

SECTION 7 – AIRPLANE AND SYSTEMS DESCRIPTIONS

INTRODUCTION

AIRPLANE

The airframe of the Fire Boss is adapted from the Air Tractor AT-802A agricultural airplane. It is an all-metal, low cantilever wing design. It is powered by a Pratt and Whitney PT6A-67AG or PT6A-67F turboprop engine. The controls are all well harmonized with light control forces assured by the use of servo tabs for all three axes. The airframe is detailed in Air Tractor publications.

To create this fire suppression version of the airplane, a number of changes to the landplane were incorporated:

1. Amphibious floats with hydraulically actuated water scoops are installed.
2. The Air Tractor Fire Retardant Delivery System (FRDS) is utilized.
3. The Air Tractor foam system and controls are utilized.
4. Additional foam tanks in the floats supplement the standard firewall tank.
5. Changes to the hopper venting system are incorporated.
6. A new upper instrument panel is added to contain some of the scoop related system controls and indicators.
7. A power warning system is added with voice and visual alerts.
8. A bilge pumping system and a water in floats warning system are incorporated.

These changes will be briefly discussed in the following paragraphs.

FLOATS

Wipline Model 10000 amphibious floats are installed on the Fire Boss. As a part of the float installation, the following additional changes are made to the landplane:

1. The hydraulic landing gear retraction system components and cockpit controls are added.
2. The landing gear emergency gear operation cockpit hand pump and system are added.
3. The float water rudder retraction system and cockpit controls are added. The water rudders are locked center when retracted for improved directional stability.
4. A ventral fin is added for improved directional stability.
5. Auxiliary finlets are added to each side of the horizontal stabilizer for improved directional stability.
6. The vertical fin is sealed to the fuselage/stabilizer top for improved directional stability.
7. The rudder trim tab rigging is revised from that of the landplane for improved directional stability.
8. The open fuselage structure near the landplane tail-wheel mount is faired over for improved directional stability.
9. Vortex generators are added to the wing upper surface leading edges for improved longitudinal controllability.
10. Vortex generators are added to the horizontal stabilizer upper surface leading edges for improved longitudinal controllability.
11. The elevator trim/servo tabs incorporate a 1-inch chord extension for improved longitudinal controllability.

AMPHIBIAN LANDING GEAR SYSTEM

The landing gear incorporated within the amphibious floats on this airplane is retractable, quadricycle type with two swiveling nose (or bow) wheels and four (4) (two (2) sets of dual) main wheels. Shock absorption is provided by air-oil shock struts on the two main landing gear assemblies. Each main wheel is equipped with a hydraulically-actuated disc-type brake.

Landing gear extension and retraction is accomplished by two (2) electrically-driven hydraulic pumps and four (4) hydraulic actuators (one (1) for each gear). The hydraulic pumps are located in fuselage aft of cockpit and the hydraulic actuators are located adjacent to each gear. Hydraulic system fluid level should be checked at 25-hour intervals by checking the sight glass for fluid level in the upper one-third of the range. If fluid is low, fill with MIL-H-5606 (or equivalent).

Filter screens are installed on each pickup tube inside of hydraulic reservoirs and there are also 3 external 10 micron filters as well. Clean filter screens and elements every 100 hours.

Visually inspect Spin-on filter assembly adjacent to the Hydraulic Pump Assembly. Check that the Pop out gage has not been activated. If pop out gage activated refer to the applicable Service Manual for corrective action.

Hydraulic pump operation is initiated by manual operation of the landing gear handle. When the handle is repositioned, hydraulic pressure in the system will drop and pressure switches will automatically turn on the hydraulic pump motors to maintain operating pressure in the system. When the gear cycle is completed, pressure in the system will automatically shut off the actuators. If the pressure in the system drops to a preset value, the pressure switches turn the pump motors back on and build up the pressure to the limit again. Eight (8) position-indicator lights (four (4) gear UP and four (4) gear DOWN) are provided to show landing gear position. Two (2) additional indicator lights show when the landing gear pump motors are operating.

LANDING GEAR HANDLE

The landing gear handle controls a hydraulic selector valve within the control unit on the left-hand side of cockpit by the fuel shut-off handle and has two (2) positions (UP and DOWN) which give a mechanical indication of the gear position selected. From either position, the handle must be pulled out to clear a detent before it can be repositioned.

INDICATOR LIGHTS

Ten (10) indicator lights are mounted on the landing gear control unit adjacent to the landing gear handle. Four (4) blue indicator lights, labeled NOSE and MAIN (left-hand lights for the left float and right-hand lights for the right float), show by their illumination that the landing gear is up and locked. The four (4) green indicator lights, labeled NOSE and MAIN (left-hand lights for the left float and right-hand lights for the right float), are illuminated when the landing gear is down and locked. Neither set of lights is illuminated when the landing gear is in transit. Two (2) red indicator lights, labeled PUMP ON 1 and 2 illuminate when current is supplied to the landing gear motors. If the motors continue running during flight or on and off repeatedly, the motors should be shut off by pulling the AMPHIBIAN PUMP 1 AND AMPHIBIAN PUMP 2 circuit breakers on the avionics panel, since continual running of the motors can result in premature motor failure. Prior to landing, the circuit breakers should be pushed in to reactivate the circuits.

LANDING GEAR OPERATION

To retract or extend the landing gear, pull out on the landing gear handle and move it to the desired position. When the handle is positioned, pressure on the hydraulic system reduces to where the hydraulic motors automatically turn on. The motors power the hydraulic pumps and actuate the gear actuator for each gear. During operation of the landing gear motors the PUMP ON 1 and 2 indicator lights are illuminated. When the gear cycle is completed, pressure builds up in the hydraulic system and automatically shuts off the hydraulic motors. Each gear operates independently of the other, and therefore, the position lights illuminate at various times.

EMERGENCY HAND PUMP

An emergency hand pump is located on the floor to the left side of the seat for use in the event the normal hydraulic system fails. This hand pump may be used to retract or extend the land gear. To actuate the hand pump, use the stowed handle for the aircraft hydraulic hand pump. Prior to utilizing the emergency hand pump, pull the AMPHIB PUMP 1 and 2 circuit breakers to deactivate the electric hydraulic pumps. Select UP and DOWN using the normal landing gear selector handle. Place the emergency hand pump handle in the pump and pump back and forth (approximately 400 cycles). When a gear reaches the selected position, its indicator light will illuminate. After all four (4) gears are in the selected position there is a noted increase in resistance of hand pump operation.

HYDRAULIC FLUID LEVEL INDICATOR (IF EQUIPPED)

NOTE: The hydraulic fluid level indication light is a non-required auxiliary aid to pilots for monitoring hydraulic fluid levels in between required 25 hour fluid level inspections.

The landing gear pump reservoir may be equipped with an optical fluid sensor which activates an amber light on the face of the instrument panel to alert the pilot of a possible low fluid situation in the hydraulic gear actuating system. The amber light is normally off when the sensor is submerged in hydraulic oil, but will activate when the fluid sensor is exposed to air.

Steep turns, sudden accelerations or decelerations may cause the light to activate intermittently if the level of fluid is close to the level of the optical sensor. If this occurs, the fluid level should be visually checked as soon as practicable and fluid added if necessary.

HYDRAULIC FLUID LEVEL INDICATOR OPERATION	
OFF	Fluid level sufficient for normal operation
INTERMITTENT	Fluid level is low and must be serviced before next flight
ON	Fluid level is very low and may not be sufficient for normal gear operation. Must be serviced before next flight

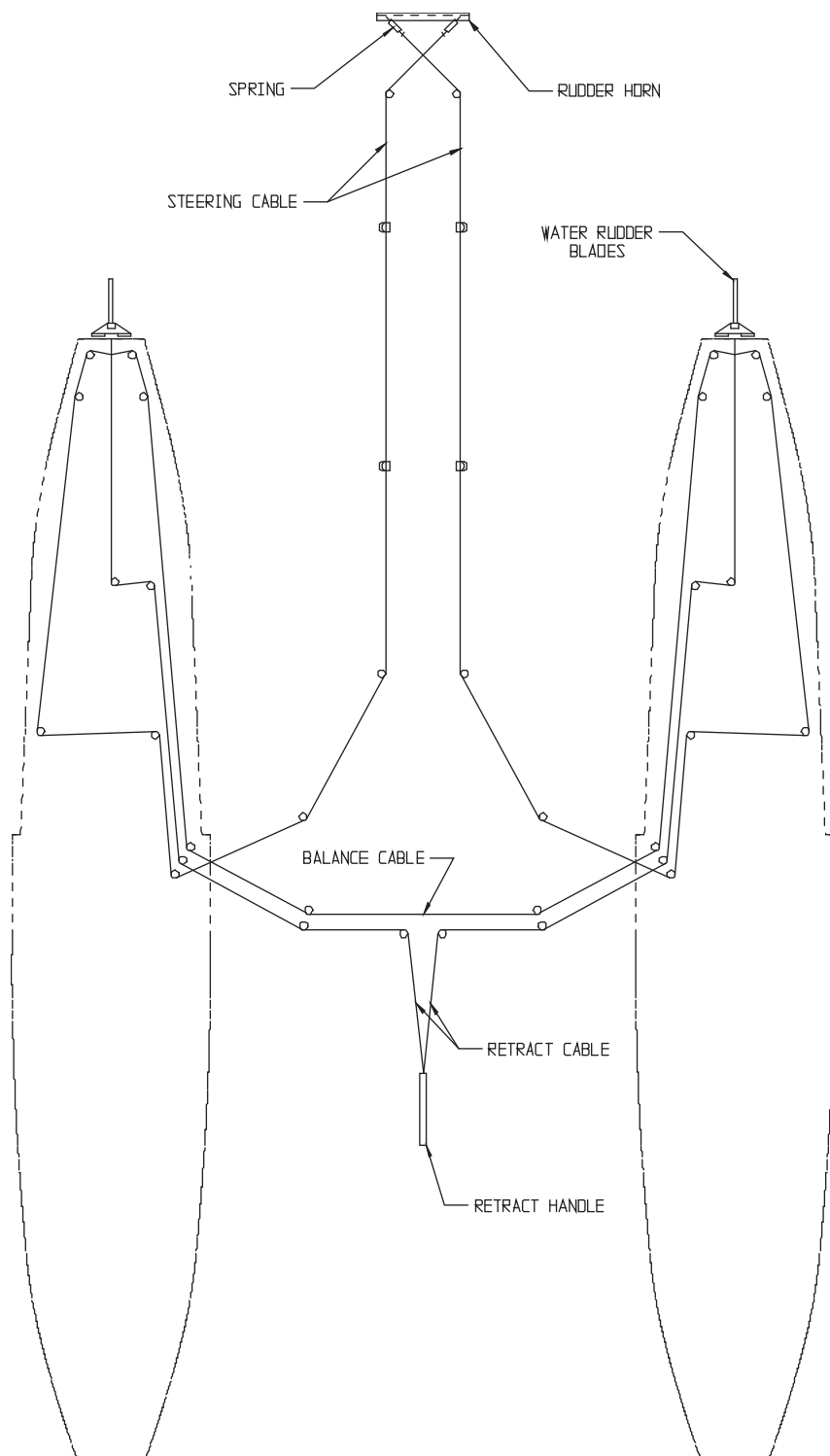
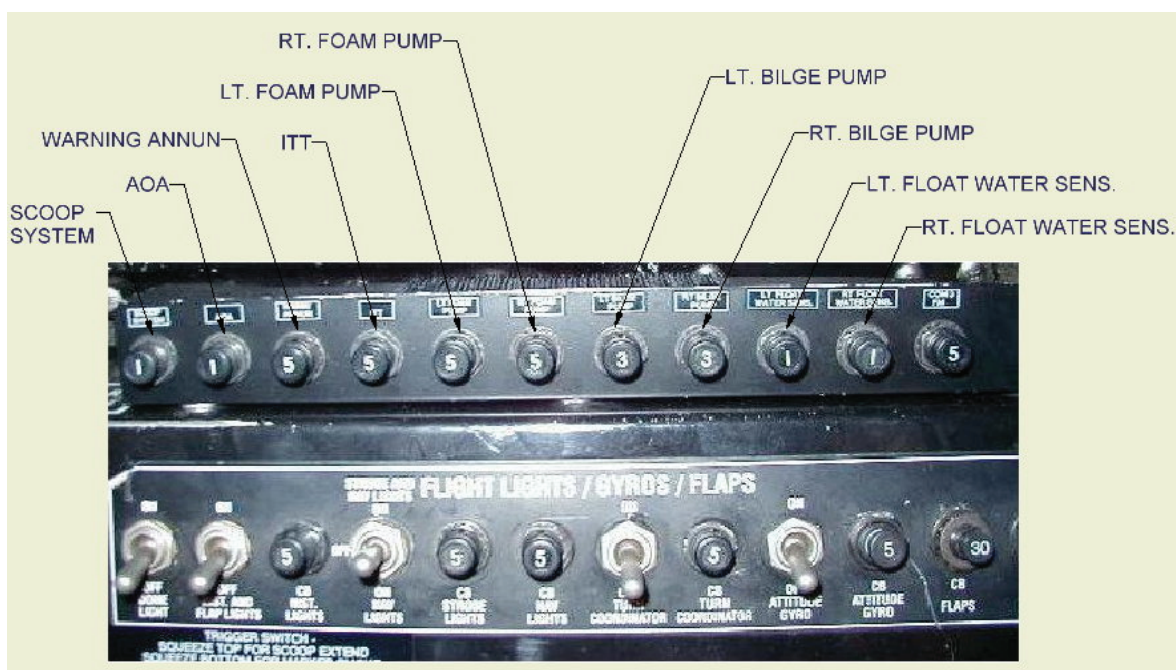
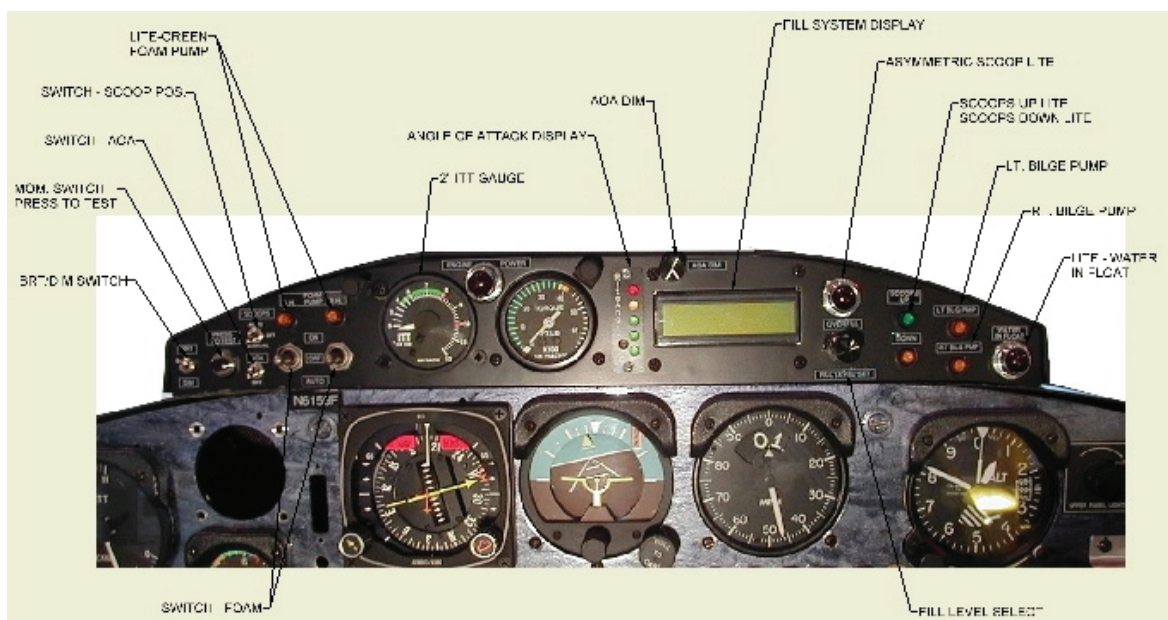


Figure 7-1. Water Rudder Steering & Retraction System

INSTRUMENT PANEL



Alternate Air Tractor Instrument Panel

Figure 7-2. Instrument Panel

WATER RUDDER RETRACT SYSTEM

There are two possible water rudder retract system installations. One option is for a manually operated water rudder retraction lever mounted to the aft wall of the cockpit on the left side of the pilot. In the retracted position this lever engages a catch hook to ensure the water rudders remain retracted. A second option is an electric water rudder retraction system. For this system, extension and retraction of the water rudders is accomplished by means of a 3-position toggle switch on the left side of the console. The toggle switch provides a neutral off position, but the water rudders are also stopped in the full up and full down positions by means of actuator limit switches. Full up and full down annunciators are adjacent to the toggle switch for verification of water rudder position. The system is electrically protected by a 5 amp circuit breaker located on the aux circuit breaker panel.

SCOOP SYSTEM

The Wipaire 802A Fire Boss has two water scoops, one in each float. The scoops are three inches in diameter and are hydraulically operated by the 1000 psi float hydraulic system. The scoops have an accumulator to enhance the speed of scoop deployment and retraction. The scoops complete a down or up cycle in approximately one second. The scoops are controlled by a trigger switch located on the front of the control stick grip. Pulling in the bottom of the trigger switch puts the scoops down. Releasing the trigger switch puts the scoops back up (pulling on the top of the trigger switch operates the microphone).

The scoop system master switch is located on the upper instrument panel and has three positions: auto, off, and manual. When manual is selected, the scoops move to the down position and remain there as long as the trigger switch is depressed; when the trigger switch is released, the probes move back to the up/stowed position.

CAUTION!

In the manual position, it is possible to overflow the hopper.

When auto is selected, the pilot may select how many gallons he wants to scoop by rotating the fill level selector knob located to the right side of the hopper quantity and fill level readout window (hopper quantity is on the top reading and the selected fill level is on the bottom). When the quantity reads approximately 255 gallons the hopper is empty (the scale starts at that number) with auto selected, the scoops will go down when the rocker switch is depressed and move back up automatically when the quantity selected is reached (with the rocker switch still depressed). If the rocker switch is released before the quantity is reached, the scoops will move back up, thusly, if the pilot wants to abort the scoop operation once it is initiated, simply releasing the rocker switch will put the scoops back up, such as in an emergency or other unplanned occurrence. Scoop up and scoop down lights are provided that indicate scoop position via position sensors on the probe jack cylinder that illuminates the lights. An asymmetrical scoop light and audio warning are also provided. Light will illuminate and audio warning will annunciate when one probe is down and the other probe is up. The scoop lights (3) can be tested utilizing the test switch on the glare shield panel.

NOTE

A personal floatation device should be worn during scooping operations.

FIRE RETARDANT DELIVERY SYSTEM (FRDS)

The AT-802A Fire Boss amphibian is equipped with an Air Tractor Fire Retardant Delivery System (FRDS) which is highly suitable for the fire suppression mission. The system utilizes specialized computerized dump gate control equipment which assures accuracy and precise control over the materials being used in fire control work. The system has separate automatic and manual override control of the servo-hydraulic system that opens and closes the fire doors using dual hydraulic valves and switches.

NORMAL OPERATION

When the airplane master switch is turned on, the FRDS computer and control panel are powered up. All of the quantity and pressure indications are available at this time.

NOTE

All of the programmable settings on the FRDS control panel may be made with the control panel master switch in the off position.

When the FRDS control panel master switch is turned on, the system sensors tell the computer that the hydraulic pressure is low and the hydraulic pump is started. When the system operating pressure is attained, the hydraulic pump is turned off.

The number of gallons to be dropped is set with the Gallons to Drop knob on the FRDS control panel. The quantity may be set anywhere from 200 to 800 gallons in 50-gallon increments, or to Manual. If the Manual setting is used, the doors will move full open at the depression of the FIRE button and snap closed when the FIRE button is released.

The coverage level is set by the Coverage Level knob and indicated in the Coverage Level window. The numbers for the coverage level indicate the distribution in gallons per 100 square feet. Coverage levels from 0.5 to 4.0 may be selected in increments of $\frac{1}{2}$ gallon per 100 square feet. Salvo may also be selected. When Salvo is selected, the coverage display will show F.C. for full coverage. In the Salvo mode, the dump doors will move to the full open position when the FIRE button is depressed and remain there until the programmed amount of material has been released.

If it is possible to estimate the groundspeed at the drop site from wind velocity and flight direction the Ground Speed knob is set at the correct position.

With the hydraulic pressure up and the desired program entered in the computer, turning on the Armed switch will prepare the system to perform the programmed drop. The green Armed light will illuminate. The drop is initiated by depressing the red Fire button on the top of the control stick. System parameters are computer monitored throughout the drop and the door opening will be constantly changing. Then the doors snap shut to end the drop cycle.

Following the drop cycle, hydraulic pressure is restored and the system is readied for another drop. The program may be changed or left as is for the next drop.

MANUAL OVERRIDE OPERATION

A separate manual control system allows the pilot to manually control the servo-hydraulic system that operates the dump doors in the event of a failure in the automatic system computer or associated sensors. An additional computer handles the control functions necessary to provide the separate manual control system. When in the normal mode, the hydraulic pump and servo supply solenoid valve (supplies hydraulic oil to the servo system) are controlled by the normal system computer. In the manual mode, the pump and servo supply solenoid are controlled by the manual system computer.

The manual control panel is just below the normal system control panel. The operation and function of the switches and indicators is as follows:

Power Switch – This switch is located on the FRDS normal panel. When set to Auto the automatic delivery system is powered and the system is controlled as described above under normal operation. To activate the manual system, this switch should be set to the Man position, causing the power light on the manual panel to illuminate. To turn power to the hydraulic pump off, the switch should be set to the Off position.

Run Pump/Close Gate Switch – This toggle switch runs the hydraulic pump to charge the accumulator when moved to the down position and closes the doors when moved to the up position. In the event of a pump failure detected by the manual system computer, toggling the switch down will reset the pump error and the pump will run until the pressure reaches 3000 psi or a pump error is detected again. If the run pump switch is held down continuously, the pump will run as long as the switch is held. This allows the pilot to override the fault detected by the manual system computer to manually run the pump.

CAUTION!

Be sure the system has sufficient hydraulic oil before using the Run Pump switch. The pump motor may be destroyed using this switch since the systems error checking features are disabled by this switch. The switch should never be held down for more than one minute continuously since the pump motor may overheat (1 minute on, 3 minutes off is the maximum duty cycle).

Arm Switch – This two position locking toggle switch arms the manual system when in the up position. The switch is only active when the power switch on the automatic FRDS panel is set to Man. No hydraulic pressure can be applied to the manually controlled servo system unless the Arm switch is set to Arm.

Manual Salvo – This lighted (amber), latching pushbutton removes power from the automatic system, supplies power to the manual system, opens the dump doors, and runs the pump for a maximum of 30 seconds when depressed. After this period, the pump and hydraulics are turned off. The light flashed anytime the button has been depressed. The automatic or manual system cannot be operated normally when this button is pushed.

NOTE

The Salvo pushbutton works regardless of the position of the automatic panel power switch.

Gate Indicator – This amber light is illuminated anytime the doors are open.

Pump Fail Indicator – This amber light is illuminated when the system has detected a pump problem (in automatic or manual mode) and has shut the pump off. In this condition, the pump can still be forced to run using the Run Pump switch on the manual control panel. If the automatic control panel power switch is in the Auto position and a pump fail has been detected by the automatic system computer, the indicator will be illuminated steadily. If the power switch is positioned to Man, the indicator will flash to show that a pump error has been detected by the manual system computer.

Power On Indicator – This green light will be illuminated when power is applied to the manual system.

MANUAL SYSTEM OPERATION

The dump doors can be opened with the manual system by selecting Man on the normal system power switch. The power indicator on the manual panel will illuminate. Then set the manual panel Arm switch to the Arm position. This arms the manual system computer to apply hydraulic pressure to the system when operating the doors.

CAUTION!

Never arm the system until ready for a delivery. This safeguards against an inadvertent delivery due to system malfunction or pilot error.

To open the doors press the Fire pushbutton on the control stick. The doors will open and the Gate Open indicator will illuminate. When the Fire button is released, the doors will automatically close. Hydraulic pressure will be maintained on the system for a few seconds to give the doors sufficient time to close, then the servo supply solenoid valve will close and remove pressure from the system. The Gate Open indicator will extinguish.

NOTE

If the manual system has detected a problem and the Pump Fail light is illuminated, it is necessary to toggle the Run Pump/Close Gate switch down to run the pump and supply oil pressure to the system. Make sure the system has oil in it before using this switch.

If the dump doors are open, they cannot be closed using the automatic system without initiating a delivery sequence on the automatic system. They must be closed using the manual system. Set the automatic panel power switch to Man; the manual panel Power indicator will illuminate. Set the manual panel Arm switch to the Arm position. This arms the manual system computer to apply hydraulic pressure to the system when operating the doors.

CAUTION!

Never arm the system until ready for a delivery. This safeguards against an inadvertent delivery due to system malfunction or pilot error.

Toggle the Close Gate/Run Pump switch to the Close Gate position to close the doors. The Gate Open indicator will extinguish. Once the Close Gate switch is released, the hydraulic pressure is removed from the system and the doors are held closed with the mechanical over center latch arrangement on the door linkages.

NOTE

If the manual system has detected a problem and the Pump Fail light is illuminated, it is necessary to toggle the Run Pump/Close Gate switch down to run the pump and supply oil pressure to the system. Make sure the system has oil in it before using this switch.

MANUAL SALVO OPERATION

This button overrides the Power and Arm switches to open the doors. If no hydraulic pressure is present in the system, the doors will open slowly as the pump delivers flow to open them. The manual Salvo button must be deactivated to restore normal system operation.

BILGE SYSTEM – WATER IN FLOAT WARNING

An automatic bilge system is provided for both step compartments of the Wipline 10000 floats where the scoops and associated ducting is located (sta -19 to -44). In the event of a breach in the compartment or scoop ducts, two automatic bilge pumps located in the step compartments of both floats will pump bilge water overboard from the upper inside of the float. When water builds up in the bottom of the float enough to cover the bilge pumps (approximately 1 gallon), the pumps automatically pump water overboard out of the $\frac{3}{4}$ inch white ports located just ahead of the rear spreader bar. The pumps will turn off when the pumps are no longer submerged. The pump has a level switch that controls the pump.

When the pumps are operating, there is an amber light located on the right side of the glare shield panel which becomes illuminated. There is also a red “water in float” warning located on the right side of the glare shield panel that illuminates when water is approximately 1/3 of the way up the step compartment. When this red light illuminates, there is also an audible voice warning – “water in float.” If this light illuminates, scoop operations should be terminated and a land landing made to investigate the cause of water in the float. The bilge pumps may not be able to stay ahead of the volume of water entering the float. There is one water-in-float warning light. The float in question should also have the bilge pump on light illuminated before the water in float warning comes on. The water in float warning is tested utilizing the test switch on the left side of the glare shield panel.

NOTE

Occasional illumination of the bilge pump on lights would be considered normal, because of normal condensation in the float. In this instance, the pumps would only run for a matter of seconds.

FOAM SYSTEM

Including either the 13 U.S. gallon (49.2 liter) or 30 U.S gallon (113.5 liter) foam tanks the Wipaire 802 Fire Boss foam system can consist of as many as three individual tanks. The standard 18-gallon firewall tank may be supplemented by the addition of a 13 gallon (49.2 Liters) or 30 gallon (113.5 liter) tank in each float (at sta.+1) of which approximately 10.3 gallons (39 Liters) or 28 gallons (106 liters) per tank is useable in the automatic mode. In the manual mode all 13 gallons (49.2 Liters) and 30 gallons (113.5 liter) are useable. When 2 float tanks are used, a total of approximately 38.6 gallons (146 Liters) or 74 gallons (280 liters) can be delivered to the hopper in the automatic mode. In the manual mode, a total of 44 gallons (166.5 liters) or 78 gallons (295 liters) can be delivered to the hopper.

To use fluid stored in the float tanks, it is necessary to pump fluid from the float tank/s up to the fuselage firewall tank. This transfer can be accomplished manually or automatically by selecting the appropriate position with the left and right foam control switches located on the panel. When manual "on" is selected, fluid will be pumped via the electric pump located near the supply ports on the 13 gallon float tanks or on top of the 30 gallon float tank up to the firewall tank. In manual mode, the pump does not shut off automatically when the firewall tank is full. When in auto "on" mode, the pump will shut off when there is approximately 2 gallons (5.6 liters) remaining in the float tank. In the event of an over flow, fluid would come out of the firewall tank vent fitting and be deposited back into the float tanks via the fluid return lines.

When auto is selected with the appropriate foam switch, the float tank transfer pump will come on at approximately 7 gallons (19.5 liters) of fluid remaining in the firewall tank. The transfer pump will shut off automatically when the firewall tank is approximately 2/3's full or whenever the selected float tank level is below 2.7 gallons (10.2 liters) remaining in the 13 gallon tanks or 2 gallons (5.6 liters) remaining in the 30 gallon tanks.

The left and right transfer systems can be used individually or simultaneously as desired. Whenever a foam transfer pump is operating, the appropriate green Pump On light will illuminate (manual or auto). The Pump On lights can be tested utilizing the test switch on the left side of the glare shield panel.

ENGINE POWER WARNING SYSTEM

The AT-802A Fire Boss has an engine power warning system installed. The engine power red light is located between the ITT gage and the torque gage on the glare shield panel. If the engine torque red line is reached (4943 lb-ft) or the limiting ITT temperature (870°C) is reached, the red engine power light will be illuminated, along with an audible voice warning that says, "check engine power." When power is reduced below the torque red line (or temperature limit), the warning light and audible warning stop. The engine power light can be tested utilizing the test switch on the left side of the glare shield panel.

VENT AND OVERFLOW PROTECTION

The original 802-hopper vent/door has been modified to allow for a greater venting volume during scooping operations. The original 3-inch Air Tractor vent located on the aft right side of the fire gate is supplemented with the addition of a 5-inch vent that exits at the right aft side of the rear fire gate fairing. In the event of an overflow during scoop operations, a spring loaded vent door is located directly aft of the main drop vent door. This allows the vent to offset against spring pressure in the event of an overflow. Water will exit the hopper to the right and forward of the cockpit windshield. The pilot can see ahead out of the left side of the windshield during an overflow condition.

NOTE

Before opening the main vent door for access, the door bracing turnbuckles (located inside the hopper just below the vent door) need to be disconnected. They are accessible with the drop vent door open (1 on each side).

STICK GRIP SWITCHING



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