May 21, 1982

SUBJECT: VACUUM DISTRIBUTION SYSTEM TROUBLESHOOTING

TO: CESSNA ZONES AND DEALERS

PURPOSE: To announce a new vacuum system test kit and provide expanded troubleshooting procedures to help field maintenance personnel pinpoint vacuum system malfunctions and avoid unnecessary component replacements.

MATERIAL: The Vacuum System Test Kit is available from the Cessna Supply Division at the suggested list price shown below.

<table>
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<tr>
<th>Part Number</th>
<th>Description</th>
<th>Price</th>
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<tr>
<td>343</td>
<td>Airborne Vacuum System Test Kit</td>
<td>$179.00 (T) ea.</td>
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The test kit comes with regulator, ejector, gauges, fittings and instructions enclosed in a durable shock protected case. It allows testing without running the aircraft engines and is being recommended to Cessna Dealers for use in servicing and maintaining vacuum systems on all Cessna aircraft. Additional information is provided in an Airborne brochure being mailed to each Dealer.

ACCOMPLISHMENT INSTRUCTIONS: Attached is a representative troubleshooting procedure for multi-engine vacuum systems which may be used until the more detailed procedures are incorporated in future revisions to the Multi-Engine Maintenance Manuals.

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ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CUSTOMER SERVICE
VACUUM DISTRIBUTION SYSTEM - TROUBLESHOOTING

General
A. Troubleshooting the vacuum distribution system consists of isolating the problem to an individual component.

Troubleshooting
A. Troubleshooting the Vacuum System.
(1) For a guide to troubleshooting the vacuum system.

B. Troubleshooting Vacuum System using Airborne's 343 Test Kit.

NOTE: When using Airborne's 343 Test Kit, it is recommended that a large compressor with an adequate storage tank be used.

Also, always try to position the airplane as close to the air compressor as possible.

(1) Remove wing gap fairings by removing all attaching screws.
(2) Remove upper engine cowlings.
(3) Remove engine system vacuum hose (1) from vacuum pump (dry air).
(4) Combine the test kit 1H88-1 regulator with the 1H89-1 ejector.
(5) Attach vacuum system hose (1), which was removed from pump, to the 5/8-inch tube on the 1H89-1 ejector and secure with clamp.
(6) Attach shop air supply hose to the fitting on the 1H88-1 regulator.

NOTE: Air supply hose 3/8-inch I.D. minimum.

(7) Slide the ON-OFF supply valve on the 1H88-1 regulator to the ON position, which is toward the regulator side, and screw adjustment down.
(8) Increase pressure until the 1H89-1 ejector gage peaks.
(9) If the reading on the 1H89-1 ejector is in excess of 8-inches Hg., there is some type of obstruction in the hoses. The difference between the reading at the 1H89-1 ejector gage and the airplane suction gage (2) with two gyro installation should be no greater than 1-inch Hg. With four gyro installation, it should be no greater than 2-inch Hg.
(10) Now with the system connected, proceed to the appropriate section for troubleshooting for step by step outline.

Troubleshooting Guide
A. No Vacuum.

(1) The system performs satisfactorily.
   (a) Vacuum pump is defective. Replace vacuum pump.
   (b) If the system is still inoperative, proceed to step 2.

(2) System still indicates that side is inoperative but you can hear the gyro's are functioning.
   (a) Using the 1G31-1 gage and probe, check the suction gage (2) by inserting probe in the hose pertinent to the side that is being tested.
   (b) If there is a reading of 4.8-inches Hg., then suction gage (2) is defective.
   (c) Replace suction gage (2).
   (d) If there is no reading, proceed to step 3.

(3) Using 1G31-1 gage and probe, check the system, starting right after the 1H89-1 ejector and working toward the vacuum air filter (11).
   (a) Check the reading at hose (6). If reading is at or above 4.8-inches Hg., continue to check moving up the system. If the reading is extremely high, steadily increasing, one possibility is that the relief valve (4) may be stuck. If this situation exists, try to adjust the relief valve (4). If that doesn't resolve the problem replace relief valve. The other possibility is there is a partially plugged hose or line. Continue to check for a 4.8-inches Hg. reading working toward the relief valve (4). Once you do not get a reading, you have passed over a location of a partially plugged hose or line. Remove plugged substance from hose or line.
(b) A check should then be conducted at hose (8) to see if the relief valve (4) is operational. If the reading is 4.8-inches Hg., then proceed to step (d). If the reading is not 4.8-inches Hg., then relief valve (4) needs to be readjusted to 4.8-inches Hg. If it will not readjust, replace with a relief valve and adjust to 4.8-inches Hg.

(c) Next check reading in hose (7) starting at the relief valve (4) and working toward manifold (5) to see if it is 4.8-inches Hg. If so, proceed to step (d). If, when checking hose (7), you get a reading which is not consistent with the system or no reading, it is possible that you have an obstruction in the hose and it should be removed.

(d) Check the manifold (5) for proper operation by checking vacuum at hose (9) for the side you are testing as close to the manifold as possible. The reading should be 4.8-inches Hg. If so, proceed to next step. If not, there possibly is an obstruction in the manifold. Replace manifold.

(e) Check the hose (9) from the manifold connection to the suction gage (2) always looking for the 4.8-inches Hg. reading. If the reading is continuous all the way through the hose up to the suction gage (2), the gage is defective. Replace gage. If, during checking of the hose (9) you lose the 4.8-inches Hg., then, in that portion of hose from where you were getting the 4.8-inches Hg. reading to where you lose the reading, there is some type of blockage or collapsed wall in the hose. Replace hose.

B. Low Vacuum.

(1) The system performs satisfactorily.
   (a) Vacuum pump is defective. Replace vacuum pump.

(2) The system still indicates low vacuum.
   (a) A system showing low vacuum should have all hoses checked for any loose clamps and connections. Then using the 1G31-1 gage and probe, check the system as outlined step-by-step.
   (b) Check the reading at hose (8) for 4.8-inches Hg. If it is 4.8, proceed to the next step. If it is not, then the relief valve (4) needs to be readjusted. If it cannot be readjusted, replace relief valve.
   (c) Check the manifold check valve (5) by checking the reading at hose (7) or (9) on the opposite side from test side for any reading. If there is no reading, proceed to next step. If there is a reading, the manifold check valve (5) is defective and is allowing ambient air to enter the system. Replace manifold check valve (5).
   (d) Check the vacuum air filter at hose (3) for any reading. If there is none, then the filter is good, but if there is more than 1 1/4-inch Hg. reading, the filter is partially plugged and has to be replaced.

C. High Vacuum.

(1) The system shows high vacuum using the 1G31-1 gage and probe. Proceed step-by-step as outlined.
   (a) Check the reading at hose (8). If it is high and reads the same as suction gage (2), then the relief valve (4) filter is possibly dirty. Replace filter.
   (b) Another possible problem is that the relief valve (4) is improperly adjusted. Readjust to 4.8-inches Hg. If it will not adjust, replace relief valve (4).

D. Suction Gage Fluctuates.

(1) Check for panel vibration or plumbing vibration and correct as required.

E. Erratic Vacuum.

(1) This is an indication that there might be some type of fluid in the vacuum pump; i.e., oil, varsol, water, etc. Check vacuum pump exterior for any signs of oil, varsol, etc. If it is apparent that there is fluid in the pump, remove and replace pump.

F. Gyro Gage Follows Engine RPM.

(1) To simulate a gage following engine RPM, vary the pressure on the 1H88-1 regulator with excessive pressure. If the gage fluctuates, this is an indication that the relief valve (4) might have something in the seat. Remove the adjustment screw on the relief valve (4) and with clean shop compressed air, blow the seat area off. Reinstall adjustment screw and readjust relief valve (4). If relief valve (4) still fluctuates, replace relief valve (4).
G. One Gyro Inoperative.

(1) If one gyro operates properly while the other gyro will not erect or precesses and tumbles, use the 1G31-1 gage and probe to check at the back of the inoperative gyro at the hose (10) connected to the manifold (5) for a reading of 4.8-inches Hg. If you get a reading of 4.8-inches Hg., this is an indication that the gyro is defective. Replace gyro. If there is no reading at the back of the gyro, there must be a clogged line from the manifold (5) to the gyro. With the 1G31-1 gage and probe, work your way toward the manifold (5) until you get a reading. Replace that plugged segment of hose.

NOTE: Make sure that the hose (3) from the vacuum air filter (11) to the gyro is also clean and unrestricted by checking with the 1G31-1 gage and probe to ensure that no vacuum is in that line. If there is a vacuum, replace filter or hose to correct the situation.

H. Gyros will not Erect.

(1) In a nondifferential gage vacuum system, when the suction gage (2) reads okay, but the gyros will not erect, using the 1G31-1 gage and probe, check for any reading at hose (3). If there is any reading, this is an indication that the vacuum air filter is clogged or the hoses (3) could have a plugged section in them. Replace vacuum air filter or section of bad hose (3).

I. Both Fail Source Indicators Retract with One Side Operational.

(1) Using the 1G31-1 gage and probe, check for a reading in hose (9) on the opposite side from testing. If you get a reading, then the manifold (5) is defective. Replace manifold.

J. Gyro Gage Indicates Frequent Regulator Adjustment.

(1) In a differential gage system using the 1G31-1 gage and probe, check for any reading at hose (3). If there is a reading, then the vacuum air filter is partially clogged. Replace filter. Also, check for a higher than normal reading in hoses (10) and (7) which might be an obstruction in the hoses or lines. Remove obstruction.

K. Frequent Vacuum Pump Replacement.

(1) If it is obvious that one side is having frequent vacuum pump replacement exhibiting shorter than normal vacuum pump life, then it is very important that that side be thoroughly inspected and tested using an Airborne 343 Test kit. Make sure that:
   (a) This is proper vacuum pump for application.
   (b) There are no restrictions in the discharge side of the vacuum pump.
   (c) There are no kinked or plugged lines.
   (d) Filters are all in satisfactory condition.
   (e) Vacuum pressure is set properly.
   (f) Deice control valve is operating properly.

L. Surface Deice Control Valve Operation.

(1) If the airplane is equipped with surface deice system, ensure that the system is operating properly as outlined in applicable section or chapter of Service or Maintenance Manual.
   (a) If the pressure control valve electrical solenoid valve fails to return to its normally open (OFF) position after cycling or the vent is obstructed, the valve would remain in the closed, nonventing condition resulting in high system pressure and increased load on the vacuum pump. Increased pressure between the vacuum pump and pressure control valve could cause the pump to fail.
   (b) Connect regulated air supply to hose at outlet port of vacuum pump. Ensure surface deice system is OFF. Apply regulated air and check pressure between vacuum pump and pressure control valve; reading should be zero (0) psi.

NOTE: For regulated air pressure, refer to Surface Deice System in applicable airplane Service or Maintenance Manual.
VACUUM DISTRIBUTION SYSTEM - ADJUSTMENT/TEST

Adjustment Vacuum Relief Valve

NOTE: Since a relief valve is used for each vacuum source, each relief valve must be adjusted separately.

A. Remove wing gap fairings by removing attaching screws and remove safety wire from adjusting screw locknut.

B. Start the engines and idle the right engine. Operate left engine so tachometer reads 1700 RPM, and the suction gage should read 4.8 inches Hg.

C. Adjust the left relief valve by bending down the lock tabs and adjusting to obtain the desired reading. Clockwise rotation of the adjusting screw increases the vacuum.

D. Idle the left engine and operate the right engine so tachometer reads 1700 RPM.

E. Adjust the right relief valve by bending down the lock tabs and adjusting to obtain the 4.8 inches Hg. vacuum reading. Clockwise rotation of the adjusting screw increases the vacuum.

F. With both engines operating at tachometer RPM of 1700, the suction gage should read 5.00 ±0.25 inches Hg.

NOTE: If the suction gage reading is not within limits described, both relief valves should be readjusted to those limits.

G. Shut down both engines and check that the lock tabs are turned back up, locking the adjustment screw in place.

H. Install wing gap fairings.

Adjustment Vacuum Relief Valve using Airborne's 343 Test Kit (See Figure 102 for Component Location)

NOTE: Since a relief valve is used for each vacuum source, each relief valve must be adjusted separately.

A. Position airplane as close to the shop compressor as possible.

NOTE: When using the 1H89-1 ejector, a large supply of air is required. A large compressor with a large storage tank is recommended.

B. Remove wing gap fairings by removing attaching screws.

C. Remove upper engine cowlings.

D. Remove engine system vacuum line from vacuum pump.

E. Combine the 1H88-1 regulator to 1H89-1 ejector at quick disconnect.

F. Attach vacuum system line (1) which was removed from pump, to the 5/8" tube on the ejector and secure with clamp.

G. Attach shop air supply hose to the fitting on the 1H88-1 regulator.

NOTE: Minimum shop air supply hose is 3/8" I.D.

H. Slide the ON-OFF valve on 1H88-1 regulator to the ON position towards the regulator side.

I. Increase regulator adjustment screw until 1H89-1 ejector gage peaks.

J. With the 1H89-1 ejector peaked, the suction gage (2) should read 4.8 inches Hg.

K. If the suction gage (2) does not read 4.8 inches Hg., loosen the locking device on the adjustment screw on the relief valve (4) and rotate adjustment screw clockwise to increase and counterclockwise to decrease until the desired setting of 4.8 inches Hg. is reached on the suction gage (2).
L. After system is adjusted, remove vacuum system line (1) from 1H89-1 ejector and resecure to vacuum pump and tighten clamp.

M. To adjust other side of system, perform steps D through L.

N. Reinstall engine cowlings.

O. Position airplane in a suitable place to run both engines.

P. With both engines operating at tachometer RPM of 1700, the suction gage (2) should read 5.00 ±0.25 inches Hg.

   NOTE: If the suction gage reading is not within limits described, both relief valves should be readjusted to maintain these limits.

Q. Shut down both engines and check that the relief valve (4) locking devices are secure.

R. Reinstall wing fairings.

Cleaning Vacuum System Components

A. Protection of Pneumatic System Components when Cleaning the Engine Compartment.

   WARNING: FAILURE TO PROTECT THE PNEUMATIC SYSTEM COMPONENTS FROM CONTAMINATION BY ENGINE CLEANING SOLVENTS MAY RESULT IN FAILURE OF THE VACUUM PUMP WITHIN A SHORT PERIOD OF OPERATION.

(1) Prior to washing down engine compartment, the following precautions must be taken to assure expected service life of the pneumatic system components.
   (a) Vacuum pump coupling.

      CAUTION: DO NOT BLAST THE VACUUM PUMP COUPLING AREA OR OTHER PNEUMATIC SYSTEM COMPONENTS WITH CLEANING SOLVENT UNDER HIGH PRESSURE.

      DO NOT ALLOW PROTECTIVE COVERING AROUND THE COUPLING OR FILTERS TO BECOME SATURATED WITH SOLVENT.

(1) Protect the coupling area between the vacuum pump mounting flange and the vacuum pump housing by wrapping a protective covering around that area during engine cleaning.

   NOTE: The seals in the front frame of the housing behind the coupling are designed to keep out foreign material; such as dirt, dust and light fluid. However, fluid under high pressure can be forced by the seals and enter the vacuum pump combining with the carbon dust to create a gumming condition which will cause vacuum pump failure.

   (a) Vacuum pump fittings.
      1) Before washing the engine off, check the vacuum pump fittings for looseness of the threaded fittings. Fluid can seep through loose threads and enter the vacuum pump.

   (b) Vacuum pump discharge hose (Vacuum Instrument System).
      1) Recommendation is to plug the end of the hose or the fitting and flag it with a red REMOVE BEFORE RUNNING ENGINE tag, then clean the engine.

         CAUTION: REMOVE PLUG PRIOR TO RUNNING ENGINE.

   (c) Deice control valve.
      1) If the deice control valves are in the engine compartment, install some protective devices before the airplane engine and area are cleaned.

         CAUTION: MAKE SURE THE PROTECTIVE DEVICES ARE REMOVED AFTER THE ENGINE AND AREA ARE CLEANED.

      2) Check the area in and around the valves to ensure they are dry and free of any cleaning fluids prior to running the engine.

   (d) Vacuum system lines and hoses.
      1) The vacuum system lines and hoses may be cleaned by immersing them in dry cleaning solvent and then internally dried by using filtered dry compressed air.

      2) Wipe exterior of lines and hoses with a clean, dry cloth.

      3) Clean vacuum air filter with clean, dry air and tap lightly while blowing air over the filter.

      4) Clean vacuum relief valve as required by removing old filter and blasting with filtered dry compressed air.
Vacuum System Installation