
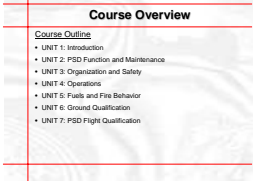
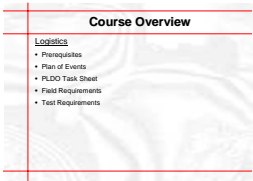
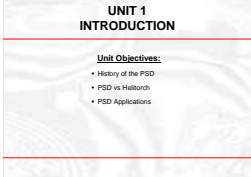
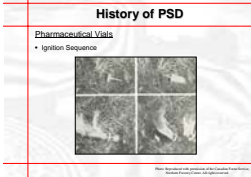
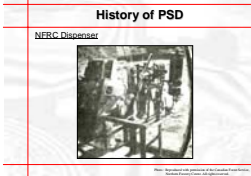





Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
 UNIT 0: COURSE OVERVIEW

ITEM	DESCRIPTION
 <p style="text-align: center;">RED DRAGON PSD OPERATOR TRAINING</p>	<p>INTERAGENCY RED DRAGON PSD OPERATOR TRAINING</p>
<p style="text-align: center;">Instructor Qualifications</p>	<ol style="list-style-type: none"> 1. Qualified and current as a plastic sphere dispenser operator and any helicopter manager qualifications. 2. Approval of regional helicopter operations specialist or state/regional aviation manager.
	<ol style="list-style-type: none"> I. Introduction <ol style="list-style-type: none"> A. Welcome and cadre introductions B. Housekeeping <ol style="list-style-type: none"> 1. Phone messages 2. Restrooms 3. Fire exits 4. Vending machines 5. Coffee 6. Local area accommodations/directions
	<ol style="list-style-type: none"> II. Course Outline <ol style="list-style-type: none"> A. UNIT 1: Introduction to PSD B. UNIT 2: PSD Function and Maintenance C. UNIT 3: Organization and Safety D. UNIT 4: Operations E. UNIT 5: Fuels and Fire Behavior F. UNIT 6: Ground Qualification G. UNIT 7: PSD Flight Qualification
	<ol style="list-style-type: none"> III. Logistics <ol style="list-style-type: none"> A. Review prerequisites. B. Discuss the plan of events: class, bench test, field ops. C. Distribute and explain the PLDO Task Sheet. D. Review field requirements: PPE, lunches, water, and transportation. E. Review the test requirements.

UNIT 1: INTRODUCTION

ITEM	DESCRIPTION
UNIT 1: INTRODUCTION	
<p>Unit Objectives</p> 	<ol style="list-style-type: none"> 1. Introduce trainees to the history of the PSD. 2. Examine advantages and disadvantages of PSD vs Helitorch. 3. Discuss applications of PSD.
Class Time	1/2 hour classroom
Materials, Equipment, & Handouts	<p>Materials: <i>Interagency Aerial Ignition Guide (IAIG)</i></p> <p>Equipment: Computer, computer projector</p> <p>Handouts: PLDO Task Sheet</p>
Instructor Note	Instructor may substitute local photographs where appropriate.
<p>IAIG Ch III.I</p>  	<ol style="list-style-type: none"> I. History of the PSD <ol style="list-style-type: none"> A. The plastic sphere dispenser (PSD) machine was developed to provide a method of igniting continuous surface fuels, in a short timeframe, on large and small acreages without causing undue damage to the over story. This method had to be cost effective, environmentally acceptable, simple to use, and readily available. B. During the early 1960s, Australian foresters developed a spot-firing technique whereby ignition devices were dropped from aircraft onto 5,000 - 10,000 acre blocks of eucalyptus forests to consume the litter and reduce the fire hazard. This early system consisted of a pharmaceutical vial containing potassium permanganate. A syringe was used to inject ethylene glycol into the plastic vial, and then the charged device was dropped from an aircraft. The exothermic reaction resulted in spot fires where the device landed. C. In 1972, a dispenser was developed by the Northern Forest Research Center to mechanize the process of injecting the vials. It was utilized to backfire in Canada's Yukon Territory using a Bell 47 helicopter. The dispenser was limited in speed due to the irregular shape of the vials.

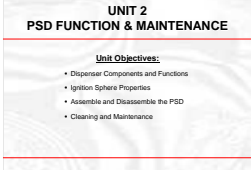
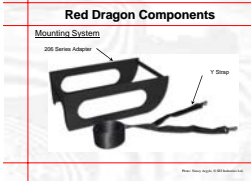

Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (10-12-07)
 UNIT 1: INTRODUCTION

<p style="text-align: center;">History of PSD</p> <p>PRFC MkII Dispenser</p> 	<p>D. A spherical container was introduced by the Alberta Department of Land Management and Forest, Equipment Development Section.</p> <p>The Pacific Forest Research Center developed a dispenser for this spherical container. The PRFC center MkII dispenser and spheres were commercially manufactured by Premo Plastics.</p>
<p style="text-align: center;">History of PSD</p> <p>Premo MkIII Dispenser</p> 	<p>E. In 1980, Premo introduced the MkIII dispenser. Improvements included a larger hopper with a built in agitator and a two speed drive motor.</p>
<p style="text-align: center;">History of PSD</p> <p>SEI Red Dragon Dispenser</p> 	<p>F. In 2006, SEI Industries introduced its Red Dragon Dispenser and Dragon Egg aerial ignition spheres.</p>
<p style="text-align: center;">IAIG Ch III</p> <p style="text-align: center;">PSD vs Helitorch</p> <p>Advantages of PSD</p> <ul style="list-style-type: none"> • Better Control <ul style="list-style-type: none"> - Firing Boss onboard helicopter - operator can assess / address problems - operator can monitor qty of spheres remaining • Less Complex <ul style="list-style-type: none"> - separate helibase not required - spheres safer to transport and handle • Lower Cost <ul style="list-style-type: none"> - lower equipment cost - less support staff • Fire Behavior <ul style="list-style-type: none"> - minimum damage to tree canopy - possible to lay very long ignition lines <p><small>Ref: IAIG Ch III Table 2</small></p>	<p>II. PSD vs Helitorch</p> <p>A. Discuss the advantages of the PSD versus the helitorch.</p> <ol style="list-style-type: none"> 1. Better Control <ol style="list-style-type: none"> a. Firing Boss onboard helicopter b. operator can assess / address problems c. operator can monitor qty of spheres remaining 2. Less Complex <ol style="list-style-type: none"> a. separate helibase not required b. spheres safer to transport and handle 3. Lower Cost <ol style="list-style-type: none"> a. lower equipment cost b. less support staff 4. Fire Behavior <ol style="list-style-type: none"> a. minimum damage to tree canopy b. possible to lay very long ignition lines
<p style="text-align: center;">PSD vs Helitorch</p> <p>Disadvantages of PSD</p> <ul style="list-style-type: none"> • Fire Behavior <ul style="list-style-type: none"> - spheres burn for a shorter time - cannot duplicate helitorch drop pattern - fire lines take longer to form • Safety <ul style="list-style-type: none"> - possible fire in PSD - requires constant operator attention - Plus cannot replace PSD <p><small>Ref: IAIG Ch III Table 2</small></p>	<p>B. Discuss the disadvantages of the PSD versus the helitorch.</p> <ol style="list-style-type: none"> 1. Fire Behavior <ol style="list-style-type: none"> a. spheres burn for a shorter time b. cannot duplicate helitorch drop pattern c. fire lines take longer to form 2. Safety <ol style="list-style-type: none"> a. possible fire in PSD b. requires constant operator attention


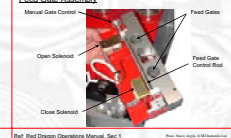
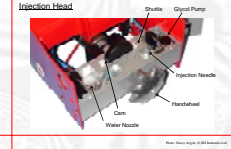

UNIT 1: INTRODUCTION

	c. Pilot cannot jettison PSD
Instructor Note	A discussion should follow about how the PSD is used nationally and an example of the uses specific to your area.

Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
 UNIT 2: PSD FUNCTION AND MAINTENANCE

ITEM	DESCRIPTION
UNIT 2: PSD FUNCTION AND MAINTENANCE	
Unit Objectives 	<ol style="list-style-type: none"> 1. Know the basic parts of the dispenser and their function. 2. Become familiar with the ignition spheres used in the unit. 3. Be able to assemble and disassemble the dispenser. 4. Perform routine cleaning and maintenance.
Class Time	2 classroom hours
Materials, Equipment, & Handouts	Materials: 1. <i>Interagency Aerial Ignition Guide (IAIG)</i> 2. <i>Red Dragon Operations Manual</i> Equipment: Red Dragon PSD Handouts: None
Instructor Note	You will need to set up the Red Dragon PSD in front of the class.
	I. Introduction The function of the dispenser is to inject an ethylene glycol mixture into a plastic sphere containing potassium permanganate and to expel the primed sphere from the aircraft after which an exothermic reaction takes place.
Red Dragon Operations Manual Section 1 	II. Parts of the dispenser and function A. Mounting System <ol style="list-style-type: none"> 1. Removable adapter fits body contour of Bell 206 series aircraft. For aircraft with flat cabin floors, adapter is not required. 2. Nylon “Y” strap secures dispenser to the aircraft. Standard strap suits all type III helicopters.
Red Dragon Operations Manual Section 1 	B. Tank Assembly: <ol style="list-style-type: none"> 1. Acts as a frame to which other components are mounted 2. Contains the water and glycol tanks. 3. Drain valves for tanks.


Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
 UNIT 2: PSD FUNCTION AND MAINTENANCE

<p style="text-align: center;">Red Dragon Operations Manual Section 1</p> <p style="text-align: center;">Red Dragon Components</p>  <p><small>Ref: Red Dragon Operations Manual, Sec 1</small></p>	<p>C. Hopper:</p> <ol style="list-style-type: none"> 1. Stores 950 unprimed spheres. 2. Agitator provides a constant supply of spheres to the feed gates. 3. Receives power from gate assembly via an automatically mating plug.
<p style="text-align: center;">Red Dragon Operations Manual Section 1</p> <p style="text-align: center;">Red Dragon Components</p> <p style="text-align: center;">Feed Gate Assembly</p>  <p><small>Ref: Red Dragon Operations Manual, Sec 1</small></p>	<p>D. Feed Gate Assembly:</p> <ol style="list-style-type: none"> 1. Controls the flow of spheres from the Hopper into the Injection Head. 2. Easily removable from the Injection Head. 3. Feed gate position controlled by a toggle switch on the remote control. 4. Manual override to close and lock the feedgate.
<p style="text-align: center;">Red Dragon Operations Manual Section 1</p> <p style="text-align: center;">Red Dragon Components</p> <p style="text-align: center;">Injection Head</p>  <p><small>Ref: Red Dragon Operations Manual, Sec 1</small></p>	<p>E. Injection Head:</p> <ol style="list-style-type: none"> 1. Injects the spheres with glycol. 2. One reciprocating shuttle with two sphere cavities. 3. Two constant displacement glycol pumps that inject the same amount of glycol regardless of drop rate. No need to calibrate. 4. Water nozzles connected to the emergency water tank and pump to direct water into the injection chamber. 5. Manual handwheel to drive cam and shuttle in case of power failure. Machine can be turned in either direction.
<p style="text-align: center;">Red Dragon Operations Manual Section 1</p> <p style="text-align: center;">Red Dragon Components</p> <p style="text-align: center;">Outlet Chute</p>  <p><small>Ref: Red Dragon Operations Manual, Sec 1</small></p>	<p>F. Outlet Chute:</p> <ol style="list-style-type: none"> 1. Guides primed spheres from the Injection Head to a point below the aircraft.

Interagency Aerial Ignition Guide
Red Dragon PSD Operator Training (12-01-07)
UNIT 2: PSD FUNCTION AND MAINTENANCE

Red Dragon Operations Manual Section 1

Red Dragon Components




The diagram shows a rectangular control panel with a central digital display. To the left of the display are two indicator lights and a switch. To the right are two more indicator lights and a switch. Labels with red arrows point to each of these components.

G. Main Control Panel:

1. Houses the main control board, switches and indicators.
2. “RUN/STOP” switch controls the hopper motor and enables the injection drive motor.
3. “WATER” switch activates the emergency water pump. This switch is always active because of battery backup.
4. “RESET” switch controls the count display. Pushing the switch toggles between trip count and lifetime count. Pushing and holding resets the trip count.
5. “POWER” indicator illuminates when the machine is connected to an external power source.
6. “RUN/STOP” indicator illuminates when the hopper motor is turned on. It flashes when the injection drive motor is running.
7. “MOTOR FAULT” indicator illuminates when the injection drive is jammed.
8. “LOW WATER” indicator illuminates when the water level is too low and the machine will not start.
9. Pump indicator illuminates when the emergency water pump is operating.
10. Segment LED displays the sphere count and low battery warning message.

Red Dragon Operations Manual Section 1

Red Dragon Components



The diagram shows a handheld remote control device with a vertical orientation. It has several indicator lights and two control knobs. Labels with red arrows point to these features.

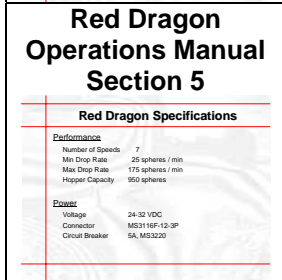
H. Tethered Remote Control:

1. Controls the feed gates and adjusts the drop rate.
2. Seven-position “SPEED” knob to adjust the drop rate.
3. “FEED GATE” momentary toggle switch opens and closes the feed gates and controls the injection drive motor.
4. “POWER” indicator illuminates when dispenser is connected to an external power source.
5. “RUN/STOP” indicator illuminates when hopper motor is turned on. It flashes when injection drive motor is running.
6. “FAULT” indicator flashes when there is a problem.

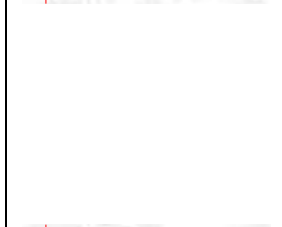
Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
 UNIT 2: PSD FUNCTION AND MAINTENANCE



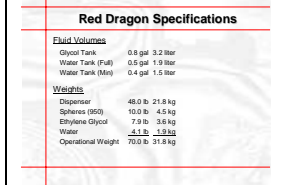
- I. Power Cords:
1. The main power cord connects dispenser to aircraft's power system using a standard MS3116F-12-3P plug.
 2. The auxiliary power cord connects to the auxiliary power supply or to batteries.



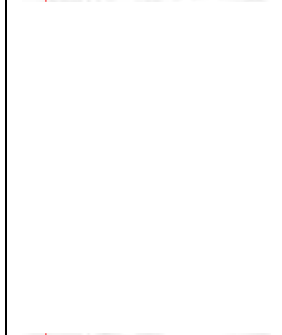
- III. Red Dragon Specifications
- A. Performance:
- | | | |
|-----------------|---|------------------------|
| # of Speeds | 7 | |
| Min Drop Rate | | 25 spheres per minute |
| Max Drop Rate | | 175 spheres per minute |
| Hopper Capacity | | 950 spheres |



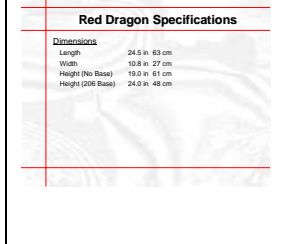
- B. Power:
- | | | |
|-----------------|--|------------------------------|
| Voltage | | 24-32 VDC |
| Connector | | MS3116F-12-3P (A +28, B Gnd) |
| Circuit Breaker | | 5A, MS3320 |



- C. Fluid Volumes:
- | | | | |
|-------------------|---------|-----------|----------------|
| Glycol Tank | 0.8 gal | 3.2 liter | (5000 spheres) |
| Water Tank (Full) | 0.5 gal | 1.9 liter | |
| Water Tank (Min) | 0.4 gal | 1.5 liter | |



- D. Weights:
- | | | | |
|---------------------------|----------------|----------------|--|
| Red Dragon | 48.0 lb | 21.8 kg | |
| Spheres (950) | 10.0 lb | 4.5 kg | |
| Ethylene Glycol | 7.9 lb | 3.6 kg | |
| Emergency Water | 4.1 lb | 1.9 kg | |
| Operational Weight | 70.0 lb | 31.8 kg | |




- E. Dimensions:
- | | | | |
|--------------------|---------|-------|--|
| Length | 24.5 in | 63 cm | |
| Width | 10.8 in | 27 cm | |
| Height (No Base) | 19.0 in | 48 cm | |
| Height (with Base) | 24.0 in | 61 cm | |

Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
 UNIT 2: PSD FUNCTION AND MAINTENANCE

Dragon Egg Specifications


Diameter	1.0 in	25 mm
Potassium Permanganate	0.11 oz	3.0 g
Total Mass	0.17 oz	4.8 g
Shell Material	High Impact Polystyrene	
Ignition Delay	20-30s @ 50°F	



Dragon Egg Ignition Spheres

Ignition Delay Variables

- Temperature
- Humidity
- Amount of Glycol



IV. Dragon Egg Aerial Ignition Spheres

A. One inch diameter plastic sphere containing potassium permanganate (KMnO₄) which reacts with ethylene glycol to produce a delayed ignition.

B. Specifications:

Diameter	1.0 in	25 mm
Potassium Permanganate	0.11 oz	3.0 g
Total Mass	0.17 oz	4.8 g
Shell Material	High Impact Polystyrene	
Ignition Delay	20-30s @ 50°F	

C. Ignition Delay Variables:

Ignition delay is typically 20-30s, but depends on the following parameters:

- 1. Temperature**
- 2. Humidity**
- 3. Amount of Ethylene Glycol**

Ethylene Glycol

Which Antifreeze to Use?

- Use Standard Vehicle Antifreeze (90 - 100% Ethylene Glycol)
- Do not use 50/50 Pre-Mixed Antifreeze
- Do not use Propylene Glycol Antifreeze (Non-Toxic)







V. Ethylene Glycol

A. Use standard vehicle antifreeze which is 90-100% ethylene glycol.

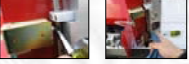



B. Do not use 50/50 premix antifreeze.

C. Do not propylene glycol based antifreezes which are usually labeled as non-toxic.

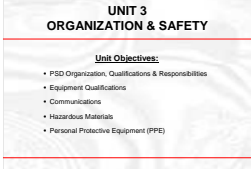
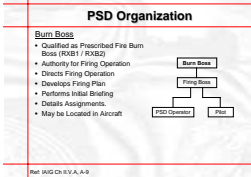
Interagency Aerial Ignition Guide
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 UNIT 2: PSD FUNCTION AND MAINTENANCE

<p style="text-align: center;">Red Dragon Operations Manual Section 6</p> <p style="text-align: center;">Cleaning and Maintenance</p> <p>Tool Kit</p> <ul style="list-style-type: none"> • 1/4" Slotted Screwdriver • #1 Phillips Screwdriver • 7/16" Combination Wrenches • Long Nose Pliers • 1/8" Allen Key Wrench • 2.5mm Allen Key Wrench • Metal Bristle Brush • Sharpening Stone • Tip Cleaner Set • Scotch Brite Abrasive Pad 	<p>VI. Cleaning and Maintenance</p> <p>A. Tool Kit</p> <ol style="list-style-type: none"> 1. 1/4" Slotted Screwdriver 2. #1 Phillips Screwdriver 3. 7/16" Combination Wrenches 4. Long Nose Pliers 5. 1/8" Allen Key Wrench 6. 2.5 mm Allen Key Wrench 7. Tip Cleaner Set 8. Metal Bristle Brush 9. Scotch Brite Abrasive Pad
<p style="text-align: center;">Red Dragon Operations Manual Section 6</p> <p style="text-align: center;">Cleaning and Maintenance</p> <p>Spare Parts</p> <ul style="list-style-type: none"> • 8mm x 32" Red Drain Tube • 6mm x 12" Blue Tube • 6mm x 12" Red Tube • (2) Injection Needles • (2) 6mm Tube Caps 	<p>B. Spare Parts</p> <ol style="list-style-type: none"> 1. (2) Injection Needles 2. 6mm x 12" Blue Tube 3. 6mm x 12" Red Tube 4. 8mm x 32" Red Drain Tube 5. (2) 6mm Tube Caps
<p style="text-align: center;">Red Dragon Operations Manual Section 6</p> <p style="text-align: center;">Cleaning and Maintenance</p> <p>Cleaners & Lubricants</p> <ul style="list-style-type: none"> • Use Citrus Based Cleaner / Degreaser • No Petroleum Based Lubricants 	<p>C. Cleaners and Lubricants</p> <ol style="list-style-type: none"> 1. Use a citrus based cleaner / degreaser to clean the Red Dragon (Simple Green® or equivalent). 2. The running surfaces of the injection head are self-lubricating. Do not lubricate with products such as WD-40 or light machine oil These will cause potassium permanganate residue to accumulate and may cause mechanical seizure.
<p style="text-align: center;">Red Dragon Operations Manual Section 6</p> <p style="text-align: center;">Daily Cleaning</p> <p>Hopper</p> <ul style="list-style-type: none"> • Wipe down hopper • Check linkages for wear 	<p>D. Daily Cleaning</p> <ol style="list-style-type: none"> 1. Hopper <ol style="list-style-type: none"> a. Remove the hopper from the Red Dragon b. Empty any remaining spheres. c. Wipe down interior of hopper d. Check agitator and linkage for signs of wear.

Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
UNIT 2: PSD FUNCTION AND MAINTENANCE

<p style="text-align: center;">Daily Cleaning</p> <p><u>Gate Assembly</u></p> <ul style="list-style-type: none"> Remove gate assembly from injection head. Unlock the feed gate control rod. Clean the sphere paths. 	<p>2. Gate Assembly</p> <ol style="list-style-type: none"> Unlock gate and remove assembly from injection head. Unlock the feed gate control rod using screwdriver. Clean the sphere paths using a cloth and a citrus based cleaner / degreaser. Close gates using manual knob and check lock.
<p style="text-align: center;">Daily Cleaning</p> <p><u>Glycol Pumps</u></p> <ul style="list-style-type: none"> Remove glycol pump assemblies from injection head. Clean using cloth and cleaner / degreaser as required. Check condition of needles and sharpen as required. Check pump operation. 	<p>3. Glycol Pumps</p> <ol style="list-style-type: none"> Remove glycol pump assemblies from injection head. Clean using cloth and cleaner / degreaser as required. Check condition of needles and sharpen as required. Check pump operation.
<p style="text-align: center;">Daily Cleaning</p> <p><u>Injection Head</u></p> <ul style="list-style-type: none"> Wire brush the injection shuttle and injection block as required. Clean using a cloth and cleaner / degreaser. Rotate handwheel and check for smooth operation and signs of wear. 	<p>4. Injection Head</p> <ol style="list-style-type: none"> Loosen any potassium permanganate residue from the shuttle and injection block using the wire brush provided. Clean the surfaces of the injection block and shuttle using a cloth and cleaner / degreaser as required. Rotate the handwheel and check for smooth operation. Check cam guides and shuttle guides for signs of wear. Replace the glycol pumps.
	<p>5. Tank Assembly</p> <ol style="list-style-type: none"> Wipe down surfaces with cloth to remove and glycol. Check tanks and lines for signs of leakage.
<p style="text-align: center;">Long Term Storage</p> <p><u>Drain Tanks</u></p> <ul style="list-style-type: none"> Drain the glycol tank. Drain the water tank. 	<p>E. Long Term Storage</p> <ol style="list-style-type: none"> Drain the glycol tank. <ol style="list-style-type: none"> Insert drain tubing into drain valve. Using screwdriver, rotate drain valve so slot is vertical. Close drain valve when empty. Drain the water tank. <ol style="list-style-type: none"> Insert drain tubing into drain valve. Using screwdriver, rotate drain valve so slot is vertical. Close drain valve when empty.

Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
 UNIT 3: ORGANIZATION AND SAFETY

ITEM	DESCRIPTION
UNIT 3: ORGANIZATION AND SAFETY	
Unit Objectives 	<ol style="list-style-type: none"> 1. PSD Organization, Personnel Qualifications and Responsibilities 2. Equipment Qualifications 3. Communications 4. Hazardous Material Handling 5. PPE
Class Time	1/2 - 1 classroom hours
Materials, Equipment, & Handouts	Materials: <ol style="list-style-type: none"> 1. <i>Interagency Aerial Ignition Guide (IAIG)</i> 2. <i>Red Dragon Operations Manual</i> Equipment: <ol style="list-style-type: none"> 1. Computer and computer projector 2. Harness, tether, and carabiners Handouts: PSD checklist
Instructor Note	For the purpose of this course, the burn boss / firing boss refers to the person riding next to the pilot.
IAIG Ch II.V.A 	<ol style="list-style-type: none"> I. Personnel Qualifications & Responsibilities <ol style="list-style-type: none"> A. Burn Boss <ol style="list-style-type: none"> 1. Qualified as Prescribed Fire Burn Boss (RXB1 / RXB2) 2. Complete authority for firing operation 3. Directs firing operation. 4. Develops firing plan. 5. Performs initial briefing. 6. Details assignments of each boss / supervisor and pilot. 7. May be located in aircraft with PSD operator.

Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
UNIT 3: ORGANIZATION AND SAFETY

IAIG Ch II.V.A

PSD Organization

Firing Boss

- Qualified as Firing Boss (FIRB)
- Reports to Burn Boss
- May be Same Person as Burn Boss
- Directs PSD Operator
- Instructs the Pilot as to the Ignition Plan and Firing Sequences
- Keeps Pilot Informed

Ref: IAG Ch II.V.A, A-9

- B. Firing Boss**
1. Qualified as Firing Boss (FIRB)
 2. Reports to burn boss.
 3. Instructs the pilot as to the plan, firing sequences, and keeps the pilot informed throughout the entire operation.
 4. Directs the PSD operator.
 5. May be the same person as the burn boss.

IAIG Ch III.VI.A

PSD Organization

PSD Operator

- Qualified as Plastic Sphere Dispenser Operator (PLDO)
- Reports to Burn Boss / Firing Boss
- Briefs Pilot, Identifies Safety Requirements, and Monitors PSD Operation
- Provides information on aerial safety procedures to be used by the Burn Boss / Firing Boss
- Preparation, Installation, Operation, Maintenance, and Care of PSD
- Verifies Ignition Spacing

Ref: IAG Ch III.VI.A, A-9

PSD Organization

PSD Operator (cont)

- Determines if a malfunction occurs and acts accordingly
- Determines whether an onboard fire can be extinguished or the unit must be jettisoned
- Communicates on all procedures associated with the operation and/or emergencies occurring during the operation
- May serve as Helicopter Manager

Ref: IAG Ch III.VI.A, A-9

- C. PSD Operator**
1. **Qualified as Plastic Sphere Dispenser Operator (PLDO).**
 2. Serves as PSD operator to the ignition specialist / firing boss.
 3. Briefs the pilot, identifies safety requirements at the operations briefing, and monitors the overall operation.
 4. Provides information on aerial safety procedures to be used by the ignition specialist / firing boss.
 5. Preparation, operation, maintenance, and care of the PSD.
 6. Verifies for the ignition specialist / firing boss that prescribed spacing of ignition is occurring and makes the necessary adjustments.
 7. Determines if a malfunction occurs and acts accordingly.
 8. Determines whether an onboard fire can be extinguished or the unit must be jettisoned.
 9. Communicates with the pilot and ignition specialist / firing boss on all procedures associated with the operation and/or emergencies occurring during the operation.

IAIG Ch II.V.B
IAIG Ch III.VI.C

PSD Organization

Pilot

- Qualified for Aerial Ignition PSD Operations
- Responsible for Aircraft Operations and Safety
- Oversees PSD Installation
- Performs Helicopter Load Calculations
- Follows Ignition Plan under direction Firing Boss

Ref: IAG Ch II.V.B, A-9

PSD Organization



Pilot (cont)

- Pilot Qualification Card must be inspected before a mission is flown

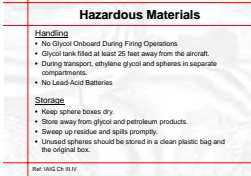
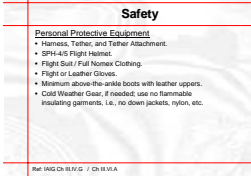

Ref: IAG Ch II.V.B, A-9

- D. Pilot**
1. **Qualified for aerial ignition PSD operations.**
 2. **Responsible for all matters related to aircraft operations and safety.**
 3. Follows the ignition plan under the direction of the firing boss.
 4. Oversees PSD installation
 5. Performs helicopter load calculation.
 6. **Pilot qualification card must be inspected before a mission is flown.**

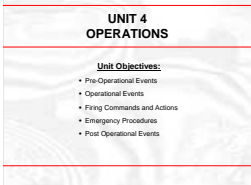
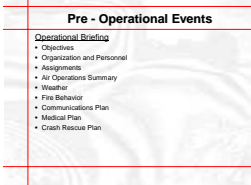

Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
 UNIT 3: ORGANIZATION AND SAFETY

<p>IAIG Ch II.V.B</p> <p>Aircraft Qualifications</p> <p>• Inspection of Helicopter Data Card</p>  <p><small>Ref: IAIG II.V.B</small></p>	<p>II. Equipment Qualifications</p> <p>A. Helicopter</p> <ol style="list-style-type: none"> 1. Helicopter data card must be inspected before a mission is flown.
<p>Communications</p> <p>Internal</p> <ul style="list-style-type: none"> • All three personnel inside the helicopter must have intercoms <p>External</p> <ul style="list-style-type: none"> • Dedicated Air / Ground Frequency • Some burns may only require one frequency. 	<p>III. Communications</p> <p>A. Internal Communications</p> <p>All three personnel inside of the ship must have intercom.</p> <p>B. External Communications</p> <ol style="list-style-type: none"> 1. Use dedicated air/ground frequency to obtain clearance from holding forces that they are ready (to start and stop). 2. Some burns may only require one frequency.
<p>DOT SP09198</p> <p>Hazardous Materials</p> <p>Regulations</p> <ul style="list-style-type: none"> • Special Permit Exemption • Training Required • Documents required onboard Aircraft <ul style="list-style-type: none"> - Interagency Aviation Transportation of Hazardous Materials - Emergency Response Guidebook - Hazardous Materials Manifest  <p><small>Ref: DOT SP09198</small></p>	<p>IV. Hazardous Materials</p> <p>A. Regulations</p> <ol style="list-style-type: none"> 1. Potassium permanganate (KMnO₄) is classified as a hazardous material by DOT regulations. Use in aerial ignition devices by the US Forest Service and US Dept of the Interior is exempt from these regulations under Special Permit #9198. 2. PSD operators must complete course <i>A-110: Aviation Transport of Hazardous Materials</i>. 3. The following documents must be onboard the aircraft: <ol style="list-style-type: none"> a. <i>Interagency Aviation Transportation of Hazardous Material Guide</i> (NFES 1068) b. <i>Emergency Response Guidebook</i> c. <i>Hazardous Materials Manifest</i> (DOT E-9198)
<p>Instructor Note</p>	<p>Course A-110 may be taken online at <http://iat.nifc.gov>.</p>




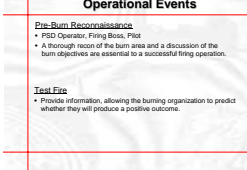
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<p>IAIG Ch III.IV IAIG Ch III.XX</p>  <p>Hazardous Materials</p> <p>Handling</p> <ul style="list-style-type: none"> No Glycol Onboard During Firing Operations Glycol tank filled at least 25 feet away from the aircraft. During transport, ethylene glycol and spheres in separate compartments. No Lead-Acid Batteries <p>Storage</p> <ul style="list-style-type: none"> Keep sphere boxes dry. Store away from glycol and petroleum products. Sweep up residue and spills promptly. Unused spheres should be stored in a clean plastic bag and the original box. <p>Ref: IAIG Ch III.IV</p>	<p>B. Handling</p> <ol style="list-style-type: none"> Under no circumstances will extra ethylene glycol be carried on board the helicopter during firing operations The glycol tank must be filled and capped at least 25 feet away from the aircraft. If in transport, ethylene glycol and spheres must be in separate compartments. Lead acid batteries will not be carried in the cabin to power the PSD. <p>C. Storage</p> <ol style="list-style-type: none"> Keep boxes dry. Store away from glycol and petroleum products. Sweep up residue and spills promptly. Unused spheres should be stored in a clean plastic bag and the original box.
<p>Instructor Note</p>	<p>Show different types of in-flight storage by aircraft and emphasize non-porous materials</p>
<p>IAIG Ch III.IV.G</p>  <p>Safety</p> <p>Personal Protective Equipment</p> <ul style="list-style-type: none"> Harness, Tether, and Tether Attachment. SPH-4/5 Flight Helmet. Flight Suit / Full Nomex Clothing. Flight or Leather Gloves. Minimum above-the-ankle boots with leather uppers. Cold Weather Gear, if needed; use no flammable insulating garments, i.e., no down jackets, nylon, etc. <p>Ref: IAIG Ch III.IV.G / Ch III.IV.A</p>	<p>V. Personal Protective Equipment (PPE)</p> <ol style="list-style-type: none"> Approved harness, tether, and tether attachment. SPH-4/5 flight helmet. Flight suit or full Nomex clothing. Flight or leather gloves. Minimum above-the-ankle boots with leather uppers. Cold weather gear, if needed; use no flammable insulating garments, i.e., no down jackets, nylon, etc.
<p>Instructor Note IAIG Ch III.VI.A</p>	<p>Some agencies require the operator to wear a fullbody restraint system in addition to seat belts. Seat belts shall be worn according to the manufacturer's specifications.</p>
 <p>SAFECOM</p>	<p>VI. SAFECOM</p> <ol style="list-style-type: none"> Review recent SAFECOM's relating to PSD operation.

Interagency Aerial Ignition Guide
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 UNIT 4: OPERATIONS

ITEM	DESCRIPTION
UNIT 4: OPERATIONS	
Unit Objectives 	<ol style="list-style-type: none"> 1. Pre-Operational Events 2. Operational Events 3. Post-Operational Events 4. Firing Commands and Actions 5. Emergency Procedures
Class Time	1 hour classroom
Materials, Equipment, & Handouts	Materials: 1. <i>Interagency Aerial Ignition Guide (IAIG)</i> 2. <i>Red Dragon Operations Manual</i> Equipment: Red Dragon PSD Handouts: None
	<ol style="list-style-type: none"> I. Pre – Operational Events <ol style="list-style-type: none"> A. Operational Briefing <ol style="list-style-type: none"> 1. Objectives 2. Organization and Personnel 3. Assignments 4. Air Operations Summary 5. Weather 6. Fire Behavior 7. Communications Plan 8. Medical Plan 9. Crash Rescue Plan <ol style="list-style-type: none"> a. Roles and responsibilities b. Engines, hand crews, dozers, aircraft
	<ol style="list-style-type: none"> B. PSD Bench Test <ol style="list-style-type: none"> 1. The purpose of the bench test is to confirm proper operation of PSD and proper sphere ignition. 2. This test need only be conducted once at the start of a multi-day operation.
Instructor Note	Details of the Bench Test Procedure will be covered in Unit #6


Interagency Aerial Ignition Guide
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<p style="text-align: center;">Pre - Operational Events</p> <p>Helibase Briefing</p> <ul style="list-style-type: none"> • Organization and Personnel • Communications • Landing Areas • Safety / Hazards • Operations • Administration 	<p>C. Helibase Briefing</p> <ol style="list-style-type: none"> 1. Organization and personnel 2. Communications 3. Landing Areas 4. Safety / Hazards 5. Operations 6. Administration
<p style="text-align: center;">Operational Events</p> <p>PSD Installation</p> <ul style="list-style-type: none"> • Prepare PSD Outside Aircraft Safety Circle • Prepare Aircraft • Install PSD in Aircraft <p>Pre-Flight Checks</p> <ul style="list-style-type: none"> • Check Function of PSD 	<p>II. Operational Events</p> <p>A. Machine Installation</p> <p>B. Pre-flight Checks</p>
<p style="text-align: center;">Operational Events</p> <p>Pre-Flight Briefing</p> <ul style="list-style-type: none"> • PSD Operator, Firing Boss, Pilot • Safety / Aerial Hazards • Weight and Balance • In-Flight Commands • Emergency Procedures • Frequency Management • Available Flight Time • Aircrew Responsibilities • PSD Go / No Go checklist • Equipment Installation 	<p>C. Preflight Briefing</p> <ol style="list-style-type: none"> 1. The pilot, ignition specialist, and PSD operator must be present at the pre-mission aircraft briefing 2. This briefing should address: <ol style="list-style-type: none"> a. Safety / Aerial Hazards b. Weight and Balance c. In-flight Commands d. Emergency Procedures e. Frequency Management f. Available Flight Time g. Aircrew Responsibilities h. PSD Go / No Go checklist. 3. The pilot and/or mechanic must inspect and approve of the PSD machine installation.
<p style="text-align: center;">Operational Events</p> <p>Pre-Burn Reconnaissance</p> <ul style="list-style-type: none"> • PSD Operator, Firing Boss, Pilot • A thorough recon of the burn area and a discussion of the burn objectives are essential to a successful firing operation. <p>Test Fire</p> <ul style="list-style-type: none"> • Provides information, allowing the burning organization to predict whether they will produce a positive outcome. 	<p>D. Pre Burn Reconnaissance</p> <ol style="list-style-type: none"> 1. A thorough recon of the burn area and a discussion of the burn objectives are essential to a successful firing operation 2. Participants should include the pilot, burn boss, and PSD Operator <p>E. Test Fire</p> <ol style="list-style-type: none"> 1. The purpose of the test burn is to provide information, allowing the burning organization to predict whether they will produce a positive outcome.

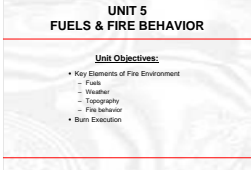

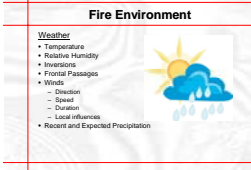
Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
 UNIT 4: OPERATIONS

<p>IAIG Ch III.XI.A</p> <hr/> <p style="text-align: center;">PSD Operation</p> <p><i>Firing Commands and Actions</i></p> <table border="1" style="width: 100%; border-collapse: collapse; font-size: 8px;"> <thead> <tr> <th style="text-align: left;">Firing Boss Command</th> <th style="text-align: left;">PSD Operator Action</th> <th style="text-align: left;">PSD Operator Reply</th> </tr> </thead> <tbody> <tr> <td>"Prepare to Fire"</td> <td>Switch to RUN</td> <td>"Ready to Fire"</td> </tr> <tr> <td>"Start Firing Speed X"</td> <td>Select Speed X Feed Gate OPEN</td> <td>"Firing Speed X"</td> </tr> <tr> <td>"Prepare to Stop Firing"</td> <td>Grasp Remote Control</td> <td>"Ready to Stop Firing"</td> </tr> <tr> <td>"Stop Firing"</td> <td>Feed Gate CLOSE Check Gate Closed</td> <td>"Gates Closed"</td> </tr> <tr> <td>"Secure Machine"</td> <td>Check Drive Stopped Switch to STOP</td> <td>"Machine Cleared" "Machine Secured"</td> </tr> </tbody> </table> <p style="font-size: 8px;">Ref: IAIG Ch III.XI.A</p>	Firing Boss Command	PSD Operator Action	PSD Operator Reply	"Prepare to Fire"	Switch to RUN	"Ready to Fire"	"Start Firing Speed X"	Select Speed X Feed Gate OPEN	"Firing Speed X"	"Prepare to Stop Firing"	Grasp Remote Control	"Ready to Stop Firing"	"Stop Firing"	Feed Gate CLOSE Check Gate Closed	"Gates Closed"	"Secure Machine"	Check Drive Stopped Switch to STOP	"Machine Cleared" "Machine Secured"	<p>III. PSD Operation</p> <p style="text-align: center;">A. Firing Commands and Actions</p> <table border="1" style="width: 100%; border-collapse: collapse; font-size: 12px;"> <thead> <tr> <th style="text-align: left;">Firing Boss Command</th> <th style="text-align: left;">PSD Operator Action</th> <th style="text-align: left;">PSD Operator Reply</th> </tr> </thead> <tbody> <tr> <td>"Prepare to Fire"</td> <td>Switch to RUN</td> <td>"Ready to Fire"</td> </tr> <tr> <td>"Start Firing Speed X"</td> <td>Select Speed X Feed Gate OPEN</td> <td>"Firing Speed X"</td> </tr> <tr> <td>"Prepare to Stop Firing"</td> <td>Grasp Remote Control</td> <td>"Ready to Stop Firing"</td> </tr> <tr> <td>"Stop Firing"</td> <td>Feed Gate CLOSE Check Gate Closed</td> <td>"Gates Closed"</td> </tr> <tr> <td></td> <td>Check Drive Stopped</td> <td>"Machine Cleared"</td> </tr> <tr> <td>"Secure Machine"</td> <td>Switch to STOP</td> <td>"Machine Secured"</td> </tr> </tbody> </table>	Firing Boss Command	PSD Operator Action	PSD Operator Reply	"Prepare to Fire"	Switch to RUN	"Ready to Fire"	"Start Firing Speed X"	Select Speed X Feed Gate OPEN	"Firing Speed X"	"Prepare to Stop Firing"	Grasp Remote Control	"Ready to Stop Firing"	"Stop Firing"	Feed Gate CLOSE Check Gate Closed	"Gates Closed"		Check Drive Stopped	"Machine Cleared"	"Secure Machine"	Switch to STOP	"Machine Secured"
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<hr/> <p style="text-align: center;">Operational Events</p> <p><i>Purge Sequence</i></p> <ul style="list-style-type: none"> • After gates closed, the drive motor runs to purge remaining three spheres. • Three revolutions. • Increase speed to shorten purge time. 	<p style="text-align: center;">B. Purge Sequence</p> <ol style="list-style-type: none"> 1. After the feed gate is closed, the drive motor continues to run to purge the three remaining spheres in the PSD. 2. Two revolutions are required, but the machine runs for three revolutions just in case. 3. To shorten purge time, operator can increase speed. 																																							
<hr/> <p style="text-align: center;">Operational Events</p> <p><i>Anti-Jam Sequence</i></p> <ul style="list-style-type: none"> • Controller detects jam if the motor should be turning, but it is not. • Motor reverses direction at slow speed for a fraction of a second to allow the jam to clear. • "MOTOR FAULT" indicator on the main control panel illuminates • The "FAULT" indicator on the remote control flashes. • Motor resumes forward operation at the selected speed. • Fault indicators extinguish. 	<p style="text-align: center;">C. Anti-Jam Sequence</p> <ol style="list-style-type: none"> 1. Controller can detect a jam when the motor should be turning, but it is not. 2. When a jam is detected, the motor reverses direction at slow speed for a fraction of a second to allow the jam to clear. 3. The "MOTOR FAULT" indicator on the main control panel illuminates 4. The "FAULT" indicator on the remote control illuminates. 5. The motor then resumes operation in the forward direction at the selected speed. 6. The fault indicators extinguish. 																																							



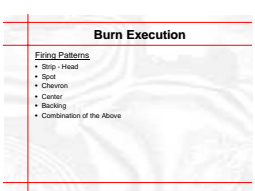


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Instructor Note	The jettison of a PSD from the aircraft has not been accomplished during a live operation to the best of current knowledge. The IAIG states that this should be done in the event of an uncontrollable fire. It is recommended that you first use water to extinguish the fire; if this doesn't work, jettison the hopper to remove the fuel source. As a last resort jettison the PSD.
	<p>V. Post Operational Events</p> <ul style="list-style-type: none">A. Post Operation Debriefing<ul style="list-style-type: none">1. Successes & Failures2. Consequences and MitigationB. Documentation<ul style="list-style-type: none">1. Aircraft / Flight Use Report (OAS 23 / FS-6500-122)2. Unit log3. Cost summary4. PSD logbook5. Safecom (OAS 34 / FS-5700-14)6. SafeNetC. Equipment Maintenance and Storage

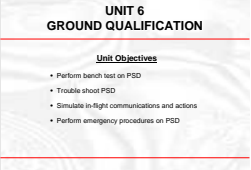
Interagency Aerial Ignition Guide
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 UNIT 5: FUELS AND FIRE BEHAVIOR

ITEM	DESCRIPTION
UNIT 5: FUELS AND FIRE BEHAVIOR	
<p>Unit Objective</p> 	<ol style="list-style-type: none"> 1. Identify key elements of the fire environment <ol style="list-style-type: none"> a. Fuels b. Weather c. Topography d. Fire behavior 2. Discuss how the fire environment influences burn execution.
Class Time	1 hour classroom
Materials, Equipment, & Handouts	Materials: None Equipment: Computer, computer projector Handouts: None
Instructor Note	This is an optional unit. Spend more time on this unit if pilots are taking the aerial ignition training for the first time.
	<ol style="list-style-type: none"> I. Fire Environment <ol style="list-style-type: none"> A. Fuel Characteristics <ol style="list-style-type: none"> 1. Type and loading 2. Continuity 3. Fuel moisture 4. Chemical properties
	<ol style="list-style-type: none"> B. Weather Factors <ol style="list-style-type: none"> 1. Temperature 2. Relative humidity 3. Inversions 4. Frontal passages 5. Winds <ol style="list-style-type: none"> a. Direction b. Speed c. Duration d. Local influences 6. Recent and expected precipitation

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 UNIT 5: FUELS AND FIRE BEHAVIOR

<p style="text-align: center;">Fire Environment</p> <p><u>Topography</u></p> <ul style="list-style-type: none"> • Slope • Aspect • Elevation • Local Influences <ul style="list-style-type: none"> - canyons - lakes - mountains - glaciers 	<p>C. Topography</p> <ol style="list-style-type: none"> 1. Slope 2. Aspect 3. Elevation 4. Local influences <ol style="list-style-type: none"> a. canyons b. lakes c. mountains d. glaciers
<p style="text-align: center;">Fire Behavior</p> <p><u>Fire Types</u></p> <ul style="list-style-type: none"> • Surface • Crown <p><u>Fire Growth</u></p> <ul style="list-style-type: none"> • Head Fire • Backing Fire • Flanking Fire 	<p>II. Fire Behavior</p> <p>A. Fire Types</p> <ol style="list-style-type: none"> 1. Surface 2. Crown
<p style="text-align: center;">Burn Execution</p> <p><u>Firing Patterns</u></p> <ul style="list-style-type: none"> • Strip - Head • Spot • Chevron • Center • Backing • Combination of the Above 	<p>B. Fire Growth</p> <ol style="list-style-type: none"> 1. Head Fire 2. Backing Fire 3. Flanking Fire
<p style="text-align: center;">Burn Execution</p> <p><u>Interaction</u></p> <ul style="list-style-type: none"> • Fuels, weather, topography, the behavior, and ignition pattern interact to create fire effects. • Adjustments to firing patterns can be made to produce fire effects that will meet burn objectives. 	<p>III. Burn Execution</p> <p>A. Aerial Ignition Firing Patterns</p> <ol style="list-style-type: none"> 1. Strip - Head 2. Spot 3. Chevron 4. Center 5. Backing 6. Combination of the Above
<p style="text-align: center;">Burn Execution</p> <p><u>Interaction</u></p> <ul style="list-style-type: none"> • Fuels, weather, topography, the behavior, and ignition pattern interact to create fire effects. • Adjustments to firing patterns can be made to produce fire effects that will meet burn objectives. 	<p>B. Interaction</p> <ol style="list-style-type: none"> 1. Fuels, weather, topography, fire behavior, and ignition pattern interact to create fire effects. 2. Adjustments to firing patterns can be made to produce fire effects that will meet burn objectives.

Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
 UNIT 6: GROUND QUALIFICATION

ITEM	DESCRIPTION
UNIT 6: GROUND QUALIFICATION	
Unit Objectives 	<ol style="list-style-type: none"> 1. Perform bench test on PSD 2. Simulate in-flight communications and actions. 3. Perform emergency procedures on PSD. 4. Troubleshoot the PSD.
Instructor Note	<p>The purpose of the ground qualification is to confirm that trainees are safe to operate the Red Dragon in the aircraft. Under no circumstances will a trainee be allowed to operate the machine in the aircraft before passing the ground qualification.</p> <p>A ratio of 5 trainees and 1 Red Dragon PSD per instructor is recommended.</p>
Class Time	1-3 hours outside
Materials, Equipment, & Handouts	<p>Materials: <ol style="list-style-type: none"> 1. <i>Interagency Aerial Ignition Guide (IAIG)</i> 2. <i>Red Dragon Operations Manual</i> </p> <p>Equipment: <ol style="list-style-type: none"> 1. Red Dragon PSD 2. Red Dragon Spheres 4. Ethylene glycol 5. Power source (24-volt converter) 6. Water 7. Metal bucket 3. Tool kit 8. Spare parts 9. Chair or seat 10. Harness(es), tethers, and carabiners </p> <p>Handouts: None</p>
Instructor Note	<p>This phase of the training requires the activation of ignited spheres that will create several safety hazards to training personnel and adjoining property if not properly conducted.</p>

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UNIT 6: GROUND QUALIFICATION

	<p>I. Bench Testing</p> <p>A. Selection of Bench Testing Site</p> <ol style="list-style-type: none">1. The training site must be outdoors and clear of buildings, vehicles, aircraft, and flammable materials.2. Adequate fire extinguishers and water sources must be available.3. During this session, spheres should not be dropped in the water. If moisture is allowed to come in contact with an injected live sphere, the sphere may be propelled erratically long distances endangering personnel and property.4. The wind direction must be considered so that the operator and trainees will stay clear of the smoke.5. During bench testing operations, designated individuals will remove activated spheres from the test area.6. The test platform needs to be stable to allow for the proper installation of the PSD. (i.e., PSD box, heavy duty picnic table, or bench).
	<p>B. Test Procedure</p> <ol style="list-style-type: none">1. Remove the base adapter and hopper assembly and set aside.2. Mount the Red Dragon securely on a suitable table or bench.3. Connect the bench test power cord to the Red Dragon dispenser. Connect the other end of the power cord to the optional 28VDC power supply or to two 12VDC batteries wired in series to produce 24VDC.4. Ensure water drain valves is closed. Check / fill the water tank. A safety interlock, indicated by a light on the main body control panel, will inhibit system operation if the water tank is not sufficiently filled with water.5. Ensure glycol drain valves is closed. Check / fill the glycol tank with undiluted and unused ethylene glycol (anti-freeze).

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Red Dragon PSD Operator Training (12-01-07)
UNIT 6: GROUND QUALIFICATION

	<ol style="list-style-type: none">6. Remove the two pump assemblies from the injection head by loosening the captive screws in the side panel. Prime each pump assembly by squeezing and releasing the pump arm until glycol squirts from the injection needle. Replace the pump assemblies.7. Place an open-top metal container under the injection head outlet.8. Attach the tethered remote control to the control panel on the main body.9. Press the main circuit breaker on the front panel to the reset position.10. Switch the "RUN/STOP" switch on the main control panel to "RUN".11. Set the "SPEED" switch on the tethered remote control to "1."12. Place two spheres into each of the cavities of the gate assembly.13. Press and release the "FEED GATE" switch on the tethered remote control to the "OPEN" position.14. When the second sphere exits the machine, begin timing the ignition delay. The injected spheres should ignite within 25-30 seconds depending on temperature. Only three of the four spheres will ignite as the first sphere is not injected15. Press the "FEED GATE" switch on the tethered remote control to "CLOSE."16. Switch the "RUN/STOP" switch on the main control panel to "STOP."
Instructor Note	At the end of this exercise, the instructor should demonstrate the effect of loose potassium permanganate coming in contact with glycol and how water is effective in extinguishing the chemical.

Interagency Aerial Ignition Guide
 Red Dragon PSD Operator Training (12-01-07)
 UNIT 6: GROUND QUALIFICATION

	<p>II. Normal Operation</p> <p>The instructor will establish a trainee rotation and test each trainee on the correct actions and responses to the firing commands.</p>
<p>Instructor Note</p>	<p>The trainees shall wear flight helmet, and flight gloves to simulate flight conditions.</p> <p>Test each trainee in front of the group. The repetition of hearing the commands and seeing the actions will help reinforce them to all the trainees.</p>
	<p>A. Prepare the PSD.</p> <ol style="list-style-type: none"> 1. Remove both glycol pump assemblies from the injection head. 2. Install the hopper assembly and fill with spheres. <p>B. Review the firing commands and actions with the trainees.</p> <p>C. Test each trainee with the following command / action sequence.</p> <ol style="list-style-type: none"> 1. Give command “Prepare to Fire” <ol style="list-style-type: none"> a. Trainee sets switch to “RUN” b. Trainee replies “Ready to Fire” 2. Give command “Start Firing Speed 4” <ol style="list-style-type: none"> a. Trainee sets speed to “4” b. Trainee presses Feed Gate Open. c. Trainee replies “Firing Speed 4” 3. Give command “Prepare to Stop Firing” <ol style="list-style-type: none"> a. Trainee replies “Ready to Stop” 4. Give command “Stop Firing” <ol style="list-style-type: none"> a. Trainee pressed Feed Gate Close. b. Trainee checks that gate has closed. c. Trainee replies “Gates Closed” d. Trainee waits for drive motor to stop. e. Trainee replies “Machine Cleared” 5. Give command “Secure Machine” <ol style="list-style-type: none"> a. Trainee sets switch to “STOP” b. Trainee replies “Machine Secured”

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 UNIT 6: GROUND QUALIFICATION

	<p>III. Emergency Procedures</p> <p>The instructor will establish a trainee rotation and test each trainee on the correct actions for various emergency situations.</p> <p>Although there are two types of machine malfunctions that can leave a live sphere in the machine and will cause a fire inside the machine, the emergency corrective procedure is the same.</p>
Instructor Note	<p>The trainees shall wear flight helmet, and flight gloves to simulate flight conditions.</p>
	<p>A. Review the emergency procedures with the trainees</p> <ol style="list-style-type: none"> 1. Power Failure 2. Sphere Jam 3. Fire in PSD 4. PSD Jettison <p>B. Test each trainee with the following procedure.</p> <ol style="list-style-type: none"> 1. Use normal firing commands to get into firing sequence. 2. Give commands to open and close the feed gates and change speeds to keep the operator distracted. 3. Create malfunctions at random by turning off the power supply to simulate power failure or sphere jam. 4. You must emphasize to the trainees that if the manual assist stops turning, the operator must initiate emergency procedures to clear the machine.
Instructor Note	<p>During this exercise, the instructor should become aware of the trainees' abilities to react to stressful conditions and to operate the machine.</p> <p>Any trainee who can't satisfactorily perform shall not be allowed to operate the machine in the aircraft.</p>
Instructor Note	<p>It is very difficult to manipulate the machine so the trainee cannot clear the machine using the manual hand wheel. The instructor must ask each trainee to demonstrate the correct procedure to follow if the manual hand wheel fails to clear the machine.</p>

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IV. Troubleshooting

A. No power to the PSD. (“POWER” indicator not illuminated)

1. Check that the PSD main circuit breaker is not tripped.
2. Check that the power cord is properly attached to the launcher.
3. Check that the power cord is properly attached to the aircraft outlet.
4. Check that the aircraft circuit breaker is not tripped.

B. Hopper motor does not start (“RUN/STOP” in “RUN” position)

1. Check that the PSD has external power. If not see A
2. Check that the “LOW WATER” indicator is not illuminated.
3. Check that the hopper is seated correctly on the gate assembly.
4. Remove the hopper and check that the agitator mechanism is not jammed.

C. The drive motor does not start when feed gate is open.

1. Check that the “RUN/STOP” is in the “RUN” position.
2. Check the “MOTOR FAULT” indicator to determine if a sphere jam has occurred.
3. Check that the tethered remote control is connected properly.

D. Feed Gates won't Open

1. Check that the tethered remote control is connected properly.
2. Remove the hopper and gate assembly and check for obstructions in the gate assembly.

E. The spheres do not flow when the drive is operational.

1. Check that the feed gate is in the open position.
2. Check that no jam has occurred in the hopper outlet.
3. Remove the hopper and gate assembly and check for obstructions in the feed gate and injection head.

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F. Plastic spheres do not ignite.

1. Check the glycol level in the tank.
2. Check that injection needles are not plugged.
3. Squeeze and release pump arm to check that pump is primed.

G. The water system does not function.

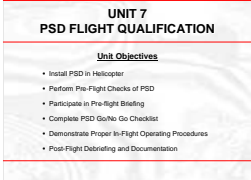
1. Check the water level in the tank.
2. Check the water pump by removing the water lines from the water nozzles and activating the pump switch.
3. Check that the water nozzles are not blocked.
4. Check for frozen lines when working in cold temperatures.

H. Leakage of glycol.

1. Check that the glycol drain valve is closed.
2. Check all glycol lines and fittings for leakage.

Note: Any spilled glycol must be cleaned up thoroughly.

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 UNIT 7: PSD FLIGHT QUALIFICATION

ITEM	DESCRIPTION
UNIT 7: PSD FLIGHT QUALIFICATION	
<p>Unit Objectives</p>  <p>UNIT 7 PSD FLIGHT QUALIFICATION</p> <p>Unit Objectives</p> <ul style="list-style-type: none"> • Install PSD in Helicopter • Perform Pre-Flight Checks of PSD • Participate in Pre-Flight Briefing • Complete PSD Go/No Go Checklist • Demonstrate Proper In-Flight Operating Procedures • Post-Flight Debriefing and Documentation 	<ol style="list-style-type: none"> 1. Successfully install Red Dragon PSD in the Helicopter 2. Perform preflight checks on Red Dragon PSD. 3. Participate in the preflight briefing with pilot, burn boss/ignition specialist, helibase manager, and operator; and complete PSD Air Operations/Safety Go/No Go Checklist. 4. Demonstrate proper operating procedures of Red Dragon PSD while in flight. 5. Post flight debriefing and documentation.
Class Time	Suggested time will vary due to class size. We will use the classroom and field for this unit. The instructor needs to consider the logistics for the field operations: travel time, lunch, water, etc.
Materials, Equipment, & Handouts	<p>Materials: 1. <i>Interagency Aerial Ignition Guide (IAIG)</i></p> <p> 2. <i>Red Dragon Operations Manual</i></p> <p>Equipment: 1. Personal protective equipment</p> <p> 2. Red Dragon PSD</p> <p> 3. Helicopter</p> <p> 4. PSD operator safety harness</p> <p> 5. Fire shelters</p> <p> 6. Ethylene glycol</p> <p> 7. Water</p> <p> 8. Spheres</p> <p> 9. Metal bucket</p> <p> 10. Helicopter support kit</p> <p> 11. Shovel</p> <p> 12. Pulaski</p> <p> 13. Tri-max or fire protection group (optional)</p> <p>Handouts: 1. PSD Operations Checklist</p>
	<p>I. Preparation of Red Dragon PSD</p> <p>The Red Dragon PSD must be readied for installation outside the safety circle of the aircraft.</p> <p>A. Ensure glycol tank drain is closed. Fill the glycol tank at least 25 feet from the aircraft.</p> <p>B. Ensure water drain tank is closed. Fill the water tank.</p>

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UNIT 7: PSD FLIGHT QUALIFICATION

	<p>II. Preparation of Aircraft</p> <ul style="list-style-type: none">A. Remove the appropriate door/doors from the aircraft.B. Remove all loose cushions and other loose materials.C. Use tape or other means to protect aircraft paint finish. Consult pilot.D. Locate and ensure proper electrical fittings.
	<p>III. Installation</p> <ul style="list-style-type: none">A. If installing in a Bell 206 series aircraft, install the base adapter into the aircraft.B. Install Red Dragon in the doorway.C. Attach the outlet chute.D. Attach belly strap:<ul style="list-style-type: none">1. Clips on "Y" end attach to PSD frame beside outlet chute.2. Pass strap under the fuselage, making sure it clears all wiring and accessories attached to the bottom of the aircraft.3. Return through the opposite door.4. Fasten to adjuster buckle on Red Dragon handle.5. Cinch tight and secure loose ends.E. Attach remote control to connection on front panel of PSD.F. Connect power supply cord to aircraft power supply.G. Connect power supply cord to PSD and secure breakaway connection with velcro straps.H. Reset the main circuit breaker and check that the POWER indicator on the main control panel illuminates. If the breaker trips immediately, check wiring polarity.

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 UNIT 7: PSD FLIGHT QUALIFICATION

	<p>IV. Preflight Briefing</p> <p>A. The pilot, ignition specialist, and PSD operator must be present at the pre-mission aircraft briefing</p> <p>B. This briefing should address:</p> <ol style="list-style-type: none"> 1. Safety / Aerial Hazards 2. Weight and Balance 3. In-flight Commands 4. Emergency Procedures 5. Frequency Management 6. Available Flight Time 7. Aircrew Responsibilities 8. PSD Go / No Go checklist. <p>C. The pilot and/or mechanic must inspect and approve of the PSD installation.</p>
<p>Instructor Note</p>	<p>Pass out the PSD Operations Checklist and review.</p>
<p>Instructor Note</p>	<p>Specific crash procedures and crash seating positions must be discussed in the preflight briefing for aircraft being used</p>
	<p>V. Preflight Check</p> <p>A. Reset main circuit breaker.</p> <ol style="list-style-type: none"> 1. Check POWER indicator on main control panel illuminated. 2. Check PWR indicator on remote control illuminated. 3. Check LOW WATER indicator on main control panel not illuminated. <p>B. Switch RUN/STOP to RUN position.</p> <ol style="list-style-type: none"> 1. Check hopper agitator motor starts 2. Check indicator above RUN/STOP switch illuminates 3. Check RUN indicator on remote control illuminates. <p>C. Press FEED GATE switch to OPEN position.</p> <ol style="list-style-type: none"> 1. Check feed gate opens. 2. Check injection drive motor starts 3. Check RUN indicator on remote control flashes. 4. Check LED display on main control panel is counting spheres.

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UNIT 7: PSD FLIGHT QUALIFICATION

- D. Adjust the SPEED control from 1 to 7
 - 1. Check injection drive motor speed changes.
- E. Press FEED GATE switch CLOSE position.
 - 1. Check feed gates close immediately.
 - 2. Check injection drive motor purges machine and stops.
 - 3. Check RUN indicator on remote control stops flashing.
 - 4. Check LED display on main control panel stops counting spheres.
- F. Press the COUNT switch to the RESET position and hold for two seconds.
 - 1. Check that sphere count resets to zero.
 - 2. Switch RUN/STOP to STOP position.
 - 3. Check hopper agitator motor stops
 - 4. Check indicator above RUN/STOP switch extinguishes.
 - 5. Check RUN indicator on remote control extinguishes.
- G. Remove the hopper. Remove the Gate Assembly. Press and hold the "WATER" switch on the main control panel.
 - 1. Check that pump injects water into both chambers.
 - 2. Check that indicator on main control panel illuminates.
- H. Check that a one gallon container of water is available.
- I. Check that a sharp knife is within reach of the PSD operator.
- J. Check that PSD harness is secure and attached to helicopter hard points and seatbelt is on and buckled.
- K. Check that additional spheres carried within the aircraft are properly secured.
- L. Check one fire shelter per occupant of the aircraft.
- M. Check the intercom and air-to-ground communications.

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Red Dragon PSD Operator Training (12-01-07)
UNIT 7: PSD FLIGHT QUALIFICATION

	<p>VI. In-Flight Operations</p> <ul style="list-style-type: none">A. Dry run over the burn area proceduresB. Check that the burn area is clear of personnel.C. Identify burn area boundaries.D. Ensure communication with ground personnel.E. Make practice run of the first firing sequence.F. Coordinate machine speed and sphere spacing to be used on the first run with burn boss/ignition specialist.G. Identify helispots and emergency landing areas.H. Notify ground personnel that ignition will commence.
	<p>VII. Ignition Operation</p> <ul style="list-style-type: none">A. The burn boss/ignition specialist gives the directions as to where he/she wants the spheres 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 (burn boss/ignition specialist, pilot, and PSD operator) understand where the firing is to be done. This includes the starting points, ending points, and desired placement and spacing.B. The maximum recommended speed should be 50 mph. Slow aircraft speed to planned application speed when the firing operation is in progress. Optimum speed is 25 to 35 mph.C. The firing boss gives direction to the pilot once the firing run has begun and during the dry run to ensure correct placement of the injected spheres.D. Recommended flight operations are between 300' AGL and 500'AGL. Some firing operations may be above 500' AGL, but never below 300' AGL.E. Occupants of the helicopter shall be limited to the pilot, PSD operator, and burn boss/ignition specialist or instructor if essential to the mission.F. When the helicopter with the PSD leaves the burn area (crosses a fire control line) the RUN/STOP switch must be in the STOP position.

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Red Dragon PSD Operator Test

- 1. List some of the advantages of using a PSD compared with a Helitorch.**
 - a. _____
 - b. _____
 - c. _____
 - d. _____
 - e. _____
 - f. _____

- 2. Aerial ignition can utilize firing patterns that could not be implemented by ground forces due to safety concerns.**
 - a. true
 - b. false

- 3. In the planning for the use of the PSD what equipment and personnel must be qualified/approved to perform the mission? (Circle your answers.)**
 - a. Pilot
 - b. Burn Boss
 - c. Helicopter
 - d. Line Officer

- 4. Who holds the ultimate responsibility for the safety of the aircraft? (Circle your answer.)**
 - a. Burn Boss
 - b. Pilot
 - c. Line Officer
 - d. Dispatch

- 5. Approximately how many spheres does the hopper hold?**
 - a. 250
 - b. 450
 - c. 950

Interagency Aerial Ignition Guide
Red Dragon PSD Operator Training (12-01-07)
Red Dragon PSD Operator Test

6. What is the rounded up weight of the Red Dragon PSD with full fluids and hopper full? Circle your answer.

- a. 50 lb
- b. 70 lb
- c. 100 lb

7. What is the operating voltage of the Red Dragon PSD in the helicopter? (Circle your answer)

- a. 12V
- b. 24V
- c. 120V
- d. 220V

8. During the bench test of the machine live spheres are ran through the Red Dragon PSD. What variables can affect ignition time?

- a. _____
- b. _____
- c. _____

9. It is acceptable to transport both the spheres and glycol in the same compartment, if they are both in factory sealed containers?

- a. true
- b. false

10. List the PPE that is required of the PSD Operator.

- a. _____
- b. _____
- c. _____
- d. _____

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Red Dragon PSD Operator Test

11. What person needs to be present during the installation of the machine in the helicopter and needs to inspect and approve its installation?

_____ OR _____

12. During the preflight you discover that the water pump will not work. Since you have an alternate water source is it ok to continue to use the machine?

- a. yes
- b. no

13. The power cord to the helicopter is missing. The mechanic suggests hooking up two car batteries in series and putting them on the floor of the aircraft for power. Since they are sealed maintenance free batteries this is ok.

- a. true
- b. false

14. Glycol and water can be added to the machine while it is mounted in the helicopter.

- a. true
- b. false

15. What two documents will prove that the aircraft and pilot are certified / approved to fly the Red Dragon PSD?

- a. _____
- b. _____

16. A gallon of water and a seat belt cutter must be carried on board the helicopter within reach of the operator at all times.

- a. true
- b. false

17. List the individuals by job title that should be present at the pre-mission aircraft briefing.

- a. _____
- b. _____
- c. _____

Interagency Aerial Ignition Guide
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Red Dragon PSD Operator Test

18. List the subjects that should be discussed and clarified at the pre-flight briefing.

- a. _____ e. _____
b. _____ f. _____
c. _____ g. _____
d. _____ h. _____

19. It is an interagency regulation that a manifest and a _____ form be completed for weight and balance prior to each mission?

20. Personnel allowed onboard during the mission include; circle the correct answers.

- a. Aerial Observer
- b. Holding Boss
- c. Helicopter Engineer
- d. Pilot Trainee

21. Aerial ignition personnel should make a dry run over the planned burn unit prior to starting ignition.

- a. true
- b. false

22. The maximum recommended flight speed during dispersal of spheres with the Red Dragon PSD is?

_____ MPH

23. During your burn operation, where do you store extra spheres and glycol in the aircraft?

Spheres _____

Glycol: _____

Interagency Aerial Ignition Guide
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Red Dragon PSD Operator Test

24. Fill in the appropriate commands C and responses R.

Firing Boss Commands	PSD Operator Responses
“Prepare to Fire”	_____
“Start Firing Speed X”	_____
“Prepare to Stop Firing”	_____
“Stop Firing”	_____ and _____
“Secure Machine”	_____

25. What determines the spacing of the spheres?

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

26. Why is it important that the operator inform the pilot/burn boss that the machine has been cleared and secured?

27. A damaged or dull injector needle could cause a sphere to jam in the dispenser?

- a. true
- b. false

Interagency Aerial Ignition Guide
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Red Dragon PSD Operator Test

28. What are the two actions to be taken if a fire occurs in the machine?

a. _____

b. _____

29. The PSD should be cleaned thoroughly after each use.

a. true

b. false

30. What type of lubricant is used on the Red Dragon PSD?

Interagency Aerial Ignition Guide
Red Dragon PSD Operator Training (12-01-07)
Red Dragon PSD Operator Test Answer Key

1. **List some of the advantages of using a PSD compared with a Helitorch.**
 - a. Labour Efficient
 - b. Cost Effective
 - c. Controllability of Firing
 - d. Fewer Support People
 - e. Lower Initial Purchase Cost
 - f. Burn Boss on Board
2. **Aerial ignition can utilize firing patterns that could not be implemented by ground forces due to safety concerns.**
 - a. true
 - b. false
3. **In the planning for the use of the PSD what equipment and personnel must be qualified/approved to perform the mission? (Circle your answers.)**
 - a. Pilot
 - b. Burn Boss
 - c. Helicopter
 - d. Line Officer
4. **Who holds the ultimate responsibility for the safety of the aircraft? (Circle your answer.)**
 - a. Burn Boss
 - b. Pilot
 - c. Line Officer
 - d. Dispatch
5. **Approximately how many spheres does the hopper hold?**
 - a. 250
 - b. 450
 - c. 950

Interagency Aerial Ignition Guide
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Red Dragon PSD Operator Test Answer Key

6. What is the rounded up weight of the Red Dragon PSD with full fluids and hopper full?
Circle your answer.
- a. 50 lb
 - b. 70 lb**
 - c. 100 lb
7. What is the operating voltage of the Red Dragon PSD in the helicopter? (Circle your answer)
- a. 12V
 - b. 24V**
 - c. 120V
 - d. 220V
8. During the bench test of the machine live spheres are ran through the Red Dragon PSD. What variables can affect ignition time?
- a. Temperature
 - b. Humidity
 - c. Amount of Glycol
9. It is acceptable to transport both the spheres and glycol in the same compartment, if they are both in factory sealed containers?
- a. true
 - b. false**
10. List the PPE that is required of the PSD Operator.
- a. Approved Flight Helmet
 - b. Flight Suit or Fire Resistant Pants & Shirt
 - c. Leather Boots above Ankle
 - d. Leather / Nomex Flight Gloves

Interagency Aerial Ignition Guide
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Red Dragon PSD Operator Test Answer Key

11. What person needs to be present during the installation of the machine in the helicopter and needs to inspect and approve its installation?

Pilot OR **Mechanic**

12. During the preflight you discover that the water pump will not work. Since you have an alternate water source is it ok to continue to use the machine?

a. yes

b. no

13. The power cord to the helicopter is missing. The mechanic suggests hooking up two car batteries in series and putting them on the floor of the aircraft for power. Since they are sealed maintenance free batteries this is ok.

a. true

b. false

14. Glycol and water can be added to the machine while it is mounted in the helicopter.

a. true

b. false

15. What two documents will prove that the aircraft and pilot are certified / approved to fly the Red Dragon PSD?

a. Pilot Qualification Card

b. Helicopter Data Card

16. A gallon of water and a seat belt cutter must be carried on board the helicopter within reach of the operator at all times.

a. true

b. false

17. List the individuals by job title that should be present at the pre-mission aircraft briefing.

a. **Pilot**

b. **PSD Operator**

c. **Ignition Specialist and/or Burn Boss**

Interagency Aerial Ignition Guide
Red Dragon PSD Operator Training (12-01-07)
Red Dragon PSD Operator Test Answer Key

18. List the subjects that should be discussed and clarified at the pre-flight briefing.

- | | |
|---|------------------------------------|
| a. <u>Safety</u> | e. <u>Emergency Procedures</u> |
| b. <u>Personal Protective Equipment</u> | f. <u>Frequency Management</u> |
| c. <u>Aerial Hazards</u> | g. <u>Equipment Installation</u> |
| d. <u>In-Flight Commands</u> | h. <u>Aircrew Responsibilities</u> |

19. It is an interagency regulation that a manifest and a Load Calculation form be completed for weight and balance prior to each mission?

20. Personnel allowed onboard during the mission include; circle the correct answers.

- a. Aerial Observer
- b. Holding Boss
- c. Helicopter Engineer
- d. Pilot Trainee
- e. None of the Above**

21. Aerial ignition personnel should make a dry run over the planned burn unit prior to starting ignition.

- a. true**
- b. false

22. The maximum recommended flight speed during dispersal of spheres with the Red Dragon PSD is?

50 MPH

23. During your burn operation, where do you store extra spheres and glycol in the aircraft?

Spheres: Original Boxes or Approve Bags

Glycol: Not Allowed Onboard

Interagency Aerial Ignition Guide
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Red Dragon PSD Operator Test Answer Key

24. Fill in the appropriate commands C and responses R.

Firing Boss Commands	PSD Operator Responses
“Prepare to Fire”	<u>Ready to Fire</u>
“Start Firing Speed X”	<u>Firing Speed X</u>
“Prepare to Stop Firing”	<u>Ready to Stop Firing</u>
“Stop Firing”	<u>Gates Closed</u> and <u>Machine Cleared</u>
“Secure Machine”	<u>Machine Secured</u>

25. What determines the spacing of the spheres?

- a. Airspeed
- b. Speed Selector
- c. Altitude
- d. Wind Speed
- e. Wind Direction

26. Why is it important that the operator inform the pilot/burn boss that the machine has been cleared and secured?

So that the pilot can leave the burn unit

27. A damaged or dull injector needle could cause a sphere to jam in the dispenser?

- a. true
- b. false

Interagency Aerial Ignition Guide
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Red Dragon PSD Operator Test Answer Key

28. What are the two actions to be taken if a fire occurs in the machine?

a. Notify the Pilot

b. Press the Emergency Water Switch

29. The PSD should be cleaned thoroughly after each use.

a. true

b. false

30. What type of lubricant is used on the Red Dragon PSD?

None