P/N 2065 - BLACK MAX

The Ultimate

Engine Saver

Installation and User Manual
2065-Man Rev 2

I. Description

The Black Max Engine Saver is a device designed to reduce the possibility of water forming on the internal surfaces of an internal combustion engine when it is not operating. At the end of a flight, simply plug the unit into an 110vAC outlet, insert the air tube and special adaptor into the end of the engine breather tube where it extends from below the cowl, and your engine is protected. When an engine is shut down, the crankcase is filled with hot gasses containing a lot of moisture. As the engine cools, this moisture condenses on the internal surfaces of the engine parts, forming water droplets. The Engine Saver flushes this moist air out before it can condense. When the aircraft sits, moist air moves in an out of the engine due to the normally occurring changes in atmospheric temperature and pressure. This moisture then condenses on the engine parts forming water droplets. Over time, these water droplets encourage the formation of rust on the engine parts. Preventing the formation of water droplets in an engine promotes better engine life

The Black Max is an electrically powered device that produces a continuous supply of low humidity air. This air then flows into the engine crankcase through a special adaptor which is inserted into the end of the breather tube, and exits the engine through the intake or exhaust system. Air is drawn into the unit by a pump. This air then passes through a special thermal electric cooler. The drop in temperature causes water dissolved in the air to condense, lowering its relative humidity, and producing a supply of low humidity air. The unit is capable of producing temperatures below freezing. The water which is removed from the air is collected and evaporated within the unit and never drops out of the housing. The Black Max can operate continuously without maintenance.

II. Normal Operation

1. Locate the end of the engine breather tube which exits the engine compartment at the bottom of the cowl. The Black Max kit includes 2 special adaptors which are used to insert the dry air into the engine. These adaptors are fitted with a series of foam washers which are designed to compress and form an airtight seal with the inside of the breather tube. The small adaptor, (5/8 inch diameter) is designed to fit the most common sized breather tubes. If this size does not fit your breather tube, you can cut the rings on the large diameter adaptor as needed to fit. The engine breather tube normally contains a small “ice hole” located about 2 to 3 inches up from the end of the tube. This

hole is designed to prevent a buildup of pressure in the crankcase if ice were to form over the end of the breather tube when flying in certain atmospheric conditions. The adaptor must be inserted into the end of the breather tube sufficiently far to place the foam washers above the "ice hole" and form an air tight seal in the tube. Inspect your breather tube to find the "ice" hole. Some aircraft have more than one hole, or have the hole located in a different location. Inspect the complete length of the breather tube to insure that it does not contain any additional holes. If other holes are found, they must be temporarily plugged to form an airtight system.

NOTE: Whenever the adaptor is removed from the breather tube it should be examined to make sure that all of the foam washers are in place, are firmly attached, and that none of them have come off and become lodged in the breather tube. The engine must not be operated if any foreign material is lodged in the breather tube.

2. Plug the cord into an 110vAC outlet. The unit draws about 1.2 amp current and can run continuously.

3. Place the unit on the floor of your hanger in a location where it is level and where there is good air flow into the cooling fan. The unit must sit level on the floor if the water is to drain properly.

4. There are 4 indicator lights located on the top of the unit. When the unit is plugged in, the GREEN light will come on indicating power is available. After power is applied, the 3 remaining RED lights will turn on and off individually as a test of the lights.

5. The LED labeled "COOL" will now light as the unit starts in the cool down mode. A cooling fan located in the front of the unit will be running any time the cooler is operating. After about 2 min. of operation, the system will have cooled sufficiently so that the air flow can begin.

6. The pump will now start, and the RED light labeled "PUMP" will come on in addition to the "COOL" light. Air will pass through the cooler where moisture is removed and its dew point is lowered. The system incorporates 2 temperature sensors, one indicating the outside air temperature, and one measuring the temperature of the cooler. Should the cooling system develop a problem so that the air is not being cooled sufficiently to remove the moisture, the unit will sense this condition and shut down.
a) If the air temperature indicator fails, the "COOL" LED will flash, and the system will shutdown
b) If the cooler temperature indicator fails, the "HEAT" LED will flash, and the system will shut down.
c) If the cooler is not cooling the air sufficiently, the system will shut down and the "PUMP" LED will flash. The system will sit idle for 30 mins to stabilize, and then try to restart the cooling cycle. If the problem was temporary, the system will continue to run. The system will make 3 attempts to restart before shutting down permanently.

6. The cooler normally operates at temperatures below freezing. After a period of operation, ice can build up in the air passages in the cooler. This will effect air flow. To prevent this, after about 15 min. of operation, the unit will automatically go into a defrost mode. The RED "COOL" light and

the RED “PUMP” lights will shut off and the RED “HEAT light will come on. The fan will also turn off. The cooler temperature indicator is used to determine if the system is below freezing. If it is not, the system will restart the cooling and air flow cycle. If the temperature is below freezing, the system enters a defrost mode .The defrost cycle takes about 12 min. Periodically during this time heat will be applied by the system to help melt any ice, and any water formed will drain into the internal evaporator.

7. During the defrost cycle, the RED “HEAT” light will turn on and off as it goes through the various steps in defrosting. When the defrost cycle is completed, the RED “COOL” light will come on indicating that the system has again entered the cool down portion of the process and the cycle has restarted as described above.

8. When the outside air temperatures are very low, there is a greater possibility of the air passages freezing with ice. To prevent this, the system has been programed to recognize these low air temperatures, and to modify the cooling cycle to best operate in low air temperature conditions. The cooling and air flow cycle becomes shorter, and the defrost cycle longer.

III. Trouble Shooting

The following are trouble shooting tips.

1. No green light.
The GREEN light should be on at all times when the unit is plugged in. If it is not, first verify that power is getting to the unit. Next check the fuse located on the back end plate. The unit takes a standard 120v, 2 amp size 3ag fuse. If the fuse appears O.K. listen for the fan. If the fan is running, and the fuse is good, the unit is operating but the GREEN light is bad.

2. Air Flow
The system has been set to deliver about 1 liter per min. of air to the engine. From time to time the system should be checked to verify that air is flowing from the tube. Make sure that the RED “PUMP” light is on, and then check for air flow. This can be done by holding the tube close to your face and feeling the air. Remember that the flow rate is only about 1 liter per min. You will not feel much air, and you will normally not detect much coolness in the air coming from the tube. The air exiting the cooler is cold, but by the time it passes through the length of the tube it warms.

The actual air flow rate is set by two conditions, the resistance in the cooler system, and the resistance in the engine. Air flows into the engine crankcase, past the piston rings, and exits through the intake or exhaust. The piston rings and ring gap present the major resistance to this air flow, and in large part determine what the flow rate through the engine will be. A good tight 4 cylinder engine will have a higher resistance and lower air flow that a worn 8 cylinder engine. The pump resistance and Engine Saver flow rate has been set during manufacturing to insure proper operation. Resetting the air flow rate (resistance) of the pump involves the following:

a) Remove the 6 screws holding the top cover on the unit, exposing the inner components.

b) Locate the pump in the middle of the unit.
c) On the top of the pump is a black dial for pressure tuning. Turning the valve counter clockwise opens the valve, increasing the flow, clockwise decreases the flow.
d) Fill a clear plastic 2 liter soda bottle, or any other clear container with water. With the pump running, place the end of the tube into the bottle, and push the wand down about 3 inches. Observe the bubbles flowing from the tube. The pump is set correctly when the stream appears as individually formed bubbles like a string of pearls. Low flow rates will have viable spaces between the bubbles. High flow rates will not have distinctly formed bubbles, and will not simulate the "string of pearls". Adjust the pump valve as necessary.
e) Reassemble the unit.

Note: Higher than normal air flows will prevent the cooler from achieving the maximum air cooling and maximum moisture removal. It will also cause more ice to form in the cooler passages.

3. "COOL" light Flashing
A flashing "PUMP" light indicates that the unit has sensed that the cooler is not cooling to the required low temperatures. If this occurs, unplug the unit and wait until the GREEN light goes off before plugging it back in. When you plug it in, the fan should start, and the RED "COOL" light should turn on indicating that the cycle has restarted. The system will run and the RED "PUMP" light will come on. The pump operates about 2 min. before it measures the cooler temperature and determines if it is cooling correctly. If the system shuts off after this 2 min. of operation, the unit needs servicing. The system will continue in the shutdown mode for 30 min. At the end of 30 min., will attempt to restart the cycle.

4. "HEAT" or "COOL" light flashing
If either of these lights flash, it indicates that the temperature indicators are not functioning correctly. Turn the unit off, and let it sit for an hour, as condensation on the cooler temperature indicator can occasionally cause an indication of a bad indicator. Try to restart the system if either light continues to flash, the unit will need servicing.

5. Water in the tube
Occasionally owners will find water in the end of the tube that is close to the case. This is generally a sign that the air flow rate through the Black Max is too high. A high air flow rate through the cooler assembly allows the water to be carried into the tube. This can occur due to a pump flow rate set to high, or an engine resistance that is too low. Check the pump flow rate as described in section III. Check the breather tube to insure that the foam washers are making a tight seal with the inside of the tube, and that they are located above the "ice "hole. Check the breather tube to insure that there is not another opening in it, and that all of the tube connections are air tight. Check the oil fill cap to insure the seal is present. The system must be air tight to allow the Black Max to build up a slight pressure in the crankcase to force the air past the rings. A leak in the engine or breather line produces a low engine resistance, prevents the pressure buildup, and results in a higher than normal flow rate and possible water in the tube. Water forming in the tube does not indicate that water is being blown into your engine. The air from the cooler is at a low temperature and contains

all the dissolved moisture it can hold at this temperature, that's why the water droplets are not evaporated. The air cannot adsorb any more water unless its temperature rises, and the section of tube close to the Engine Saver is cold so the water stays there.

5. Outside Testing
Some owners initially run the system to evaluate it without installing it in the engine, and find it does not operate satisfactorily. Remember, the system was designed to operate with an internal combustion engine, and needs the resistance created by the engine for correct air flow and operation. If you are doing this, you must simulate the engine resistance to achieve satisfactory system operation.

WARRANTY

Aircraft Components, Inc. warranties the Black Max to be free of defects in materials and workmanship for a period of (1) year from date of purchase. Aircraft Components, Inc. will at its option replace or recondition to new status any component which fails during the warranty period. Defective units are to be shipped prepaid to the factory for our evaluation. The conclusions of Aircraft Components, Inc. shall prevail in all cases. Aircraft Components shall not be responsible for costs to remove or reinstall the equipment, nor for loss of use, nor consequential damages arising from the use of this device. This warranty shall be the sole warranty, no other warranty is expressed or implied.

For Repairs please send to the address below.

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