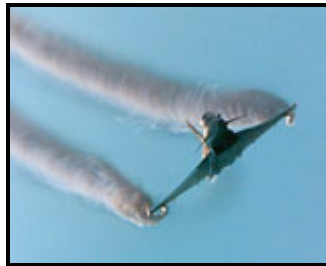


# **SANDERS**



## **SMOKE TECHNOLOGIES, INC.**



## **SMOKEWINDER® 9000-5 and 9000-6**

# **OPERATION AND MAINTENANCE MANUAL**

Revised: January 08, 2015

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## 1.0 INTRODUCTION

Smoke has been used to heighten the visual impact of flight for decades. Usually smoke systems simply pump enough oil into a hot engine exhaust, reciprocating or Jet, to produce a visible plume of smoke.

With jet exhaust systems, smoke quality is generally poor due to dispersion from the high velocity exhaust. The smoke also dissipates rapidly because of high exhaust temperature. At high power settings, especially in after burner, the smoke may disappear altogether.

The Smokewinder®, an airborne self-contained smoke generator, was developed by Sanders Smoke Technologies, Inc. to fill the need for a smoke system that is independent of the engine influence and location. The Smokewinder® has greatly expanded the application and scope to which smoke may be used in aircraft operation.

The following definitions apply to Warnings, Cautions and Notes found throughout this manual:

**Warning: Operating procedures, techniques, etc., which will result in personal injury or loss of life if not carefully followed.**

**Caution: Operating procedures, techniques, etc., which will result in damage to equipment if not carefully followed.**

**Note:** An operating procedure, technique, etc., which is considered essential to emphasize.

Black vertical bars, located in the right outside margin, will highlight the location of revised information in this manual.

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## 2.0 GENERAL DESCRIPTION

### 2.01 Description of Function

The Smokewinder® is an inert smoke system designed to visually and physically resemble a Sidewinder missile in weight, balance, polar moment of inertia and electrical interface. The Smokewinder® operates from an aircraft that is equipped to carry the Sidewinder, however, the Smokewinder® is incapable of being launched from the aircraft; it only produces inert smoke.

Each Smokewinder® (9000-5 wingtip mount left and 9000-6 wingtip mount right) is completely self-contained and will produce up to 6 minutes of dense high quality smoke. Internal tankage is provided for one gallon (3.8 liters) of gasoline and six gallons (22.7 liters) of smoke oil. Gasoline is pumped to a nozzle in the combustion chamber where it is mixed with regulated ram air. A capacitor discharge ignition source charges a coil to fire the igniter, igniting the gasoline/air mixture and providing heat to vaporize the smoke oil. Oil is pumped to a mixing chamber which discharges smoke at the tail of the Smokewinder®. It is important to note that the oil is vaporized, not burned, in the mixing chamber. This assures a maximum volume of high quality smoke from a minimum amount of smoke oil.

The Smokewinder® can be cycled on and off an unlimited number of times until the smoke oil is exhausted or it can produce smoke continuously for approximately 6 minutes. Smokewinders have been operated from sea level to over 30,000 feet, from 65 knots to .80 mach (at sea level) and 9 G's. Models of the Smokewinder® have flown for 30+ years.

### 2.02 Approved Aircraft

The following aircraft have been approved for flight with the Smokewinder®:

- Northrop YF-17
- Northrop F-5E & F-5F
- Northrop F-20
- Lockheed F-16 (all models)
- T-50 Golden Eagle
- Eurofighter EF2000
- Dassault Mirage 2000
- Mig-29
- M-346
- Dassault Rafale
- McDonnell Douglas F-15
- McDonnell Douglas F-18
- McDonnell Douglas A-4
- Saab Gripen
- Taiwan IDF
- Aero Vodochody L-159
- BAE Hawk
- HAL Tejas (LCA)

### 2.03 Mounting

The Smokewinder® is designed to be mounted on a standard AIM-9 Sidewinder launch rail. Therefore, the aircraft need not be segregated as a special air show vehicle. The Smokewinder® affords half-hour change over from front line to exhibition configuration.

### 2.04 Compatibility

The Smokewinder® has the same CG location, gross weight and inertia as the Sidewinder missile.



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## 2.05 Operation

The Smokewinder® can be cycled on and off an unlimited number of times until the smoke oil is exhausted or it can produce smoke continuously for approximately 6 minutes. A pulse of 28vdc from the pilot's trigger button starts the smoke sequence and a second pulse stops the smoke.

## 2.06 Servicing

Servicing the Smokewinder® between operations requires only the addition of ½ gallon of gasoline and 6 gallons of smoke oil

## 2.07 Altitudes

Smokewinders have been operated from sea level to over 30,000 feet. If starting the smoke generator at altitudes higher than 15,000 feet is desired, some special modifications are required.

### 3.0 LIMITATIONS

#### 3.01 Declaration

Sanders Smoke Technologies, Inc. cannot accept responsibility for the satisfactory operation of equipment outside the conditions given below, without Sanders Smoke Technologies, Inc. agreement.

#### 3.02 General

Emission of and Susceptibility to electromagnetic interference.....None established  
 Exposure to Sunlight .....Not Effected  
 External Contamination.....Ram Air Inlet must be free and clear  
 Magnetic Influence .....None established  
 Mounting Attitude ..... Horizontal  
 Mounting Method.....Launch Rail  
 Shelf Life .....Estimated 10 years  
 Ultimate Life .....Not established  
 Water Proofness..... Spray proof

#### 3.03 Dimensions

Overall length ..... 128.625" (3.2671 M)  
 Diameter – Tube body..... 7.25" (184.15 mm)  
 Diameter – With fins ..... 22.0" (558.80 mm)  
 Dry weight ..... 155.6 lbs (70.58 kg) +/-2# (.91 kg)  
 Empty weight..... 158.6 lbs (71.94 kg) +/-2# (.91 kg)  
 Gross weight ..... 203.0 lbs (92.08 kg) +/-2# (.91 kg)  
 CG Dry ..... 63.49" (1.6126 M) aft +/- 0.50" (12.7 mm)  
 CG Empty..... 63.12" (1.6032 M) aft +/- 0.50" (12.7 mm)  
 CG Gross ..... 63.32" (1.6083 M) aft +/- 0.50" (12.7 mm)  
 Inertia Empty ..... 156.1 lbs & 63.00" = 51.60 slug ft<sup>2</sup>  
 Inertia Gross..... 200.5 lbs & 63.23" = 52.94 slug ft<sup>2</sup>

#### 3.04 Electrical

Trigger (On/Off) .....3.5mA, 28vdc  
 Electrical..... 2.7 amps, 28vdc  
 2.8 amps, 115vac 400 hertz single phase

### 3.05 Fuel and Smoke Oil

Preferred Fuel ..... Aviation grade fuel (gasoline)  
 Premium automotive gasoline may be substituted  
 Do not service with jet fuel (JP-4, etc.)

Preferred Smoke Oil..... Light machine oil, 13 viscosity

Note: All paraffin based mineral oils (10 – 22 viscosity) will produce smoke. The difference between the various oils is the density and duration of the smoke produced. The best smoke is produced using the oil with the least amount of additives. Machine oil, commonly referred to as spindle oil, has very few additives and is available in all developed countries.

### 3.06 Operating Limitations

Acceleration..... + 9G's, -3G's

Altitude for Starting Unit ..... 15,000 feet and below  
 Altitude while Operating ..... No altitude limitation established

Ambient Temperature Range..... 40°F (5°C) – 131°F (55°C)

Attitude Deviation during Flight ..... Unlimited

Minimum Starting Speed..... 100 KIAS (all altitudes)  
 Maximum Starting Speed..... Sea Level to 5,000 feet – 350 KIAS  
 10,000 feet – 250 KIAS  
 15,000 feet – 150 KIAS

Maximum Smoke Speed ..... 0.8 Mach  
 Maximum No Smoke Speed ..... Not established

Operating Time..... approximately 6 minutes

Rate of Climb and Descent ..... Unlimited

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## 4.0 THEORY OF OPERATION

### 4.01 General

When the pilot or ground check operator commands the Smokewinder® to operate by pressing and releasing the trigger button, a solid state relay circuit engages, starting the smoke sequence.

With the on command, there are four functions that take place simultaneously. The 28vdc and 115vac 400 hertz single phase (rectified to 28vdc) electrical power is turned on to:

1. The capacitor discharge ignition system for igniter firing (rectified 115vac).
2. The fuel pump turns on (28vdc).
3. The fuel solenoid valve is opened (rectified 115vac). Combustion will start immediately.
4. The smoke oil pump turns on (rectified 115vac). Smoke will start immediately.

With the off command (pressing and releasing the trigger button a second time) power is turned off to all systems. The fuel solenoid valve closes; fuel pump, ignition, and the oil pump stops. The air flow is continuous in flight and keeps the combustion chamber purged and ready for the next smoke operation.

### 4.02 Auto Shutdown

The Smokewinder® is equipped with an auto shutdown system. The smoke oil pump has 8 seconds to exceed 100 PSI and close a pressure switch to continue operating. If the oil pressure drops below 60 PSI (pressure switch opens), for 8 seconds, the Smokewinder® will auto shutdown. The 8 second delay is designed in the system for the occasional pressure loss during some maneuvers; the time does not accumulate. To restart the Smokewinder®, if auto shutdown has occurred, press and release the trigger button.

## 5.0 PILOT'S NOTES – INFLIGHT OPERATION

### 5.01 General

As ram air flow is required to support combustion, we recommend that the Smokewinder® not be started below 100 KIAS. The recommended maximum speed at which the Smokewinder® can be started changes with altitude:

Sea Level to 5,000 feet	350 KIAS
10,000 feet	250 KIAS
15,000 feet	150 KIAS

If the Smokewinder® does not start, try a slower airspeed; this will richen the air/fuel ratio. Also allow approximately 15 seconds between start attempts to allow the combustion chamber to clear out excess fuel. Once started the Smokewinder® should function to a max airspeed of 0.8 Mach. The Smokewinder® can be turned on and off as many times as desired. Once all the smoke oil is consumed (approximately 6 minutes) power to the Smokewinder® should be turned off.

Note: The maximum temperature in the combustion chamber occurs at 200 kts and above. At speeds below 200 kts, the smoke oil may not be fully vaporized, resulting in a “wet” smoke trail.

### 5.02 Smokewinder® Start

Pressing and releasing the trigger button will start the smoke immediately.

### 5.03 Smokewinder® Stop

Pressing and releasing the trigger button a second time will immediately stop all systems in the Smokewinder®.

### 5.04 Smokewinder® Out of Sequence

In the remote case where the two Smokewinder®s would get 180 degrees out of sequence in function (where the command to turn off one Smokewinder® would start function of the other Smokewinder®) depress and hold the trigger button, both Smokewinders will cycle to off after 3 seconds.

### 5.05 Landing Precautions

The Smokewinder® should be turned OFF a minimum of 1 minute prior to landing. This allows time for the combustion chamber to purge and cool down.

We recommend that all the electrical power to the Smokewinder® be OFF. This guarantees that the Smokewinder® cannot be in the on condition.

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## **6.0 SAFETY PROCEDURES**

### **6.01 Handling**

The Smokewinders should be clean and free of oil on the outside. They are rather heavy if serviced (200 lbs [90 kg]) and can be very slippery if wet.

### **6.02 Servicing**

The aircraft should be grounded (earthed) when servicing the Smokewinder®. Because of flammable liquids (gasoline and smoke oil), a fire extinguisher must be available.

### **6.03 Ground Testing and Troubleshooting**

While performing ground tests or troubleshooting of components, because of flammable liquids (fuel and smoke oil), a fire extinguisher must be available.

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## 7.0 MOUNTING

### 7.01 Pre-installation Check – Aircraft

Check launch rails for proper electrical power for operation of an AIM-9 Sidewinder missile. Test boxes (SWRT-1) are available from Sanders Smoke Technologies, Inc.

### 7.02 Pre-installation Check – Smokewinder®

1. Check that the nose cone, tail cone and access door screws are in and tight.
2. Visually check that there is no damage to the Smokewinder®.
3. Visually check that the ram air inlet is free and clear.
4. Recommend loading of the Smokewinder® with a minimum of fuel and smoke oil in tanks to avoid lifting an extra 41.4 lbs (18.8 kg).

### 7.03 Loading Procedures

1. Smokewinder® to be installed on aircraft per instructions for AIM-9 Sidewinder missile.
2. Connect umbilical cable to launch rail power supply.

### 7.04 Pre-unloading Procedures

1. Aircraft should be grounded (earthed) when draining fuel and smoke oil from Smokewinder®. Because of flammable liquids (fuel and smoke oil); a fire extinguisher must be available.
2. It may be desirable, while the Smokewinder® is still installed on the aircraft, to remove the drain plugs from bottom of the Smokewinder® and drain the fuel and smoke oil, so that the Smokewinder® is lighter and easier to handle.

Note: Fuel drain plug has a 1/8" outside diameter (3.2mm) vent pipe attached.

Note: Removing filler plugs first will expedite draining.

3. Recommend checking the Smokewinder® for any stray oil that may make the Smokewinder® hard to handle. Wipe clean.

### 7.05 Unloading Procedures

1. Disconnect umbilical cable from launch rail.
2. Smokewinder® to be removed from aircraft per instructions for AIM-9 Sidewinder missile.

## 8.0 SERVICING

### 8.01 General

**Caution:** Clean fuel and smoke oil are essential; clean funnels, buckets, etc. must be used.

**Caution:** Do not over tighten the filler or drain plugs. Excessive tightening will cause increased wear or seizing of the plugs.

Recommended torque: filler plugs - 240 lb. in. (27Nm)  
drain plugs - 50 lb. in. (6Nm).

### 8.02 Fuel (Gasoline)

1. Remove 3/4" pipe plug from the forward tank marked "FUEL".



2. Service with approximately 1 gallon (3.8 liters) of gasoline. Aviation grade fuel is preferred. Premium automotive gasoline may be substituted.

**Caution:** Do not service with jet fuel (JP-4 etc.). The Smokewinder® will not function.

3. Lubricate plug with fuel resistant grease. Reinstall servicing plug.



### 8.03 Smoke Oil

1. Remove 3/4" pipe plug from the aft tank marked "SMOKE OIL".



2. Service with approximately 6 gallons (22.7 liters) of smoke oil.
3. Lubricate plug with fuel resistant grease. Reinstall servicing plug.

## 9.0 GROUND TEST

### 9.01 General

A supply of 28vdc and 115vac 400 hertz single phase will be needed for a ground function check of the Smokewinder®.

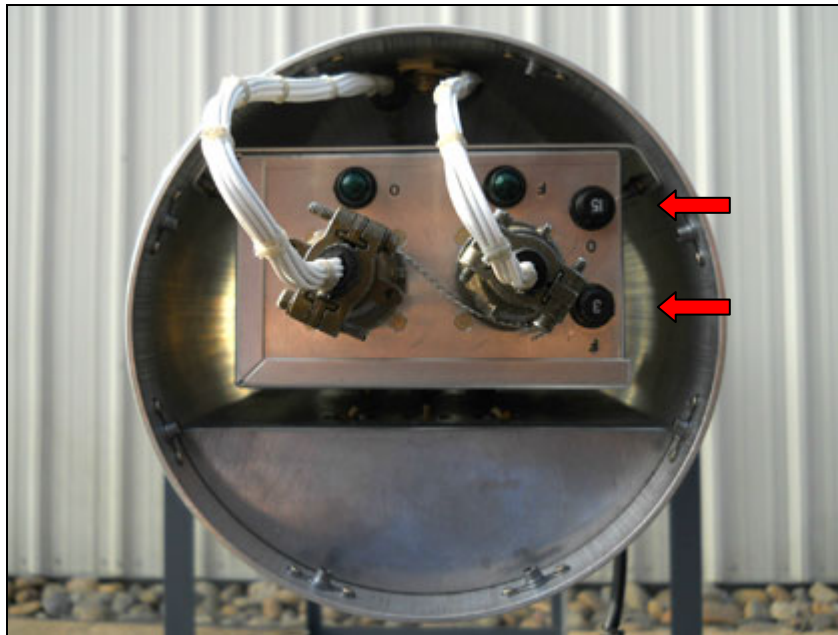
A ground operation control box (SWG-T-1), with a connector for mating to the Smokewinder® umbilical connector, may be purchased from Sanders Smoke Technologies, Inc. to operate the unit remotely; or the aircrafts electrical system may be used.

### 9.02 Passive Ground Test

The following ground test is recommended before flight:

**Caution:** Have fire extinguisher available.

1. Remove nose cone.
2. Pull out both fuel (F) and smoke oil (O) circuit breakers on Ignition/Control Box.



**WARNING:** Do not push in both circuit breakers unless both lights are not illuminated.

3. Press and hold trigger button. Fuel and smoke oil lights should illuminate, then after the 3 seconds, go out; indicating the re-sequencing feature is operating.
4. Press and release trigger button. Fuel and smoke oil lights should illuminate, then after 8 seconds, the fuel and smoke oil lights should go out indicating the auto shutdown system has operated.
5. Press and release trigger button (you have 8 seconds, until the Smokewinder® will auto shutdown, to accomplish following checks).
6. Check fuel and smoke oil lights illuminated.

7. Visually check igniter spark in combustion chamber from rear of Smokewinder®. Stand minimum 3 feet (1 meter) behind tail pipe.

For checking smoke oil and fuel pump operation:

- a) **Momentarily** (less than one second) push in smoke oil circuit breaker (also activates fuel solenoid valve). Listen for pump operation.
  - b) **Momentarily** (less than one second) push in fuel circuit breaker (fuel solenoid valve remains closed). Listen for pump operation.
8. After 8 seconds, the Smokewinder® will auto shutdown. Recommend electrical power off to Smokewinder®. **Check both lights are not illuminated.**
  9. Push in circuit breakers.
  10. Install nose cone.

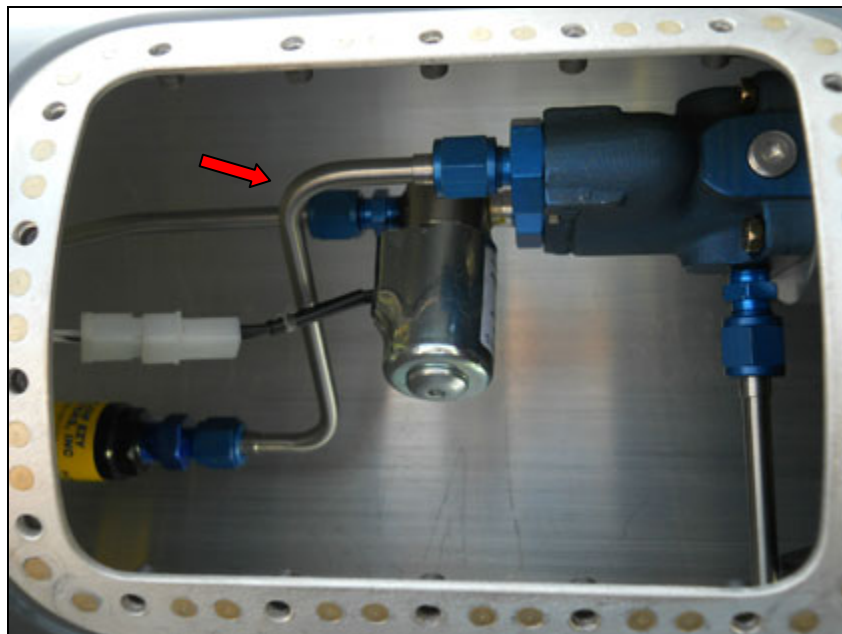
### 9.03 Operational Ground Test

It is impractical to have the Smokewinder® produce smoke on the ground. You may simulate operation by having the fuel and smoke oil by-pass the nozzles.

**Caution:** Do not remove sealed access doors #2, #3, #4. Fuel tank sealant MIL-S-8802D will be required to reinstall the tank access doors.

The Smokewinder® needs to be serviced with gasoline in the fuel tank (minimum 3/4 full) and sufficient smoke oil in the oil tank (not required to be full, needs approximately 2 gallons, [7.5 liters]).

1. Remove access door #1.
2. Disconnect fuel line at fuel solenoid valve.
3. Attach hose at solenoid valve. Place hose into a container.



4. Remove tail cone.
5. Disconnect smoke oil pressure line to spray nozzles.



6. Attach hose to fitting, install a restrictor with a .055" (1.397mm) diameter hole to other end of hose, place hose into a container.

**Caution: The smoke oil pump should put out 100 to 150 PSI.**

Note: An open line on the smoke oil pump will not provide sufficient pressure to close the pressure switch and the Smokewinder® will auto shutdown after 8 seconds.

7. Press and release trigger button.
8. Observe operation of fuel pump, smoke oil pump, and ignition.
9. If all three functions are normal, re-assembly is reverse of removal procedures.
10. If ignition, fuel or smoke oil does not function, proceed with appropriate check.

#### 9.04 Ignition Check

**WARNING: Fuel and smoke oil pump circuit breakers must be pulled out for this check.**

1. Remove nose cone.
2. Pull out both fuel (F) and smoke oil (O) circuit breakers on Ignition/Control Box.
3. Press and release trigger button.

Note: The Smokewinder® will auto shutdown after 8 seconds due to no smoke oil pressure.

4. Check fuel and smoke oil lights illuminated.

5. Visual inspection of the ignition may be accomplished by standing a minimum 3 feet (1 meter) behind tail pipe.
6. Check both lights are not illuminated. Push in circuit breakers.
7. Install nose cone.

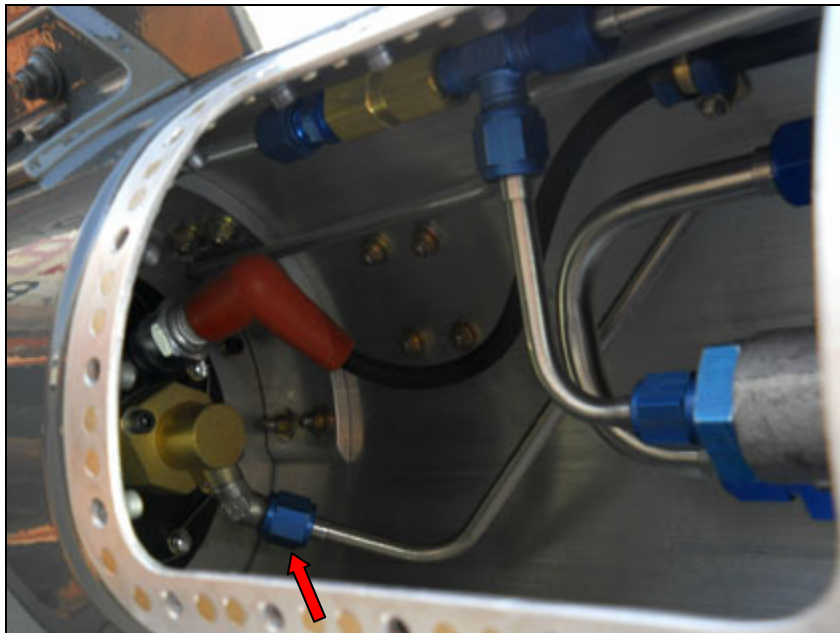
### Troubleshooting

1. If there is no ignition, a visual inspection of the igniter can be accomplished by either looking up the tail pipe or removing access door #6 and removing igniter. If igniter is dirty, clean or replace.
2. Remove access door #5. Check electrical connections at ignition coil. Check ignition cable at the coil and igniter.
3. If there is still no ignition, replace the Ignition/Control Box.

### 9.05 Fuel Check

**WARNING: Smoke Oil pump electrical connector must be disconnected for this check.**

1. Remove access doors #5 and #6.
2. Disconnect smoke oil pump electrical connector.



3. Disconnect line to fuel nozzle.
4. Remove the fuel nozzle block from the combustion head.
5. Remove nozzle from block using 5/8" socket.
6. Inspect filter screen on nozzle for contamination.
7. Plumb fuel line overboard into a container.

Note: Fuel and smoke oil circuit breakers must be pushed in.

8. Press and release trigger button.

Note: The Smokewinder® will auto shutdown after 8 seconds due to no smoke oil pressure.

9. Check fuel and smoke oil lights are illuminated.

10. Visually check for fuel flow.

Note: Ignition system will also be operating at this time.

11. For re-assembly, reconnect all lines and electrical connectors. Reinstall access doors.

### Troubleshooting

1. If there is no fuel flow, check that enough fuel is in the tank (minimum 3/4 full).
2. Check that the pump turns on when the trigger button is pressed and released.
3. Check that the fuel solenoid valve, attached on the outlet side of the pump, is energized to allow fuel to flow.
4. If the pump runs and solenoid valve is energized, but there is no fuel flow, check for clogging of the pump inlet filter.
5. If the pump does not operate, check for electrical power to pump.
  - a) If no power, replace the Ignition/Control Box.
  - b) If there is power, replace the pump.

## 9.06 Smoke Oil Check

### Nozzles

1. Check the smoke oil nozzles for clogging. There are 9 nozzles located inside the tail pipe, approximately 12 inches forward.



2. Remove nozzles with 5/8" socket and an extension.
3. Inspect and clean filter screens on nozzles.
4. Apply antiseize (MIL-A-907E or equivalent) to nozzle threads.
5. Reinstall nozzles. Recommended torque: 180 lb. in. (20Nm).

### Smoke Oil Pump

**WARNING: Fuel pump circuit breaker must be pulled out for this check.**

1. Remove nose cone.
2. Pull out fuel pump (F) circuit breaker.
3. Remove tail cone.
4. Disconnect smoke oil pressure line to spray nozzles.
5. Attach hose to the smoke oil pressure line. Install a restrictor with a .055" (1.397mm) diameter hole to other end of hose. Place hose into a container.

Note: An open line on the smoke oil pump will not provide sufficient pressure to close the pressure switch and the Smokewinder® will auto shutdown after 8 seconds.



6. Press and release trigger button.
7. Visually check for smoke oil flow.

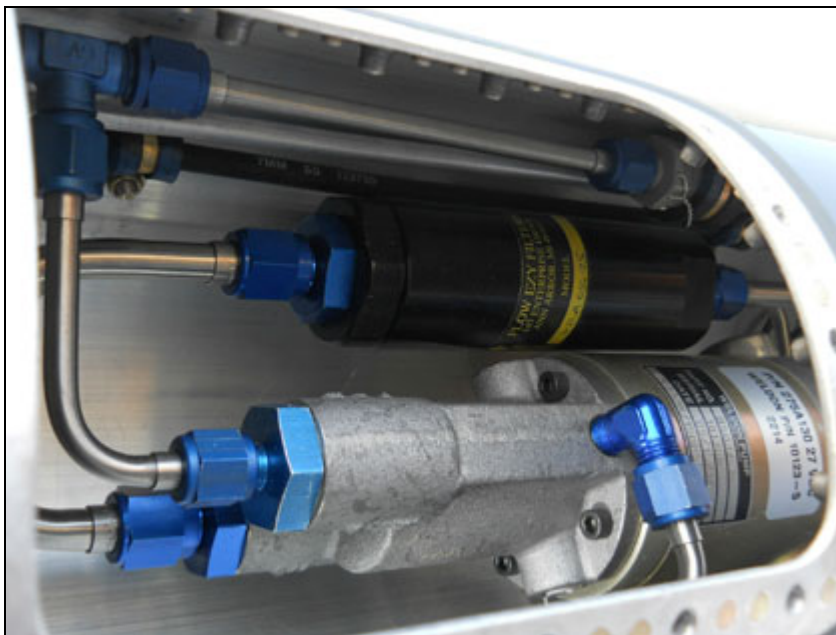
Note: If the Smokewinder® runs for 8 seconds and then shuts down, the smoke oil pump may not have sufficient pressure to close the pressure switch (100 PSI minimum).

8. Turn off all power to Smokewinder®.
9. For re-assembly, reconnect all lines, electrical connectors and push in circuit breakers.
10. Reinstall nose and tail cones.

### Troubleshooting

**WARNING: Fuel pump circuit breaker must be pulled out for this check.**

1. If there is no smoke oil flow, check that the pump is turning on.
2. Check that enough smoke oil is in the tank (approximately 2 gallons [7.5 liters]).
3. Inspect the pump inlet filter for clogging. Clean filter if necessary.
4. If the pump does not operate, check for electrical power to the pump.
  - a) If no power, replace the Ignition/Control Box.
  - b) If there is power, replace the pump.



Smoke Oil Pump, Inlet Filter and Pressure Switch

5. If there is smoke oil flow and the Smokewinder® still shuts down, attach a hose to pressure side of the pump with a pressure gauge and a restrictor with a .055" (1.397mm) diameter hole to other end of hose. Place hose into a container. If the pump pressure is less than 100 PSI, replace the pump. If the pump pressure is 100 PSI or greater, check that the pressure switch is closing. If the Smokewinder® still shuts down, replace the Ignition/Control Box.



### 9.07 Ram Air Regulator



This is the only adjustable item on the smoke generator; however no adjustment should be required. If necessary, for maintenance reasons, adjustment is set at 7 turns pre-load on the relief valve spring.

## 9.08 Auto Shutdown

This system consists of two components: the Ignition/Control Box and a pressure switch. When the Smokewinder® is turned on, the smoke oil pump has 8 seconds to come up in pressure (100 PSI minimum) and close the pressure switch, thus completing a circuit in the Ignition/Control Box. If at any time the smoke oil pressure drops below 60 PSI (the pressure switch opens the circuit) for 8 seconds the Smokewinder® will auto shutdown.

### Troubleshooting

1. The Smokewinder® will not turn on. Replace the Ignition/Control Box.
2. The Smokewinder® turns on for 8 seconds and then shuts down. Check that there is sufficient pressure from the smoke oil pump to close the pressure switch (100 PSI minimum). See Smoke Oil Pump Troubleshooting. If the switch is closing, replace the Ignition/Control Box. If the switch does not close (100 PSI minimum), replace the switch.



Smoke Oil Pump, Inlet Filter and Pressure Switch

## 9.09 Component Replacement

### Ignition/Control Box

1. Remove nose cone.
2. Disconnect the two cannon plugs and remove the four 8-32 screws on the outside of the Smokewinder®.



3. For replacement, reverse removal procedures.

### Fuel Pump

1. Remove access door #1.
2. Remove pump lines and disconnect electrical connector.
3. Remove four 8-32 screws on the outside of the Smokewinder®.
4. For replacement, reverse removal procedures.  
Note: Start connecting lines before tightening pump mounting screws.

### Smoke Oil Pump

1. Remove access door #5 and #6.
2. Remove pump lines and disconnect the electrical connector.
3. Remove four 8-32 screws on the outside of the Smokewinder®.
4. For replacement, reverse removal procedures.

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### **Ignition Coil**

The ignition coil is mounted in the aft bulkhead of the oil tank. It is not a field service item.

### **Fuel Nozzle**

1. Remove access door #6.
2. Disconnect line to fuel nozzle block.
3. Remove the fuel nozzle block from the combustion head.
4. Remove nozzle from block using 5/8" socket.
5. For replacement, reverse removal procedures.

Note: Recommended nozzle torque 180 in. lbs. (20Nm).

### **Igniter**

1. Remove access door #6.
2. Disconnect ignition lead and extract igniter with 13/16" plug socket.
3. For replacement, reverse removal procedures.

### **Combustion Chamber**

1. Remove tail cone.
2. Disconnect smoke oil line at rear of Smokewinder®.
3. Remove access door #6.
4. Remove air regulator.
5. Disconnect fuel line at nozzle block.
6. Remove the fuel nozzle block from the combustion head.
7. Disconnect igniter wire and remove igniter.
8. Remove four 8-32 allen cap screws mounting the combustion chamber to bulkhead.
9. Extract combustion chamber through tail of the Smokewinder®.
10. For replacement, reverse removal procedures.

### **Smoke Oil Nozzles**

1. There are 9 nozzles located inside the combustion chamber, approximately 12 inches forward.
2. Remove with 5/8" socket and an extension.
3. For replacement, apply antiseize (MIL-A-907E or equivalent) to nozzle threads. Recommended torque: 180 in lbs (20Nm).

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## 10.0 RECOMMENDED MAINTENANCE

### 10.01 External Inspection

Recommended after every flight: Check for damage to nose cone, fluid leaks, loose screws and rivets. Check ram air inlet is free and clear. Check fuel and smoke oil vents are clear. Check that the stencils indicating the operating points and warning message (if any) are not faded.

### 10.02 Fuel and Smoke Oil Pump Inlet Filters

Cleaning pump filters with available solvent is recommended every 20 flights under normal conditions.

### 10.03 Fuel and Smoke Oil Nozzle Filters

Cleaning nozzle filters with available solvent is recommended every 20 flights under normal conditions.

Note: Apply antiseize (MIL-A-907E or equivalent) to smoke oil nozzle threads.  
Recommended: torque: 180 in lbs (20Nm).

### 10.04 Lubrication

Fuel and smoke oil filler plug threads should be lubricated with fuel resistant grease after servicing.

### 10.05 Internal Inspection

Every 20 flights, remove nose cone fairing, tail cone fairing and doors #1, #5 and #6. Inspect Smokewinder® internally for fluid leaks, unusual stains, loose fittings and fasteners. Clean and repair as necessary.

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## **11.0 COMPONENTS (MAJOR) LIFE CYCLE**

### **11.01 Fuel Pump**

Life expectancy exceeds normal use of the Smokewinder®. Leakage from the seal drain would indicate deterioration of O-rings. If this happens, replace pump.

### **11.02 Smoke Oil Pump**

Life expectancy exceeds normal use of the Smokewinder®. Leakage from the seal drain would indicate deterioration of O-rings. If this happens, replace pump.

### **11.03 Igniter**

Should be removed and inspected approximately every 20 flight operations. With cleaning, the igniter should be good for several hundred flights.

### **11.04 Ignition/Control Box**

The electrical components in the Ignition/Control Box are solid state, requiring no service. No life cycle established.

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## 12.0 STORAGE

### 12.01 Long Term Inactivity

1. Drain fuel and smoke oil tanks.
2. Store in original shipping containers.
3. Store in clean, dry, indoor storage.

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### 13.0 GROUND SUPPORT EQUIPMENT

#### 13.01 Item Part No.

1. Launch Rail Test Box SWRT-1
2. Ground Operation Control Box SWGT-1
3. Restrictor Fitting GT-815R



## 14.0 SERVICEABLE PARTS LIST

### 14.01 Parts List

Item		Part No.
1.	Ignition/Control Box	SWCDI-2D
2.	Fuel Nozzle	10.50 70 PLP
3.	Fuel Pump	A8136-B
4.	Fuel Solenoid Valve	20CC02PV4B2B
5.	Smoke Oil Nozzle	4.00 45 PLP
6.	Smoke Oil Pump	B5034-B
7.	Pressure Switch	7G1139
8.	Igniter	J99
9.	Smoke Oil Filter	6ILA-03S-25
10.	Smoke Oil Filter Element	8504-05
11.	Fuel Filter	ILA-02-74BK
12.	Fuel Filter Element	6180-02
13.	Access Door Screw	MS24694-5
14.	Nose/Tail Cone Screw	AN526C-832R8
15.	Power Light Bulbs	JKL 327
16.	Check Valve	985

### O-Rings

Item		Part No.
1.	Fuel Pump Fittings	AS568A-906
2.	Fuel Filter Body	AS568A-016
3.	Smoke Oil Pump Fittings	AS568A-908
4.	Smoke Oil Filter Body	AS568A-916
5.	Smoke Oil Filter Element	AS568A-210
6.	Smoke Oil Filter Fittings	AS568A-908

### Conical Seals (for AN fittings)

Item	Size	Part No.
1.	-4	AS4824C04
2.	-5	AS4824C05
3.	-6	AS4824C06

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## 15.0 MISCELLANEOUS INFORMATION

### 15.01 Nose/Tail Cone Orientation

Align serial number marked on outside top of nose/tail cone with top center of tube body.

### 15.02 Door Orientation

Re-install doors with correct serial number and door number. Doors are numbered from the nose to tail. For structural reasons, Doors #1 and #2 are heavier gauge aluminum.

### 15.03 Air Regulator

Pre-load on air regulator spring is 7 turns.

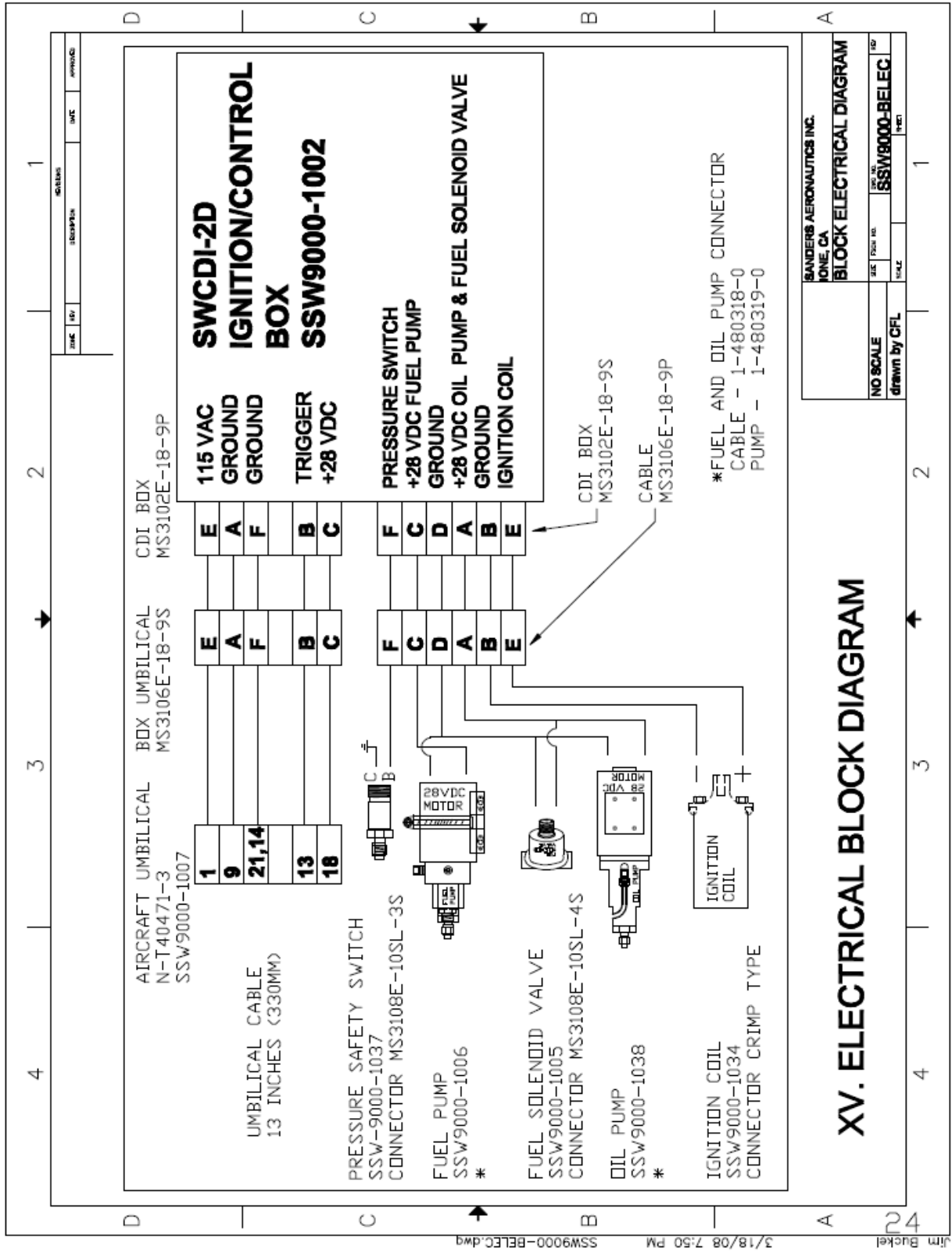
### 15.04 Electronic Shut Down

- Smokewinder® will shut down with 3 seconds of continuous trigger button activation.
- Smokewinder® will auto shutdown if oil pressure fails to exceed 100 PSI within 8 seconds.
- Smokewinder® will auto shutdown if oil pressure drops below 60 PSI for 8 seconds.

## 16.0 TORQUE PARAMETERS

Table 16-1 Torque Limits							
Thread Size**	Limits			Thread Size	Limits		
	Minimum*		Maximum		Minimum		Maximum
	Type I	Type II			Type I	Type II	
4-40	4.5	5	6	7/16-14	325	400	425
6-32	8.5	10	11.5	7/16-20	330	425	475
8-32	16	20	22	1/2-13	500	600	650
8-36	18	22	24	1/2-20	550	675	750
10-24	23	27	30	9/16-12	700	850	950
10-32	24	32	36	9/16-16	800	950	1050
12-24	35	43	48	5/8-11	1000	1200	1300
12-28	35	45	50	5/8-16	1150	1400	1500
1/4-20	50	63	70	3/4-10	1700	2100	2300
1/4-28	65	80	85	3/4-16	2000	2400	2600
5/16-16	110	140	150	7/8-9	2800	3500	3700
5/16-24	125	160	170	7/8-14	3200	4000	4200
3/8-16	200	230	270	1-8	4200	5400	5600
3/8-24	225	275	300	1-12	4800	6200	6400
<p>* Use Type I torque values where alignment of locking holes (cotter pins, etc.) is required at assembly. Use Type I torque values where alignment of locking holes is not required at assembly.</p> <p>** For screws larger than No. 8 thread size, having screwdrive slots only, use torque limits for the No. 8 thread size.</p>							
<b>All Values in Inch Pounds</b>				Sanders Smoke Technologies, Inc. Ione, CA <b>Fastener Torque Limits</b>			

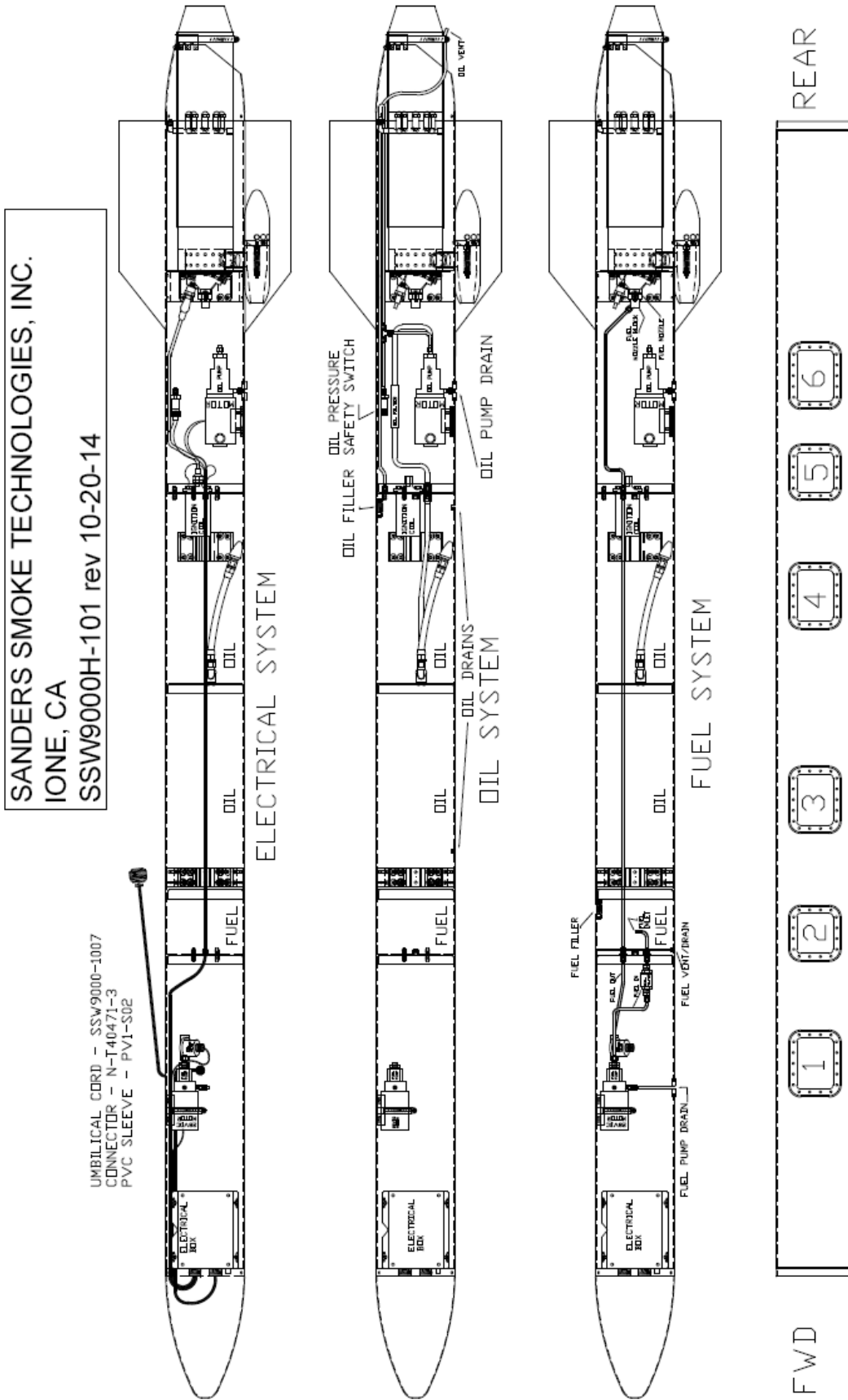
17.0 ELECTRICAL BLOCK DIAGRAM



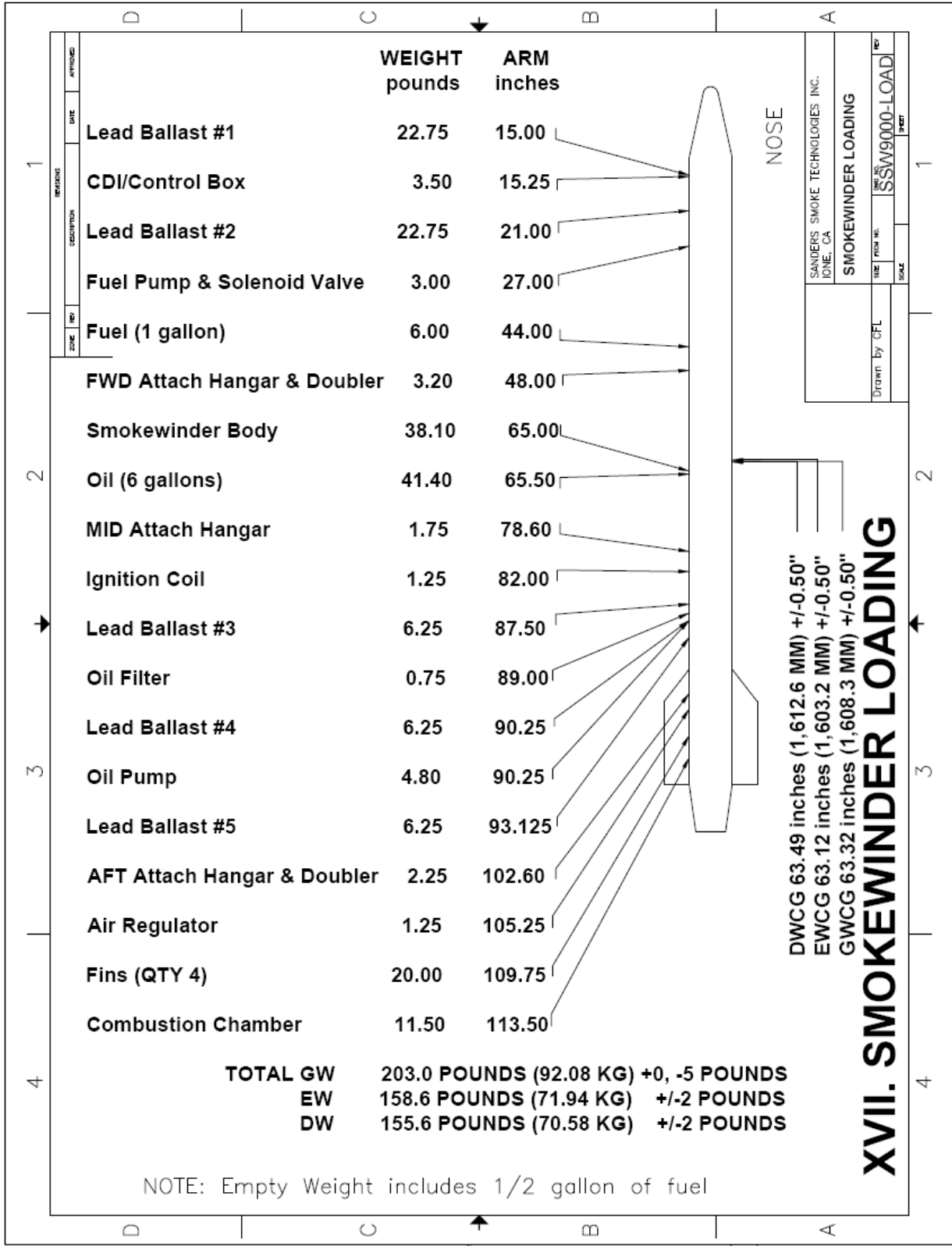
XV. ELECTRICAL BLOCK DIAGRAM

SANDERS AERONAUTICS INC. PIONEER, CA	
BLOCK ELECTRICAL DIAGRAM	
NO SCALE	DATE: SSW9000-BELEC
drawn by CFL	1/15/15

18.0 SMOKEWINDER® CONFIGURATION



**19.0 SMOKEWINDER® LOADING**



## 20.0 SMOKEWINDER® PARTS LIST

<b>SMOKEWINDER® 9000-5 (wingtip mount left)</b> <b>SMOKEWINDER® 9000-6 (wingtip mount right)</b>		
<b>List of Components</b>		
<b>ZONE 1 (electrical)</b>		
SSW9000-1000	Tube Body	7 ¼"OD, 7"ID, 6063 T6 Tube
SSW9000-1001	Nose Cone	Spun 2024 T3
SSW9000-1002	Electrical Box and Mount	SWCDI-2D, Ignition/Control
SSW9000-1003	Forward Lead Ballast	6% Antimony, 2 each
SSW9000-1004	Fuel Pump	Weldon A8136-B
SSW9000-1004A	Fuel Filter	ILA-02-74BK
SSW9000-1004E	Fuel Filter Element	6180-02
SSW9000-1005.5	Fuel Solenoid Valve	20CC02PV4B2B
SSW9000-1006	Fuel Pump Mount	.040" 2024, Stainless Steel Clamp
SSW9000-1007	Umbilical Cord	Electrical Wire and Plug Assembly
SSW9000-1008	Access Door #1	.063" 7075 T6
<b>ZONE 2 (liquids)</b>		
SSW9000-1009	Bulkhead #1	.050" 6061 T6
SSW9000-1010	Access Door #2, Fuel	.063" 7075 T6, Fuel Tank
SSW9000-1011	Filler Plug Receptacle	3/8" 7075 T6, ¾" Pipe Thread
SSW9000-1012	Filler Plug, Fuel	316 Stainless Steel
SSW9000-1013	Drain Plug Receptacle	¼" 7075 T6, 1/8" Pipe Thread
SSW9000-1014	Fuel Drain/Air Vent	1/8"OD 304 Stainless Steel
SSW9000-1015	Electrical Conduit	3/8" tubing 5052 0
SSW9000-1016	Fuel Pickup Pipe	¼" tubing 5052 0
SSW9000-1017	Bulkhead #2	.050" 6061 T6
SSW9000-1018	FWD Attach Hangar Dblr	5/8" 7075 T6
SSW9000-1019	FWD Attach Hangar	17-4 Stainless Steel
SSW9000-1013	Drain Plug Receptacle	¼" 7075 T6, 1/8"Pipe Thread
SSW9000-1021	Drain Plug, Oil	316 Stainless Steel
SSW9000-1022	Access Door #3, Oil Fwd	.050" 2024 T3
SSW9000-1023	Bulkhead #3 Mid, Oil	.050" 6061 T6
SSW9000-1024	Flop Tube Mount	.100" 6061 0
SSW9000-1025	Flop Tube Assembly, Oil	SS Braided Hose, Lead Weight
SSW9000-1011	Filler Plug Receptacle, Oil	3/8" 7075 T6, ¾" Pipe Thread
SSW9000-1012	Filler Plug, Oil	316 Stainless Steel
SSW9000-1013	Drain Plug Receptacle	¼" 7075 T6, 1/8"Pipe Thread
SSW9000-1021	Drain Plug, Oil	316 Stainless Steel
SSW9000-1030	Tank Vent, Oil	¼" 5052 0
SSW9000-1031	Mid Attach Hangar	17-4 Stainless Steel
SSW9000-1032	Access Door #4, Oil Rear	.050" 2024 T3
SSW9000-1033	Bulkhead #4 Aft, Oil	.050" 6061 T6

<b>SMOKEWINDER® 9000-5 (wingtip mount left)</b> <b>SMOKEWINDER® 9000-6 (wingtip mount right)</b>		
<b>List of Components</b>		
<b>ZONE 3 (aft electrical)</b>		
SSW9000-1034	Ignition Coil	AC Delco U505
SSW9000-1035	Ignition Coil Mount	.032" spun Stainless Steel
SSW9000-1036	Ignition Lead	AC Delco
SSW9000-1037	Pressure Safety Switch	7G1139
SSW9000-1038	Smoke Oil Pump	Weldon B5034-B
SSW9000-1039	Smoke Oil Pump Mount	.063" 2024 T3
SSW9000-1040	Access Door #5	.050" 2024 T3
SSW9000-1041	Smoke Oil Filter	6ILA-03S-25
SSW9000-1041V	Check Valve	985
SSW9000-1042	Aft Lead Ballast	6% Antimony, 3 each
SSW9000-1043	Access Door #6	.050" 2024 T3
SSW9000-1044	Rear attach Hangar Dblr	¼" 6061 T6
SSW9000-1045	Rear Attach Hangar	17-4 Stainless Steel
<b>ZONE 4 (combustion)</b>		
SSW9000-1046	Bulkhead #5	.050" 6061 T6
SSW9000-1047	Combustion Head	Cast Iron
SSW9000-1047.5	Combustion Head Gasket	Klingersil C4401
SSW9000-1048	Igniter	J99
SSW9000-1049	Ground Electrode	304 Stainless Steel
SSW9000-1050L**	Fuel Nozzle Block, Left	Brass
SSW9000-1050R*	Fuel Nozzle Block, Right	Brass
SSW9000-1050.5	Fuel Nozzle Block Gasket	Klingersil C4401
SSW9000-1051	Fuel Nozzle	Monarch 10.50 70 PLP
SSW9000-1052L**	Combustion Chamber, Left	Assembly, RA 309 Stainless Steel
SSW9000-1052R*	Combustion Chamber, Right	Assembly, RA 309 Stainless Steel
SSW9000-1054L**	Air Regulator, Left	Assembly, 6061 T6
SSW9000-1054R*	Air Regulator, Right	Assembly, 6061 T6
SSW9000-1055	Fins, 4 each	¼" 7075 T6
SSW9000-1056	Fin Attach Angles, 8 each	¼" 7075 T6 Extrusion
SSW9000-1057	Vent, Air Scoop	.032" 2024 T3
SSW9000-1058	Smoke Oil Nozzle	Monarch 4.00 45 PLP
SSW9000-1058.5	Smoke Oil Nozzle Holder	Stainless Steel
SSW9000-1060	Tail Cone	Spun 2024 T3
SSW9000-1060.5	Tail Cone Bracket	Stainless Steel
SSW9000-1061	Tail Cone Clamp	Stainless Steel
* installed on left unit only, one each ** installed on right unit only, one each		