - 12) Smoke Management: UAS was observed to be an effective tool for monitoring and documenting smoke dispersion via camera and infrared sensors.
 - 13) Announcing the Location of Aircraft: Ground resources have noted that due to its small size and relatively little noise, it was difficult to locate and keep a mental picture of where the UAS aircraft was in relation to the burn area and ground personnel. This can be easier with a helicopter due its size, and noise.

- a. The FIRB or assigned aerial ignition supervisor must be more intentional and active in announcing the actions of the UAS so that ground personnel are made aware of where and when ignitions are occurring.
 - b. The use of landmarks may suffice in an emergency, but when time allows, the use of drop-points or even a grid-pattern overlay on the burn map are extremely useful for the aerial ignition supervisor to relay the location of the drone to ground resources on the burn (“Lighting from DP 5 to DP 6” or “ignition complete from block A1 on the north to A5 and down the east flank to D6”).
- 14) Georeferenced Maps: For prescribed burn units or ignitions where map references are critical, accurate georeferenced maps of the burn units are necessary for the UAS ground control station to upload in advance. These are displayed on the pilot’s control unit and must be as accurate as possible to avoid firing outside of the unit or intended control lines if not easily identifiable from the air. UAS pilot will confirm accuracy of maps with a recon flight before ignition and can adjust as necessary. Use of recon flights for situational awareness and alternative launch locations is critical to mission success.
- 15) Planning/Pework: Planning/logistics is completed by UAS personnel behind the scenes before UAS aerial ignitions commence. This includes studying airspace requirements, airspace deconfliction with local dispatch, filing Notice to Airmen (NOTAMs), uploading digital maps into the ground control station, scouting the burn unit in advance for optimal Launch and Recovery Areas. It is important to give the UAS module time and information at least a day in advance so that they can complete these tasks. It will result in a better product on the day of the burn.

UAS Aerial Ignition Equipment Review and Approval Process

The UASSC will ensure completion of technical reviews for new/proposed UAS aerial ignition payloads. UASSC will coordinate with the IAIU prior to recommending payload approval to the National Interagency Aviation Committee (NIAC). The appropriate chair will forward NIAC’s documentation to all agencies/bureaus regarding decision of new equipment. The IAIU or UASSC Chair will formally notify vendor of NIAC/UASSC decision.

Chapter 6 – Reference Materials

Safety Data Sheets (SDS)

DISCLAIMER: Due to the three-year cycle for this document, users should consult the manufacturer's website for the current versions of specific SDS sheets.

- MAPP Gas–Methylacetylene Propadiene Propane: <https://worthingtonindustries.com/getmedia/ff77868e-b526-44ae-9064-e51aaa5ea02f/wc001-map-pro-premium-hand-torch-fuel>
- Liquefied Petroleum Gas or Propane: <https://worthingtonindustries.com/getmedia/126702bb-c40c-48f5-8131-0ee2712f3380/wc002-propane>
- Gasoline, Unleaded: <http://www.marcelsonoil.com/assets/no-e-gasoline-unleaded-regular.pdf>
- Jet A-1–Turbine Fuel, Aviation: https://www.cpchem.com/sites/default/files/2020-05/01541670_6.pdf
- Jet Fuel Jp-4–Turbine Fuel, Aviation: https://www.cpchem.com/sites/default/files/2020-05/01543807_6.pdf
- Ls No. 2 Diesel Fuel–Diesel Fuel: <https://chamberlainoil.com/wp-content/uploads/2011/08/Shell%20Diesel%202%20New.pdf>
- Aldrich Chemical Sub of Sigma-Aldrich–22346-8 Potassium Permanganate 99%: <https://msdsreport.com/ds.cfm?msds=bvsyl&name=22346-8%20potassium%20permanganate%2099%25%20a%20c%20s%20reagent&mfg=aldrich%20chemical%20co%20sub%20of%20sigma%20aldrich>
- Firetrol® Petrol Jel™ Liquid Fuel Gelling Agent: https://www.fs.fed.us/eng/aerial_ign/fuelgel/gelagent/petrogel/documents/msds.pdf
- Firetrol® Firegel (also known as Sure Fire), Chemonics Industries, Inc.: https://www.fs.fed.us/eng/aerial_ign/fuelgel/gelagent/firegel/msds.htm
- Inhibited Ethylene-Glycol Antifreeze: <https://www.cleartech.ca/ckfinder/userfiles/files/Ethylene%20Glycol,%20Inhibited%20CTI%20SDS.pdf>
- PHOS-CHeK Flash 21 A&B: <https://385xpfxe1e13almu7u8sj31b-wpengine.netdna-ssl.com/wp-content/uploads/2015/04/FLASH-21A-2014.pdf>
<https://385xpfxe1e13almu7u8sj31b-wpengine.netdna-ssl.com/wp-content/uploads/2015/04/Flash-21-B-2012.pdf.pdf>
- Halliburton MO-85M & MO-86M: https://msds.halliburton.com/msdsdocuments.aspx?doc_url=https://msds.corp.halliburton.com/wercs/DirectDocumentDownloader/Document?prd=HM005396~PDF~MTR~US~EN
https://msds.halliburton.com/msdsdocuments.aspx?doc_url=https://msds.corp.halliburton.com/wercs/DirectDocumentDownloader/Document?prd=HM005397~PDF~MTR~US~EN

DISCLAIMER: The use of trade, firm, or corporation names listed above and contained in specific SDS sheets is for information and convenience of the reader and does not constitute an endorsement by the IAIU of any product or service to the exclusion of others that may be suitable.

- ALL EMPLOYEES SHALL receive information regarding hazardous substances/materials to which they may be exposed to, and receive appropriate SDS.
- SDS – designed to help us understand how to work safely with hazardous material (chemicals) that are used during the helitorch operation.
- SDS explains proper ways to use, handle, and store chemicals, health hazards, precautionary measures to follow, and emergency procedures for spills, fire, and first aid.

Aerial Ignition Equipment Modifications

Reference Appendix D (<https://www.nwcg.gov/publications/501>).

- BLM Instruction Memorandum on Aerial and Ground Ignition Equipment Direction
- USFS memo on Required Safety Modifications: Batch Mixer, Terratorch, Mix Transfer System, and Helitorch
- Northern (Canadian) Barrel Helitorch Required Safety Modifications
- Premo Mark III Modifications
- Aerostat Mark V PSD Approval Letter
- Helicopter Operations Harness, Tether & Tether Attachment Drawing. MTDC-993
- Western Helicraft Helitorch modification

Bonding Procedures

Static Electricity Precautions for Batch Mixers / Batch Truck

- 1) Check system continuity.
 - a) Verify that the hose connecting the suction side of the pump to the tank has continuity.
 - b) Verify that the hose connecting the discharge side of the pump to the tank has continuity.
 - c) Verify that the hose from the discharge side of the pump to the hose reel has continuity.
 - d) Verify that the helitorch fill hose has continuity from the hose reel to the dry-break at the opposite end of the hose.
 - e) Verify vapor recovery/removal hose has continuity between the end fittings.
- 2) Attach vapor removal/recovery hose to camlock fitting. Bond hose end fitting to tank prior to connecting hose to camlock fitting. Bonding shall be performed before the camlock cap on the tank is removed.
- 3) Fuel from bulk fueler. Bond the batch mixer to fuel truck using either electrically conductive hose or a bonding cable.
- 4) Place powder dispenser on batch mixer tank.
Powder dispenser shall be made from electrically conductive material. Bond the powder dispenser to tank prior to opening manhole and placing powder dispenser over the manhole opening.
- 5) Dispense powder. Use only a metal can or bucket (no plastic) to pour powder into dispenser. Prior to pouring powder into dispenser, bond metal can or bucket to batch mixer.

Static Electricity Precautions for Mix Transfer Systems

- 1) Set up the drums. Bond all drums to each other.
- 2) Check continuity of hoses.
 - a) Verify that the suction hose between the pump and the drum has continuity.
 - b) Verify that the helitorch fill/recirculation hose connecting the discharge side of the pump to the drum or the helitorch has continuity.
 - c) Verify vapor recovery/removal hose has continuity between the end fittings.
- 3) Attach vapor removal/recovery hose to camlock fitting.
 - a) Bond vapor hose end fitting to drum prior to connecting hose to camlock fitting.
 - b) Bonding shall be performed before the camlock cap on the drum is removed.
- 4) Fuel from bulk fueler. Bond batch mixer to fuel truck using either electrically conductive hose or a bonding cable.
- 5) Place powder dispenser on mix transfer system drum.
 - a) Powder dispenser shall be made from electrically conductive material (not plastic).
 - b) Bond powder dispenser to drum prior to removing camlock cap and attaching dispenser to camlock on drum.
- 6) Dispense powder.
 - a) Use only a metal can or bucket (no plastic) to pour powder into dispenser.
 - b) Prior to pouring powder into dispenser, bond metal can or bucket to drum.

Static Electricity Precautions While Fueling Helitorch with Vapor Recovery Hose Connected to Batch Mixer or Mix Transfer System.

- 1) Check hose continuity. This shall have been performed during setup of the batch mixer or mix transfer system.
 - a) Verify continuity of the helitorch fill hose.
 - b) Verify continuity of vapor hose.
- 2) Hose installation sequence during refueling.
 - a) Connect helitorch fill hose to fill connection on helitorch drum.
 - b) Connect vapor recovery hose to camlock fitting on helitorch drum.

Static Electricity Precautions While Fueling the Helitorch with Vapor Removal Hose Not Connected to Batch Mixer or Mix Transfer System

- 1) Check hose continuity. These shall have been performed during setup of the batch mixer or mix transfer system.
Verify continuity of the helitorch fill hose.
- 2) Hose installation sequence during refueling.
 - a) Connect helitorch fill hose to fill connection on helitorch drum.

- b) Bond vapor recovery hose to helitorch drum prior to removal of camlock cap or camlock relief valve fitting.
- c) Connect vapor recovery hose to camlock fitting on helitorch drum.

The *NWCG Standards for Aerial Ignitions (NSAI)* is developed and maintained by the Interagency Aerial Ignition Unit (IAIU), under the direction of the National Interagency Aviation Committee (NIAC), an entity of the National Wildfire Coordinating Group (NWCG).

Previous editions: 2018, 2015, 2012.

While they may still contain current or useful information, previous editions are obsolete. The user of this information is responsible for confirming that they have the most up-to-date version. NWCG is the sole source for the publication. Users are encouraged to send recommended changes for the *NSAI* to their aviation program managers at the state, regional, or national level. This guide will be reviewed every three years; revisions will be made as warranted.

This publication is available electronically at <https://www.nwcg.gov/publications/501>.

Comments, questions, and recommendations shall be submitted to the appropriate agency program manager assigned to the IAIU. View the complete roster at <https://www.nwcg.gov/committees/interagency-aerial-ignition-unit/roster>.

Publications and training materials produced by NWCG are in the public domain. Use of public domain information, including copying, is permitted. Use of NWCG information within another document is permitted if NWCG information is accurately credited to NWCG. The NWCG logo may not be used except on NWCG authorized information. “National Wildfire Coordinating Group,” “NWCG,” and the NWCG logo are trademarks of NWCG.

The use of trade, firm, or corporation names or trademarks in NWCG products is solely for the information and convenience of the reader and does not constitute endorsement by NWCG or its member agencies or any product or service to the exclusion of others that may be suitable.

This NWCG publication may contain links to information created and maintained by other non-federal public and/or private organizations. These organizations may have different policies from those of NWCG. Please note that NWCG does not control and cannot guarantee the relevance, timeliness, or accuracy of these outside materials.