Airborne
Air & Fuel Products

Service Letter

Service Letter Number: 38A

Date: May 31, 2002 (Supersedes Product Reference Memo Number 38 dated March 9, 1994, Reprinted May, 2005)

Subject: **Mandatory** Replacement of Airborne Engine-Driven Air Pumps That Have Been Subjected to Sudden Engine Stoppage.

Applicability:

All Airborne Engine-Driven Air Pump models including Belt-Driven and Clutch-Operated Air Pumps. These air pumps are typically used on single-engine and multi-engine piston aircraft to power gyro flight instrument and de-ice systems.

Background:

Any time an engine-driven air pump is subjected to sudden stoppage (e.g., from a propeller strike during a gear up landing), the rotating elements of the pump may sustain damage. This damage **may not** be evident by rotating the pump or by visual examination.

WARNING: Failure of the air pump will result in the loss of the pneumatically powered gyro flight instruments and de-ice system.

Compliance:

Compliance with the following is **mandatory**.

Any Airborne Engine-Driven Air Pump which has been subjected to sudden engine stoppage **must be replaced before next flight**. Any authorized technician can replace the air pump in accordance with the instructions provided by the Airframe Manufacturer in the appropriate maintenance publication. Upon completion of the **mandatory** replacement, ensure an entry has been added in the aircraft's engine logbook identifying compliance with this Service Letter Number 38A.

Any questions regarding this Service Letter or requests for copies of any Airborne Service Letters (can also be printed from Airborne's website) should be directed to our Customer Support Team as follows:

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Service Letter

Service Letter Number: 43A

Date: May 31, 2002 (Supersedes Product Reference Memo Number 43 dated November 1,1996, Reprinted May, 2005)

Subject: Mandatory Inspection Intervals for Airborne Air Pumps for Oil Contamination and **Mandatory** Replacement of Oil Contaminated Airborne Air Pumps.

Applicability:

All Airborne Engine-Driven Air Pump Models including Clutch-Operated Air Pumps. These air pumps are typically used on single-engine and multi-engine piston aircraft to power gyro flight instruments and de-ice systems.

Background:

Oil contamination of Airborne Air Pumps will lead to erratic vacuum/pressure gage indications, excessive air pump operating temperatures and premature air pump failure.

WARNING: Failure of the air pump will result in the loss of the pneumatically powered gyro flight instruments and de-ice system.

Compliance:

Compliance with the following is **mandatory**.

1) At each annual aircraft inspection, or 100 aircraft hours (whichever comes first) inspect the area around the AND20000 accessory pad and lower surfaces of the air pump for evidence of oil. if evidence of oil is discovered, follow the instructions noted below:

Problem: AND20000 accessory pad drive-shaft oil seal leaking.

Corrective Action: Replace the AND20000 accessory pad drive-shaft oil seal in accordance with the instructions provided by the Airframe or Engine Manufacturer in the appropriate maintenance publication.

Problem: Air pump mounting gasket leaking.

Corrective Action: **Mandatory** gasket replacement. Install a new air pump mounting gasket in accordance with the specifications and instructions provided by the Airframe Manufacturer in the appropriate maintenance publication.

(Continued next page)

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Problem: Any oil in the air pump's drive and mounting area. Refer to Figure 1. Perform a visual examination of the pump drive end and mounting area, no oil is permitted.

Corrective Action: **Mandatory** air pump replacement. Install the new air pump in accordance with the instructions provided by the Airframe Manufacturer in the appropriate maintenance publication.

Any authorized technician can inspect and/or replace these components. Upon completion of the **mandatory** inspection and/or replacement, ensure an entry has been added in the aircraft's engine logbook identifying compliance with this Service Letter Number 43A.

2) Inspect the engine compartment for evidence of any other oil leaks, i.e., fittings, hoses gaskets, etc. Replace or repair as required.

CAUTION: Failure to correct oil leaks may allow oil to enter the air pump and cause premature air pump failure.

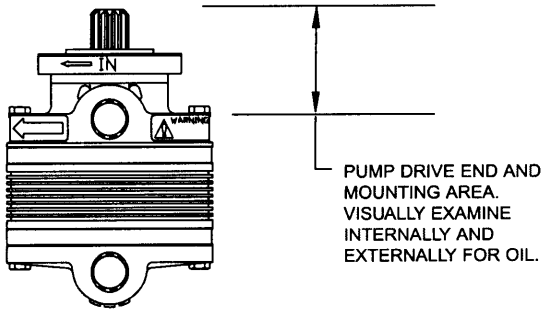

Figure 1

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Service Letter

Service Letter Number: 58A

Date: March 23, 2006 (Supersedes Service Letter Number 58 dated May 31, 2002)

Subject: **Mandatory** Replacement Times for Airborne Air Pumps.

Applicability:
All Airborne Air Pump models. These air pumps which are listed on the next page are typically used on single-engine and multi-engine piston aircraft to power gyro flight instruments and de-ice systems.

Background:

Airframe Manufacturers typically provide replacement times for air pumps in their aircraft maintenance manuals. In the absence of air pump **mandatory** replacement times provided by Airframe Manufacturers, Airborne is providing these **mandatory** replacement times.

WARNING: Failure of the air pump will result in the loss of the pneumatically powered gyro flight instruments and de-ice system.

Compliance:

Compliance with the following is **mandatory**.

Airborne air pumps **must not** be operated beyond the Airframe Manufacturer's specification for **mandatory** inspection intervals or **mandatory** replacement times or Airborne's **mandatory** inspection intervals or **mandatory** replacement times, whichever comes first.

Any authorized technician can replace the air pump in accordance with the instructions provided by the Airframe Manufacturer in the appropriate maintenance publication. Upon completion of the **mandatory** replacement, ensure an entry has been added in the aircraft's engine logbook identifying compliance with this Service Letter Number 58A.

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MANDATORY REPLACEMENT TIMES FOR AIRBORNE AIR PUMPS	
Airborne Air Pump Model Number	**Mandatory Replacement Times**
Engine-Driven Air Pump:	
Any model no. beginning with 200 through 216	500 aircraft hrs. or 6 years from date of manufacture, whichever comes first
E211CC or E2I2CW	500 aircraft hrs. or 6 years from date of manufacture, whichever comes first
Any model no. beginning with 220 through 242	500 aircraft hrs. or 6 years from date of manufacture, whichever comes first
Any model no. beginning with 28C214 or 28C444	500 aircraft hrs. or 6 years from date of manufacture, whichever comes first
Any model no. beginning with 420 through 442	400 aircraft hrs. or 6 years from date of manufacture, whichever comes first
832CW or 842CW	300 aircraft hrs. or 6 years from date of manufacture, whichever comes first
Auxiliary Motor-Driven Air Pump and Elapsed Time Indicator:	
Any model no. beginning with 4A2 or 4A3	500 pump hrs. or 10 years of service, whichever comes first

Determine the air pump date of manufacture by one (1) of the two (2) following methods:

1) The date of manufacture is encoded in the serial number located on the nameplate of the air pump as depicted in Figure 1. The first numbers (1 through 12) of the serial number indicate the **month** (January through December) of manufacture. The following letter combinations of the serial number indicate the **year** of manufacture:

T = 1972	E = 1979	AB = 1986	AJ = 1993	AT = 2000	BC = 2007
V = 1973	F = 1980	AC = 1987	AK = 1994	AU = 2001	BD = 2008
W = 1974	H = 1981	AD = 1988	AL = 1995	AV = 2002	BE = 2009
A = 1975	J = 1982	AE = 1989	AM = 1996	AW = 2003	BF = 2010
B = 1976	K = 1983	AF = 1990	AN = 1997	AY = 2004	BG = 2011
C = 1977	M = 1984	AG = 1991	AP = 1998	BA = 2005	BH = 2012
D = 1978	AA = 1985	AH = 1992	AR = 1999	BB = 2006	BJ = 2013

2) There may be an occasion when the nameplate has been lost or obliterated. Starting in 1972, a quarter/year marking may have been stamped on the back of the air pump as depicted in Figure 1. For example, 2Q02 signifies the air pump was manufactured in the second quarter of 2002.

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If the product nameplate has been lost, obliterated, or for any reason the year of manufacture cannot be substantiated, replace the air pump.

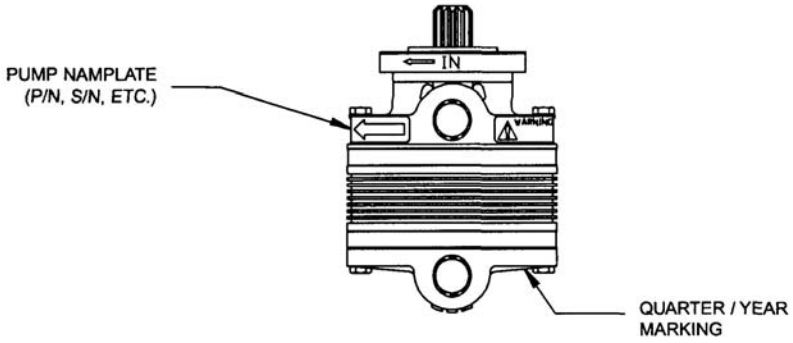

Figure 1

These **mandatory** replacement times do not take into account the shortening of air pump life caused by improper maintenance, improper regulator settings, higher than optimal air pump loads, speeds and temperatures, oil contamination, dirty filters, etc.

In no event, however, should an Airframe Manufacturer's specification for replacement times or Airborne's **mandatory** replacement times be considered an alternative to either a back-up pneumatic power source for the air driven gyros, or a back-up electric attitude gyro instrument. Air pump or pneumatic system failures can and do occur without warning, sometimes with fewer hours of service than those specified in **mandatory** replacement schedules. As stated in Airborne Service Letter Number 31, **SAFETY WARNING — Vacuum/Pressure Gyroscopic Flight Instrument Power System**, A BACK-UP PNEUMATIC POWER SOURCE FOR THE AIR DRIVEN GYROS, OR A BACK-UP ELECTRIC ATTITUDE GYRO INSTRUMENT, **MUST** BE INSTALLED IN ALL AIRCRAFT WHICH FLY IFR.

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711 Taylor Street • Elyria, Ohio 44035 • 440 284-6215 • Fax: 440 284-6208
E-mail: techhelp@parker.com • Website: www.parker.com/ag/nad

Parker Hannifin Corporation
Airborne Division
711 Taylor Street
P. O. Box 4032
Elyria, Ohio 44036 USA
Phone (440) 284-6300
FAX (440) 322-6094

To: Director of Maintenance

May 2005

Subject: INFORMATION CRITICAL TO FLIGHT SAFETY

The lack of proper maintenance has been found to be the leading cause for pneumatic system malfunction on Piston-Engine Aircraft. It is critical that air pumps and other components used in pneumatic systems that power air-driven gyro instruments, including Parker Airborne air pumps and other components, be maintained, inspected or replaced per Airborne and/or other applicable maintenance instructions. Failure to do so creates a potentially **DANGEROUS** situation for the pilot and passengers of aircraft containing such components.

Parker Airborne has just published a new comprehensive **"Pneumatic System Maintenance Manual"** (two copies enclosed). Along with the appropriate airframe and other manufacturer's publications, this publication provides instructions for proper pneumatic system maintenance. Note: **"Summary of Mandatory Service Instructions For Airborne Pneumatic Components"** (SI300-17) can be found in the appendix to this Manual.

URGENT – FORWARD THE ATTACHED COPIES TO YOUR MECHANICS.

Additional copies of the "**Pneumatic System Maintenance Manual"**, Parker Airborne maintenance, inspection and replacement instruction, and pertinent FAA documents can be found on the Parker Airborne Website www.parker.com/ag/nad or ordered at no charge by contacting Parker Airborne's Customer Support Team as follows:

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Enclosure:
Pneumatic System Maintenance Manual SI300-23, May 2005 (two copies)

To print the Pneumatic System Maintenance Manual

You will see blank pages in the following document. This document is set be printed in a 5 ½ x 8 format as a double-sided booklet.

Refer to your printer's properties to select a double-sided booklet format

PNEUMATIC SYSTEM MAINTENANCE MANUAL

Airborne
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⚠ SAFETY WARNING

PNEUMATIC SYSTEM FAILURE CAN RESULT IN DEATH, PERSONAL INJURY OR PROPERTY DAMAGE. SPATIAL DISORIENTATION OF THE PILOT AND LOSS OF CONTROL OF THE AIRCRAFT, ESPECIALLY IN INSTRUMENT METEOROLOGICAL CONDITIONS (IMC), CAN RESULT FROM:

- **FAILURE TO HAVE PROPER COMPONENT REDUNDANCY,**
- **FAILURE TO HEED MANDATORY REPLACEMENT TIMES FOR COMPONENTS,**
- **FAILURE TO PROPERLY MAINTAIN THE PNEUMATIC SYSTEM COMPONENTS, OR**
- **FAILURE OF THE PILOT TO RECOGNIZE A PNEUMATIC SYSTEM FAILURE AND FLY PARTIAL PANEL PROFICIENTLY**

LOSS OF CONTROL OF THE AIRCRAFT DUE TO PNEUMATIC SYSTEM FAILURE WILL OFTEN RESULT IN THE CRASH OF THE AIRCRAFT AND LOSS OF LIFE OF THOSE ON BOARD.

A. **Redundancy** – A back-up pneumatic power source for the air-driven gyros, or a back-up electric attitude gyro instrument, **must** be installed in all aircraft which fly under Instrument Flight Rules (IFR). Refer to FAA-P-8740-52, "The Silent Emergency (Pneumatic System Malfunction)", AFS-820 2000. Refer also to Airborne Service Letter 31 (latest revision).

B. **Component Replacement** – Airborne has **mandatory** replacement times for many of its pneumatic system components, including air pumps, check valve manifolds and filters. These replacement times are listed in the Appendix to this Manual. Refer to FAA Special Airworthiness Information Bulletin CE-05-15, "Pneumatic System Components That Power Air-Driven Gyro Instruments" dated 10 November 2004. Refer also to the "Summary of Mandatory Service Instructions for Airborne Pneumatic Components" (SI300-17) in the Appendix to this Manual.

C. **Maintenance** – Improper maintenance of aircraft pneumatic systems is the leading cause of system failures and resulting aircraft accidents. For proper maintenance, reference should first be made to the appropriate Airframe Manufacturer's publication(s) relating to Pneumatic System Maintenance. Proper maintenance is also the subject of this Pneumatic System Maintenance Manual. Refer also to FAA SAIB CE-05-15, "Pneumatic System Components That Power Air-Driven Gyro Instruments" dated 10 November 2004.

D. **Pilot Warning and Proficiency** – Air pump or pneumatic system failures can and do occur without warning. This can be the result of various factors, including but not limited to normal wear-out of components, improper installation or maintenance, premature failure, or use of sub-standard overhauled components. An annunciator light, instrument with flag indicating loss of instrument power, or other device **must** be installed to warn the pilot of loss of gyro power so that the pilot can take corrective action prior to loss of correct gyro information. Despite training in partial panel flight, many pilots are not sufficiently proficient, become spatially disoriented, and lose control of the aircraft if their pneumatic system fails in IMC. Refer to FAA-P-8740-52, "The Silent Emergency (Pneumatic System Malfunction)", AFS-820 2000.

Copies of referenced FAA Publications, Airborne Service Letters and Safety Literature may be printed from Airborne's website www.Parker.com/ag/nad. They can also be obtained by calling 440-284-6215 or 1-800-C-Parker.

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INTRODUCTION

Like any system on an aircraft, the Pneumatic System requires periodic inspection to ensure proper operating condition and verify replacement of worn or aged components. Because the pneumatic system is a critical safety of flight system in Instrument Meteorological Conditions (IMC), it is most important that it be maintained properly. A pneumatic system failure in IMC can result in loss of control of the aircraft and loss of life. Please read, understand and follow the important **Warning** at the beginning of this Manual (Page 3). The lack of proper maintenance has been found to be the leading cause for Pneumatic System malfunction. This publication, along with the appropriate Airframe Manufacturer's publications, provide a guide towards proper Pneumatic System Maintenance.

WHERE TO START

There are various reasons why you may be inspecting a Pneumatic System. Regardless if it is for an annual, squawk or pre-buy inspection, you need to understand how the system works and where its components are located. The first place to look for information is the appropriate manual(s) from the airframe manufacturer. Next look at the aircraft and engine logbooks for any record of modification to the aircraft. After gathering this information and identifying the individual components, gather whatever information is available from the component manufacturer. Component Manufacturers do publish Service Bulletins, Inspection Intervals and Replacement Times. Be advised that Component Manufacturer's information does not always make its way into the publications of the Airframe Manufacturer.

INSPECTING THE HARDWARE

Prior to any cleaning, inspect the overall system for any accumulations of oil or dirt that could potentially contaminate the Pneumatic System. Note these areas for replacement or repair and cleaning. Locate each Pneumatic System component on the airplane and identify it's part number, serial number and manufacture date. This may be needed to determine if the component is within its service life. Next inspect the connections between components. Note any loose or damaged fittings and loose or damaged clamps. Hoses should be inspected for serviceable condition, proper installation and freedom from debris, oil or solvents.

ENGINE CLEANING PRECAUTIONS

WARNING: Failure to protect the air pump and coupling from engine cleaning solvents may result in premature air pump failure.

Prior to washing the engine compartment, the following precautions **must** be taken to protect the pneumatic system components.

A. Air Pump and Coupling

1. The seal on the engine drive side of the air pump in the front frame of the housing behind the coupling is designed to keep out foreign material such as dirt, dust and light fluid. However, fluid under high pressure can be forced past the seal and enter the air pump. Protect the coupling area between the air pump mounting flange and the air pump housing by wrapping a protective covering around that area during engine cleaning.

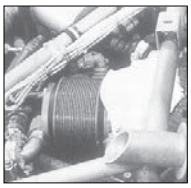

Figure 1
Coupling Protected

B. Air Pump Fittings

1. Before washing the engine, check the air pump fittings for looseness of the threaded fittings. Fluid can seep through loose threads and enter the air pump.

C. Inlet Filter

1. Whether the inlet air filter is behind the engine on the rear firewall or in the forward engine compartment, make sure to wrap a protective covering around the inlet filter.

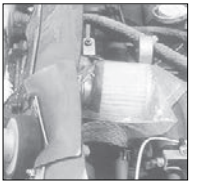

Figure 2
Covered Inlet Filter

D. Hoses

1. Vacuum System – Plug the end of the pump discharge hose or fitting and flag it with a red “Remove Before Running Engine” tag.
2. Pressure System – Inspect hose from inlet filter to pump. If there are holes, cracks or other damage which could allow solvent leaks, replace the hose.

E. Deice and Regulator Valves

1. Protect vacuum regulators, pressure regulators, deice valves and relief valves located in the engine compartment with some type of protective covering prior to engine cleaning.

WARNING: Do not blast the air pump coupling area or other pneumatic system components with cleaning solvent under high pressure.

Do not allow protective covering around the air pump coupling or filters to become saturated.

AFTER ENGINE CLEANING

Replace all components beyond their replacement time. A Summary of Mandatory Service Instructions for Airborne Pneumatic Components can be found in the Appendix to this manual.

INSPECTION AND MAINTENANCE PROCEDURE

Check all pneumatic system components, including gyros, deice and door seal valves as well as pneumatic autopilot system components.

Contamination, restrictions or malfunctions in the system can overload the system and cause premature system failure. Replace inoperative or contaminated components.

A. Filters

WARNING: Change all the filters in the system at their replacement time or after air pump failure. Failure to change all the filters may result in premature air pump failure or pneumatic system malfunction.

Dirt clogged filters reduce the flow of air through the air pump resulting in increased air pump operating temperatures that cause higher air pump wear rates. Dirty filters will also affect regulator function and cause low vacuum/pressure gage indications.

B. Fittings

Loose or damaged fittings can reduce air pump life through leakage or by restricting flow.

1. Inspect fittings for looseness or damage which may leak or restrict airflow.
2. Fittings with stripped, burred or truncated threads, or fittings that are twisted, bent or kinked **must** be replaced. Also replace fittings that have rounded wrench flats.

WARNING: Do not use Teflon tape, pipe dope or thread lube on fitting threads. Spray the fitting threads with silicone and let dry.

NOTE: MS fittings are not recommended due to excessive pressure drop.

C. Pneumatic System Hoses, Clamps and Hardware

Hoses and hardware should be inspected for condition, proper installation and freedom from debris, oil or solvents.

WARNING: This step is extremely important after an air pump failure to ensure that carbon particles are removed from the pneumatic system and to correct conditions which can reduce air pump life.

1. Check the condition of the hoses in the pneumatic system. If hoses are found to be hard, cracked, oil soaked or brittle, replace with new hose.
2. Remove hoses as required and clean them with vacuum or air pressure.
3. Inspect the inside of all system hoses to make sure they are free of all debris, oils or solvents.

D. Regulators, Check Valve Manifolds, Check Valves and Deice Valves

Regulators, check valve manifolds, check valves and deice valves should be clean and oil-free, adjusted to proper settings necessary for optimum pneumatic system service life and operating within limits specified in the Aircraft Service/Maintenance Manual.

1. Check general condition of regulators and valves to ensure they are clean and in airworthy condition. If solenoid equipped, inspect wiring and electrical connections. Check for proper operation per the Aircraft Service/Maintenance Manual.
2. On all single and multi-engine deiced aircraft, it is important to ensure that the deice valve(s) are operating completely to the off position.

WARNING: Field Service Reports have shown that some deice valves may stick in a partially closed position at completion of the deice cycle, causing excessive air pump back pressure and operating temperature, which will lead to premature air pump failure. This condition can exist when the deice system appears to be functioning properly.

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3. Replace or repair malfunctioning and inoperative regulators, check valve manifolds, check valves and deice valves.

E. Check Valve Manifolds and Check Valves

Synthetic rubber components in check valve manifolds and check valves deteriorate with age, causing loss of flexibility and the inability of the check valve to fully seal against the valve seat. Extremely deteriorated valves may separate at the hinge rendering the check valve manifold or check valve inoperable and possibly restricting downstream airflow.

SAFETY WARNING : AN IMPROPERLY FUNCTIONING CHECK VALVE MANIFOLD OR CHECK VALVE COULD CAUSE LOSS OF THE DUAL AIR PUMP REDUNDANCY FEATURE, AND POTENTIALLY RESULT IN A COMPLETE LOSS OF PNEUMATIC POWER.

WARNING: Mandatory Inspection Interval - Beginning five (5) years from date of manufacture, the serviceability of Airborne check valve manifolds, check valves and regulator check valve manifolds, must be verified every twelve (12) months in accordance with the procedure provided in Airborne Service Letter #39 (latest revision).

WARNING: Mandatory Replacement Time - Airborne pneumatic system check valve manifolds, check valves and regulator check valve manifolds must be replaced ten (10) years from date of manufacture. Refer to Airborne Service Letter #39 (latest revision).

NOTE: The above components **must not** be operated beyond the Airframe Manufacturer's specification for **mandatory** inspection intervals or **mandatory** replacement times or Airborne's **mandatory** inspection intervals or **mandatory** replacement times, whichever comes first.

F. Oil Leaks

Oil contaminated carbon components in the pump will cause erratic vacuum or pressure gage indications and generate high pump operating temperatures.

WARNING: Failure to correct oil leaks may allow oil to enter the air pump and cause premature air pump failure.

1. Inspect the area around the AND20000 pump pad seal and lower surfaces of pump for evidence of oil. If evidence of oil is discovered, follow the instructions noted below:

   Problem: AND20000 pad seal leaking.
   Corrective Action: Replace the AND20000 pad seal in accordance with the engine manufacturer's recommended procedures.

Problem: Pump mounting gasket leaking.
Corrective Action: Install new air pump mounting gasket as specified in the Aircraft Service/Maintenance Manual.

Problem: Oil in the pump's drive coupling area.
Corrective Action: Replace the pump as specified in the Aircraft Service/Maintenance Manual.

2. Inspect the engine compartment for evidence of any other oil leaks, i.e., fittings, hoses, gaskets, etc. Replace or repair as required.

G. Sudden Engine Stoppage

Anytime an air pump is subjected to sudden stoppage, the rotating elements of the pump may sustain damage. This damage may not be evident by rotating the pump or by visual examination.

WARNING: It is mandatory that any engine-driven air pump which has been subjected to sudden engine stoppage (i.e., a propeller strike during a gear-up landing, etc.) be replaced before next flight.

REFERENCE: Airborne Service Letter #38 (latest revision).

H. Dry Air Pump Blast Cooling Tube

1. If the air pump is equipped with blast cooling, inspect for satisfactory condition of tubing/hose and associated hardware.

SYSTEM CHECK OUT

The Airborne 343 Test Kit can be used to accurately check out the pneumatic system operation on both single and twin engine aircraft without running the engines. Test kit instruments pinpoint vacuum, pressure and component operating problems quickly, safely and economically. Pneumatic system functions may also be tested while aircraft engines are running after the air pump has been installed.

WARNING: The air pump can be operating in an overloaded condition even when pneumatic system operation appears satisfactory in an engine run-up check. Premature air pump failure may result.

Note: The aircraft instrument panel vacuum or pressure gage only measures gyro instrument operating vacuum/pressure, not the air pump operating vacuum/pressure. Air pump operating vacuum/pressure can easily be measured by using the 343 Test Kit.

1. Remove all protective coverings, red tags and plugs from hoses before running engine.
2. Verify that the area in and around each valve is clean, dry and free of cleaning fluids before running engine.

3. Replace all system filters before running engine if contaminated. See “Summary of Mandatory Service Instructions for Airborne Pneumatic Components” in the Appendix to this manual.

A. Gyro System

1. The vacuum or pressure instrument air gage should read in the middle of the green arc or approximately at the midpoint of pressure range specified in the Aircraft Service/ Maintenance Manual.
2. There should be less than 1.5 In-Hg drop in vacuum/pressure between the air pump and gyro instruments in single engine aircraft (less than 2 In-Hg drop in twin engine aircraft).

NOTE: If this check is made with the engine running, engine speed **must** be 1500 RPM or higher.

B. Deice System

1. Check for normal operation to manufacturer’s specifications.
2. Deice timer should inflate boots for approximately six (6) seconds. Inflation time in “pressure dependent” deice systems will vary but should be less than 6 seconds for each segment of a complete deice cycle.

NOTE: During deice system check with engines running, engine speed **must** be a minimum of low cruise RPM.

C. Inflatable Door Seals

1. Check for normal operation within limits specified in the Aircraft Service/Maintenance Manual.
2. For optimum air pump life, the pneumatic system should inflate the seal and stabilize without excessive recycling.

D. Pneumatic Autopilots

1. Check autopilot operation to Aircraft Service/Maintenance Manual or applicable STC’d supplement.
2. For optimum air pump life, autopilot regulators, servos and system filters **must** be maintained and adjusted in strict accordance with manufacturer’s instructions.

E. Sub-systems

1. Check all other pneumatic sub-systems such as pneumatic camera doors, avionics cooling, etc. per the Aircraft Service/Maintenance Manual or STC’d supplement as applicable.

F. Air Pump

1. After a satisfactory pneumatic system checkout has been accomplished, reinstall air pump/hoses as outlined per the Aircraft Service/Maintenance Manual and operate the pneumatic system by running the engine(s) to verify air pump performance.

WHEN TO TROUBLESHOOT

Since aircraft pneumatics are an integrated system, the malfunction of one component may be caused by other component problems. Troubleshooting means looking beyond the symptoms to find the root causes. Pneumatic system troubleshooting should begin:

1. When an air pump fails early or when aircraft has a history of short air pump life.
2. When pressure or vacuum gage registers above or below proper levels.
3. When gyro performance is erratic.
4. When deice, door seal or pneumatic autopilot system malfunctions.

WHAT TO TROUBLESHOOT

A. Premature Air Pump Failure (Or an aircraft history of short air pump life)

1. Check that the air pump is the correct model for the engine and/or system. Use only the component part numbers called out in the aircraft or STC'd system manufacturer's part list.
2. Check for contamination, restrictions or malfunctions in the system that can overload the air pump. Replace contaminated or inoperative components before replacing the air pump.

B. Improper Vacuum/Pressure Gage Indications (High, low, erratic or no vacuum pressure indicated)

1. Use the Airborne 343 Test Kit to check vacuum/pressure levels throughout the pneumatic system. Kinks in lines, deteriorated hoses, leaking hose connections and/or clogged filters reduce the flow of air in the system causing high or low vacuum/pressure indication.
2. Check for leakage from engine drive pad seals. Oil ingestion by the air pump(s) may generate erratic vacuum/pressure gage indications, and cause premature pump failure.
3. Use the Airborne 343 test kit to check the vacuum/pressure gage accuracy. Inoperative vacuum/pressure gages are not uncommon.

NOTE: Make regulator adjustments only after maintenance, component replacement and troubleshooting cycles have been completed.

C. Excessive Gyro Precession

1. Excessive gyro precession, even to the point of tumbling can be caused by leaking lines or restricted airflow due to plugged filters or kinked lines.

NOTE: If the air filters are clean and there are no system restriction or leaks, the problem is probably in the gyro itself.

D. Gage Indication Follows Engine RPM

1. Foreign matter on the regulator diaphragm seat causes the gage to follow engine RPM. To correct this malfunction, release tensions on regulator adjusting screw and simply raise the diaphragm using a thin blunt tool. Remove the contaminant, and reset the regulator to Aircraft Service/Maintenance Manual specifications.
2. If there is no foreign matter on the regulator seat, use the 343 Test Kit to test the regulator function. Replace inoperative regulators.

NOTE: Pneumatic systems with air pumps that have been overhauled or are nearing the end of service life may also exhibit this malfunction.

E. Frequent Regulator Adjustments

1. Kinks in lines, deteriorated hoses, leaking hose connections and/or clogged filters will affect regulator function as well as limit airflow and result in premature air pump failure.

NOTE: Make regulator adjustments only after maintenance, component replacement and troubleshooting cycle(s) have been completed.

F. Deice System Malfunction (Deice boots fail to inflate or only partially inflate)

1. Check the deice valve(s). If inoperative or not functioning fully, replace.
2. When operating on one pump and boots fail to inflate, inspect the deice system check valve on the opposite side of the deice system. Replace as necessary.
3. Check for air leaks in the system plumbing or in the boots themselves which can inhibit full inflation. Check for hairline cracks which may have developed in the boots allowing moisture to enter and freeze which creates air leaks. Replace plumbing or repair/replace boot as necessary.

REPLACEMENT COMPONENT INSTALLATION

When replacing a component after a normal service history, make a routine maintenance check of fittings, hoses, filters and regulating valves before installing. When replacing an air pump that has failed early, complete system maintenance and troubleshooting cycles **must be** completed.

When replacing components, don't automatically assume that the removed part is the correct part for that application. A previous unauthorized substitution may have been made. Use only the component part numbers called out in the aircraft or STC'd system manufacturer's part list.

NOTE: Refer to any special instructions included with the new component prior to installation. These will include additional precautions and/or procedures relative to STC'd applications and applications having specific requirements.

NOTE: For specific settings and adjustments, consult the applicable Aircraft Service/Maintenance Manual or autopilot/deice system manufacturer's supplemental service instructions.

A. Inspection of Hoses

1. Before installing hoses, inspect the inside of the hose carefully to make sure it is clean and free of all debris, oils or solvents. Use vacuum or air pressure to clean the lines. Remove the hoses from the aircraft if necessary.
2. Clean the air pump inlet and discharge hoses. After an air pump failure, carbon particles can pass in either direction, downstream as well as upstream.
3. Replace old, hard, cracked or brittle hose. Sections of the inner layers may separate, causing pump failure.
4. Where hose clearance is tight, making it difficult to reinstall it onto a fitting, spray the fitting at the hose end with silicone. Let dry, then install hose by pushing it straight on.

WARNING: Do not wiggle hose from side to side. Wiggling could cause particles to be cut from inner wall of hose which would damage the air pump.

5. Use of noncollapsing flexible tubing or hose with screw type clamps will ensure that the line losses are minimized and air pump overloading is avoided.
6. Make certain that hoses are connected to the correct fittings. Incorrect installation will cause damage to the gyro system.

B. Final Check

After the replacement component has been installed, the pneumatic system should be operated by running the engine(s) to be certain that it is operating within the aircraft manufacturer's suggested limits in the corresponding Aircraft Service/Maintenance Manual.

SUMMARY

Proper pneumatic system maintenance is essential to ensure satisfactory system operation and obtain maximum component service life. Typically, except when a severe malfunction occurs, pneumatic system maintenance has seldom consisted of much more than routine filter changes and functional checks during engine run-up.

Premature air pump failure is most often symptomatic of one or more discrepancies in the pneumatic vacuum/pressure system that have remained undetected during routine system maintenance and functional checks.

Since aircraft pneumatic systems are an integrated system, the malfunction of one component may be caused by other component problems. For example, regulator and valve adjustments often made to correct relatively minor operational discrepancies have increased the load and accelerated the wear on the air pump. Frequently these adjustments are simply compensating for system leaks, restrictions or inoperative vacuum/pressure control valves which can cause high vacuum and/or high back pressure that will ultimately lead to premature air pump failure.

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343 TEST KIT

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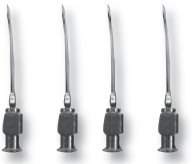
343 TEST KIT COMPONENTS

PNEUMATIC SYSTEM MAINTENANCE MANUAL

1G31-1 GAGE ASSEMBLY

1K99-1 FITTING ASSEMBLY



A7-112-1 PROBES
Kit Includes 4 Probes

TEST KIT

1H88-2 REGULATOR ASSEMBLY

1H89-1 EJECTOR ASSEMBLY

TEST KIT
DESCRIPTION AND FUNCTION

Introduction

The 343 Test Kit is designed to help the aircraft technician identify, solve and prevent pneumatic system problems. The Test Kit uses regulated and filtered shop air to test either vacuum or pressure gyro instrument systems as well as pneumatic deice systems. The test kit makes it easy to adjust vacuum or pressure regulators and to identify leaking hoses and fitting connections without running the aircraft engine(s).

1H88-2 Regulator Assembly

A lightweight air pressure regulator including a 0-30 psi gage. The air inlet port incorporates a convenient on-off shuttle valve used primarily for inflating the deice system to observe the leak rate. The air outlet port has a quick disconnect low loss fitting to mate with the 1K99-1 pressure system adapter fitting or 1H89-1 vacuum air ejector assembly. The water/debris container is easily removed for access to a cleanable porous filter. The container also has a water removal valve located on the bottom end.

1H89-1 Ejector Assembly

The 0-30 In-Hg vacuum gage is installed directly in the ejector assembly. The 1H89-1 ejector assembly will create vacuum air from shop air pressure. Designed to attach directly to the outlet air port on the 1H88-2 pressure regulator, the unit has a 5/8 inch O.D. tube which will adapt to 5/8 inch I.D. hose (suction) at air pump inlet. A muffler installed at the discharge end reduces air noise.

1K99-1 Fitting Assembly

Designed to quickly attach to the 1H88-2 air regulator assembly for pressure air systems, the fitting is stepped 3/4 inch to 5/8 inch O.D. to adapt to any 3/4 inch to 5/8 inch I.D. hose on the aircraft.

1C31-1 Gage Assembly

0-30 In-Hg/0-30 psi vacuum/pressure gage assembly with replaceable probes may be used in any vacuum or pressure application where the probe is inserted into rubber hose. The actual pump inlet vacuum is measured by inserting the probe in the air pump inlet line. Air pump discharge and/or back pressure is measured with the probe inserted in the air pump discharge line. Deice system cycle pressure can be confirmed or adjusted by inserting the 1G31-1 gage assembly probe in the tubing located adjacent to the system deflate valve.

Airborne 343 Test Kits Available For Loan

For questions about the 343 Test Kits, available for loan, please contact Airborne's Customer Service Support Team as follows:

Toll Free Phone Number:	800-382-8422
Direct Phone Number:	440-284-6215
FAX Number:	440-284-6208
E-mail:	techhelp@parker.com
Website:	www.parker.com/ag/nad

DON'T WAIT UNTIL ALL ELSE FAILS BEFORE YOU READ THE INSTRUCTIONS! READ THEM NOW, BEFORE YOU START CHECKING OUT THE PNEUMATIC SYSTEM.

The following notes, descriptions, conditions and warnings apply to each of the pneumatic systems diagrams in this Pneumatic System Maintenance Manual.

A. The system diagrams are generic pictorial representations of typical systems generally with certain Airborne components illustrated. You may encounter different configurations and should refer to the aircraft manufacturer's or other STC'd system diagrams for location of specified components and related test points.

B. Arrows not annotated with a letter in a circle indicate the direction of air flow in the system.

C. The system operating description and operation of specific system components generally apply to Airborne components unless otherwise specified. Consult the specific Aircraft Service/Maintenance Manual or autopilot/deice system manufacturer's supplemental service instructions for technical data applicable to components other than Airborne manufacture.

D. The objectives of the described tests are to identify, solve and prevent pneumatic system problems that cause unsatisfactory system operation and lead to premature pneumatic system failure. Accordingly you should perform each test in the order prescribed and correct all discrepancies prior to adjusting regulator and control valve settings.

E. **WARNING:** **Most of the test procedures call for insertion of the 1G31-1 Gage Probe in system rubber hoses to check vacuum and/or pressure readings at specified points.**

Do not use the 1G31-1 Gage Probe in plastic hoses or tubing unless the probed section can be cut out. The probe hole reseals in rubber hose but will remain a permanent air leak in plastic hose and pneumatic autopilot polyflow tubing.

Before inserting the 1G31-1 Gage Probe check to ensure it is free of rubber debris from previous use. A plugged probe may be cleared with the application of shop air applied to the 1G31-1 Gage assembly with the gage removed, or by insertion of a .010 inch wire into the A7-112-1 Probe.

F. **NOTE:** Some aircraft vacuum systems have been assembled using unreinforced latex hoses (tubing) which have been found to collapse in bend areas creating excessively high vacuum at the pump with low vacuum at the gyro instrument. It is recommended that all unreinforced latex (or other plastic) hoses be replaced with a noncollapsible rubber hose. (REF: FAR 43.13-1A Chapter 16. Section 3. Para. 895).

G. The Problem/Cause/Corrective Action Charts accompanying system troubleshooting procedures are generally applicable to most variations in system configuration.

VACUUM SYSTEMS

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⚠ TECHNICIANS SAFETY WARNING

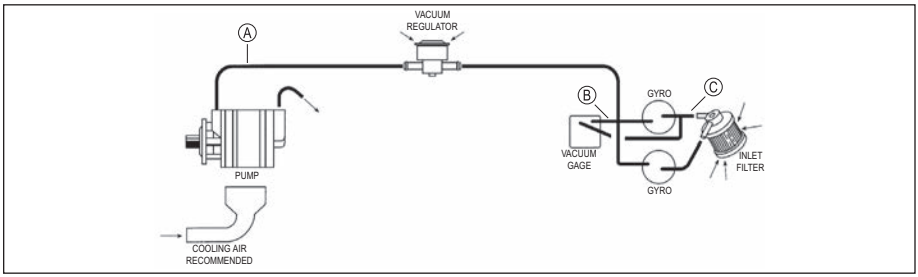
APPLICABILITY: AIRCRAFT USING AIR PUMPS TO POWER GYRO FLIGHT INSTRUMENTS WHILE FLYING INSTRUMENT FLIGHT RULES (IFR). FAILURE TO FOLLOW THE FOLLOWING INSTRUCTIONS MAY RESULT IN DEATH, BODILY INJURY OR PROPERTY DAMAGE.

- **A BACK-UP PNEUMATIC POWER SOURCE FOR THE AIR-DRIVEN GYROS, OR A BACKUP ELECTRIC ATTITUDE GYRO INSTRUMENT, MUST BE INSTALLED IN ALL AIRCRAFT WHICH FLY IFR.**
- **ANY INOPERATIVE AIR PUMP OR OTHER COMPONENT OF THE GYRO SYSTEM, AND ANY INOPERATIVE BACK-UP SYSTEM OR COMPONENT, MUST BE REPLACED PRIOR TO THE NEXT FLIGHT.**
- **AN ANNUCIATOR LIGHT, INSTRUMENT WITH FLAG INDICATING LOSS OF INSTRUMENT POWER, OR OTHER DEVICE MUST BE INSTALLED TO WARN THE PILOT OF LOSS OF GYRO POWER SO THAT THE PILOT CAN TAKE CORRECTIVE ACTION PRIOR TO THE LOSS OF CORRECT GYRO INFORMATION.**
- **WHEN ADDING INSTRUMENTS TO YOUR PNEUMATIC SYSTEM, CHECK WITH THE AIRFRAME MANUFACTURER OR THE AIR PUMP MANUFACTURER. YOU MAY BE OVERLOADING THE SYSTEMS POWER SOURCE.**

A. Redundancy - Many single engine aircraft do not have a back-up pneumatic power source or a back-up electric attitude gyro instrument. In aircraft without such back-up devices, the pilot, due to added workload, may not be able to fly the aircraft with only “partial panel” instruments (that is, turn and slip indicator, altimeter, and airspeed indicator) in the event of primary air pump or pneumatic system failure during IMC.

B. System Failure - Failure of the air pump or any other component of the pneumatic system during IFR flight in Instrument Meterological Conditions (IMC) can lead to spatial disorientation of the pilot and subsequent loss of aircraft control. This could result in an accident causing death, bodily injury, or property damage.

C. Pilot Warning - Air pump or pneumatic system failures can and do occur without warning. This can be a result of various factors, including but not limited to normal wear-out of components, improper installation or maintenance, premature failure or use of substandard overhauled components.



NOTE: If the aircraft is not equipped with an instrument panel vacuum gage, insert the 1G31-1 Gage Probe in a gyro suction line " B" close to the gyro instruments to obtain instrument panel vacuum gage readings. (See **WARNING**, General Instructions Note E, Page 20)

TEST PROCEDURE:

1. Remove system suction hose from the air pump inlet shown by letter "A".
2. Connect 1H88-2 Regulator and 1H89-1 Ejector at " A" with system suction hose connected to the 1H89-1 Ejector. The 1H88-2 Regulator handle should be backed off (counterclockwise) and the "ON-OFF" shuttle valve "OFF". (Slide toward shop air connection)
3. Connect clean shop air source to the inlet of the 1H88-2 Regulator.
4. Slide the ON-OFF shuttle valve to the "ON" position and increase air source at the 1H88-2 Regulator by slowly turning the 1H88-2 Regulator handle clockwise until the instrument panel vacuum gage stabilizes. Then turn the 1H88-2 Regulator handle two more turns.
5. Compare the vacuum gage reading on the 1H89-1 Ejector and the instrument panel vacuum gage.
   (a) The instrument panel vacuum gage should read at the aircraft manufacturer's recommended setting. (Typically 4.7 to 5.2 In-Hg).
   (b) The difference between the 1H89-1 Vacuum Gage and the instrument panel gage should be less than 1.5 In-Hg.
6. Insert the 1G31-1 Gage Probe at "C". The reading should be zero.
7. If any of the test point readings are exceeded or if the system does not operate as described, proceed to troubleshoot the system for a dirty filter, excessive line losses, malfunctioning or misadjusted system regulator and/or inoperative instrument panel vacuum gage.
8. Correct all discrepancies before adjusting the system vacuum regulator to the aircraft manufacturer's recommended setting.
9. Remove all test equipment and reinstall system suction hose on the air pump.
10. Run aircraft engine to confirm proper air pump/system operation. Refer to the Troubleshooting Vacuum Systems Table (Page 29) as needed to troubleshoot discrepancies noted during engine run-up checks.

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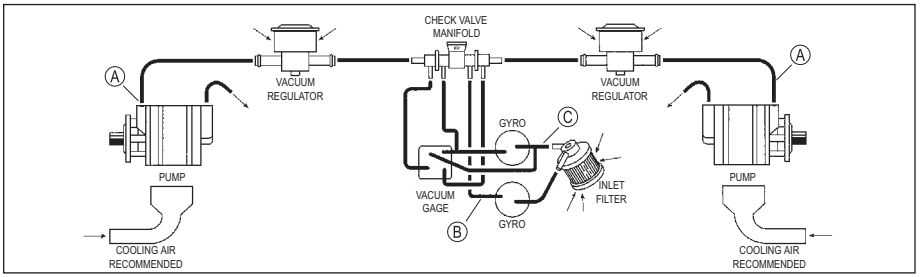

NOTES:

A. Each side of a dual pump vacuum system is tested separately as if it was a single pump system.

B. The check valve manifold integrates the two sides for a combined system and provides for isolation of a malfunctioning side.

WARNING: Mandatory Inspection Interval - Beginning five (5) years from date of manufacture, the serviceability of Airborne check valve manifolds, check valves and regulator check valve manifolds, must be verified every twelve (12) months in accordance with the procedure provided in Airborne Service Letter #39 (latest revision).

WARNING: Mandatory Replacement Time - Airborne pneumatic system check valve manifolds, check valves and regulator check valve manifolds must be replaced ten (10) years from date of manufacture. Refer to Airborne Service Letter #39 (latest revision).

C. It is important that each side of a dual pump system is maintained and adjusted so that in the event of the malfunction of one side, the other will be in adjustment and capable of performing as intended by the airframe manufacturer.

D. If the aircraft is not equipped with an instrument panel vacuum gage, insert the 1G31-1 Gage Probe in a gyro suction line “B” close to the gyro instruments to obtain instrument panel vacuum gage readings. (See **WARNING**, General Instructions Note E, Page 20)

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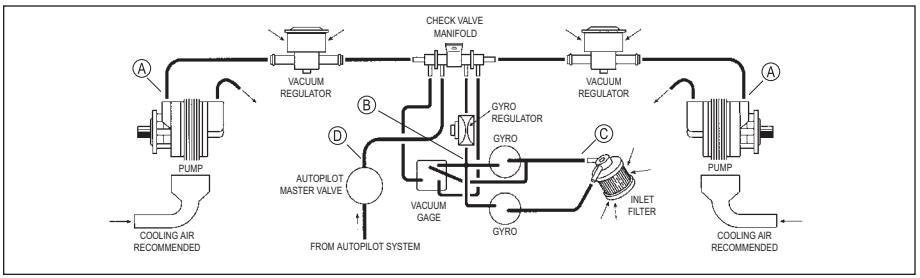
TEST PROCEDURE:

1. Remove one side system suction hose from the air pump inlet shown by letter “A”. Leave the opposite side suction hose connected to its air pump or plug the end of the hose that connects to the air pump.
2. Connect 1H88-2 Regulator and 1H89-1 Ejector at “A” with system suction hose connected to the 1H89-1 Ejector. The 1H88-2 Regulator handle should be backed off (counterclockwise) and the “ON-OFF” shuttle valve “OFF”. (Slide toward shop air connection)
3. Connect clean shop air source to the inlet of the 1H88-2 Regulator.
4. Slide the ON-OFF shuttle valve to the “ON” position and increase air source at the 1H88-2 Regulator by slowly turning the regulator handle clockwise until the instrument panel vacuum gage stabilizes. Then turn the 1H88-2 Regulator handle two more turns.
5. Compare the vacuum gage readings on the 1H89-1 Ejector and the instrument panel vacuum gage.
   (a) The instrument panel vacuum gage should read at the aircraft manufacturer’s recommended setting. (Typically 4.7 to 5.2 In-Hg)
   (b) The difference between the 1H89-1 Ejector vacuum gage and the instrument panel vacuum gage should be less than 2.0 In-Hg.
6. Insert the 1G31-1 Gage Probe at “C”. The reading should be zero.
7. The pneumatic source indicator for the side being tested should indicate positive vacuum (indicator retracted or light off) and the opposite side should indicate no vacuum (indicator extended or light is visible). If the aircraft instrumentation does not provide for separate pneumatic source indicators for each side, insert the 1G31-1 Gage Probe in the opposite side at “A”. The reading should be zero.
8. Remove all test equipment from the first side tested and reinstall the system suction hose on the air pump (or plug the end that attaches to the pump).
9. Repeat steps 1 through 7 on the second (opposite) side of the system.
10. If any of the test point limits are exceeded or if the system does not operate as described, proceed to troubleshoot the system for dirty filters, excessive line losses, malfunctioning or misadjusted system regulators, leaking or malfunctioning check valve manifolds and/or inoperative instrument panel vacuum gage or pneumatic source indicators.
11. Correct all discrepancies before adjusting system regulators to the aircraft manufacturer’s recommended settings.
12. Remove all test equipment and reinstall the system suction hoses on the air pumps.
13. Run the aircraft engine(s) to confirm proper vacuum pump/system operation. Refer to the Troubleshooting Vacuum Systems Table (Page 29) as needed to troubleshoot discrepancies noted during engine run-up checks. For twin engine aircraft run each engine separately with the other shut down. In single engine/dual air pump applications the opposite side air pump suction line **must** be disconnected during successive engine run-ups to check individual air pump performance.



NOTES:

A. Vacuum systems incorporating an autopilot often require a higher vacuum than the gyro instruments and therefore may include a secondary “flow limiting” (adjustable orifice) gyro regulator to reduce gyro instrument vacuum to proper levels.

B. Maintaining minimum vacuum for satisfactory autopilot response will produce longest air pump service life.

C. The autopilot manufacturer’s and/or aircraft manufacturer’s air adjustment settings and tolerances **must** be strictly followed. Refer to the applicable Aircraft Service/Maintenance Manual or autopilot system manufacturer’s supplemental service instructions prior to testing the system.

D. Each side of a dual pump vacuum system with a pneumatic autopilot is tested separately as if it was a single pump system. After satisfactory function of the vacuum system check valve manifold has been verified the autopilot system should be tested as follows:

WARNING: Mandatory Inspection Interval - Beginning five (5) years from date of manufacture, the serviceability of Airborne check valve manifolds, check valves and regulator check valve manifolds, must be verified every twelve (12) months in accordance with the procedure provided in Airborne Service Letter #39 (latest revision).

WARNING: Mandatory Replacement Time - Airborne pneumatic system check valve manifolds, check valves and regulator check valve manifolds must be replaced ten (10) years from date of manufacture. Refer to Airborne Service Letter #39 (latest revision).

TEST PROCEDURE:

1. Remove system suction hose from the air pump inlet shown by letter “A” and connect 1H88-2 Regulator and 1H89-1 Ejector to the system with the suction hose connected to the 1H89-1 Ejector. The 1H88-2 Regulator handle should be backed off (counterclockwise) and the “ON-OFF” shuttle valve “OFF”. (Slide toward shop air connection)
2. Connect clean shop air source to the inlet of the 1H88-2 Regulator. Insert the 1G31-1 Gage Probe in the hose at “D”. (See **WARNING**, General Instructions Note E, Page 20)
3. Slide the ON-OFF shuttle valve to the “ON” position and increase air source at the 1H88-2 Regulator by slowly turning the regulator handle clockwise until the gage on the 1H89-1 Ejector reaches peak vacuum.
4. Check Aircraft Service/Maintenance Manual or autopilot system manufacturer’s service instructions for specific autopilot vacuum requirements and setting. The 1G31-1 Gage should read at the manufacturer’s recommended setting. The gage on the 1H89-1 Ejector should not read higher than 1.0 to 1.5 In-Hg more than the 1G31-1 Gage reading.
5. Check the instrument panel vacuum gage. It should read at the manufacturer’s recommended setting. (Typically 4.7 to 5.2 In-Hg)
6. Energize the autopilot and verify function in accordance with the autopilot/aircraft manufacturer’s specified procedures.
7. When applicable repeat steps 1 through 6 on the second (opposite) side of the system.
8. If the autopilot fails to function in accordance with the manufacturer’s specifications or if any test point limits are exceeded, proceed to troubleshoot the system for improperly adjusted autopilot system components and/or restrictions or leaks in tubing, hoses and autopilot servos.
9. Correct all discrepancies before adjusting vacuum regulators to the aircraft manufacturer’s and autopilot manufacturer’s recommended settings.
10. Remove all test equipment and reinstall system suction hose(s) on air pump(s).
11. Run aircraft engine(s) to confirm proper vacuum pump/autopilot system operation. Refer to the Troubleshooting Vacuum Systems Table (Page 29) as needed to troubleshoot discrepancies noted during engine run-up checks. For twin engine aircraft run each engine separately with the other shut down. In single engine/dual air pump applications the opposite side air pump suction line **must** be disconnected during successive engine run-ups to check individual air pump performance.

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TROUBLESHOOTING VACUUM SYSTEMS

Problem	Most causes can be identified with a 343 Test Kit	Corrective Action(s)
• Frequent air pump replacement	• Incorrect air pump for application • Partially restricted (kinked) air pump discharge or inlet hose with improperly set regulator • High air pump inlet suction - plugged or partially plugged inlet filter	• Check air pump application, replace pump • Replace hose, adjust regulator • Replace filter, adjust regulator
• Vacuum gage indicates frequent need for regulator adjustment	• Inlet filter nearly plugged	• Replace filter, adjust regulator
• No vacuum at vacuum gage with engine at low RPM and vacuum OK at vacuum gage with engine at high RPM	• Oil, solvent or other liquid contaminant in air pump • Suction hose cut or crimped • Pump worn or overhauled air pump • Plugged or partially plugged inlet filter	• Replace air pump, adjust regulator • Replace hose, Adjust regulator • Replace air pump, adjust regulator • Replace filter, adjust regulator
• Erratic vacuum gage indication and/or air pump oily	• AND20000 pad seal leaking • Air pump mounting gasket leaking • Oil, solvent or other liquid contaminant in the air pump's drive coupling area (contaminated pump)	• Replace AND20000 pad seal • Install new air pump mounting gasket • Replace the air pump, adjust regulator
• Vacuum gage follows engine RPM	• Foreign material on vacuum regulator seat • Vacuum regulator inoperative • Worn or overhauled air pump	• Release tension on vacuum regulator adjusting screw, remove material, adjust regulator • Replace regulator, adjust regulator • Replace air pump, adjust regulator
• Vacuum gage reading OK; gyros tumble/precess or won't erect	• Plugged filter in gyro • Gyro(s) inoperative • Omitted or loose hose clamps • Kinked hose	• Replace gyro filter, adjust regulator • Replace gyro(s), adjust regulator • Install and/or tighten clamps, adjust regulator • Replace hose, adjust regulator
• High vacuum gage indication	• Improperly set vacuum or gyro regulator	• Readjust regulator
• No or low vacuum gage indication and/or low vacuum to autopilot servos	• Air pump inoperative • Vacuum gage inoperative • Totally or partially plugged inlet and/or inline filter • Collapsed or kinked hose • Omitted or loose hose clamps • Improperly set vacuum regulator • Gyro regulator inoperative	• Replace air pump, adjust regulator • Replace gage, adjust regulator • Replace filter, adjust regulator • Replace hose, adjust regulator • Install and/or tighten clamps, adjust regulator • Adjust vacuum regulator • Replace gyro regulator, adjust regulator(s)
• Both pneumatic source indicators retract with only one engine in operation	• Inoperative check valve manifold	• Replace check valve manifold, adjust regulator(s)
• Autopilot response slow	• Improperly set vacuum regulator	• Adjust regulator to proper setting
• Autopilot response too rapid	• System vacuum high	• Adjust vacuum regulator to proper setting
• Vacuum source OK; no autopilot response	• Autopilot master valve inoperative • Hose disconnected	• Repair or replace valve, adjust vacuum regulator • Reconnect hose, adjust vacuum regulator

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PRESSURE SYSTEMS

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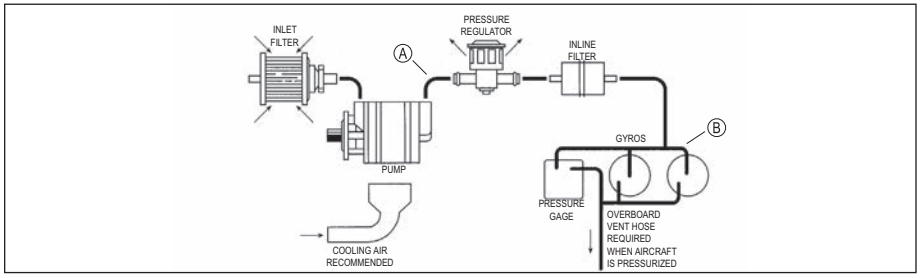
- **A BACK-UP PNEUMATIC POWER SOURCE FOR THE AIR-DRIVEN GYROS, OR A BACKUP ELECTRIC ATTITUDE GYRO INSTRUMENT, MUST BE INSTALLED IN ALL AIRCRAFT WHICH FLY IFR.**
- **ANY INOPERATIVE AIR PUMP OR OTHER COMPONENT OF THE GYRO SYSTEM, AND ANY INOPERATIVE BACK-UP SYSTEM OR COMPONENT, MUST BE REPLACED PRIOR TO THE NEXT FLIGHT.**
- **AN ANNUCIATOR LIGHT, INSTRUMENT WITH FLAG INDICATING LOSS OF INSTRUMENT POWER, OR OTHER DEVICE MUST BE INSTALLED TO WARN THE PILOT OF LOSS OF GYRO POWER SO THAT THE PILOT CAN TAKE CORRECTIVE ACTION PRIOR TO THE LOSS OF CORRECT GYRO INFORMATION.**
- **WHEN ADDING INSTRUMENTS TO YOUR PNEUMATIC SYSTEM, CHECK WITH THE AIRFRAME MANUFACTURER OR THE AIR PUMP MANUFACTURER. YOU MAY BE OVERLOADING THE SYSTEMS POWER SOURCE.**

A. **Redundancy** - Many single engine aircraft do not have a back-up pneumatic power source or a back-up electric attitude gyro instrument. In aircraft without such back-up devices, the pilot, due to added workload, may not be able to fly the aircraft with only “partial panel” instruments (that is, turn and slip indicator, altimeter, and airspeed indicator) in the event of primary air pump or pneumatic system failure during IMC.

B. **System Failure** - Failure of the air pump or any other component of the pneumatic system during IFR flight in Instrument Meterological Conditions (IMC) can lead to spatial disorientation of the pilot and subsequent loss of aircraft control. This could result in an accident causing death, bodily injury, or property damage.

C. **Pilot Warning** - Air pump or pneumatic system failures can and do occur without warning. This can be a result of various factors, including but not limited to normal wear-out of components, improper installation or maintenance, premature failure or use of substandard overhauled components.



NOTES: If the aircraft is not equipped with an instrument panel pressure gage, insert the 1G31-1 Gage Probe in a gyro pressure line "B" close to the gyro instruments to obtain instrument panel pressure gage readings. (See **WARNING**, General Instructions Note E, Page 20)

TEST PROCEDURE:

1. Remove system pressure hose from the air pump outlet shown by letter "A".
2. Install the 1K99-1 Fitting on the system pressure hose and connect to the 1H88-2 Regulator. The 1H88-2 Regulator handle should be backed off (counterclockwise) and the "ON-OFF" shuttle valve "OFF". (Slide toward shop air connection)
3. Connect clean shop air source to inlet of 1H88-2 Regulator.
4. Slide the ON-OFF shuttle valve to the "ON" position and slowly increase air source at the 1H88-2 Regulator by slowly turning the regulator handle clockwise until the instrument panel pressure gage stabilizes. The instrument panel pressure gage should be reading at the manufacturer's recommended setting (typically 4.7 to 5.2 In-Hg.).
5. Turn the 1H88-2 Regulator handle two (2) more turns. The instrument panel gage should remain stable at the manufacturers recommended setting and the system pressure regulator should be venting overboard.
6. Insert 1G31-1 Gage Probe into hose at "A" and observe the pressure reading. Convert the gage psi reading to In-Hg as follows: 1/2 psi = approx. 1.0 In-Hg; 1.0 psi = approx. 2.0 In-Hg.
7. Compare the instrument panel gyro gage reading with the 1G31-1 Gage reading (converted to In-Hg). The difference should be less than 1.5 In-Hg.
8. If any of the test point limits are exceeded or if the system does not operate as described, proceed to troubleshoot the system for dirty filters, excessive line losses, malfunctioning or misadjusted system regulator, and/or inoperative instrument panel pressure gage or pneumatic source indicator.
9. Correct all discrepancies before adjusting the pressure regulator to the manufacturer's recommended setting.
10. Remove all test equipment and reinstall the system pressure hose on the air pump.
11. Run the aircraft engine to confirm proper air pump/system operation. Refer to the Troubleshooting Pressure System Table (Page 39) as needed to troubleshoot discrepancies noted during engine run-up checks.

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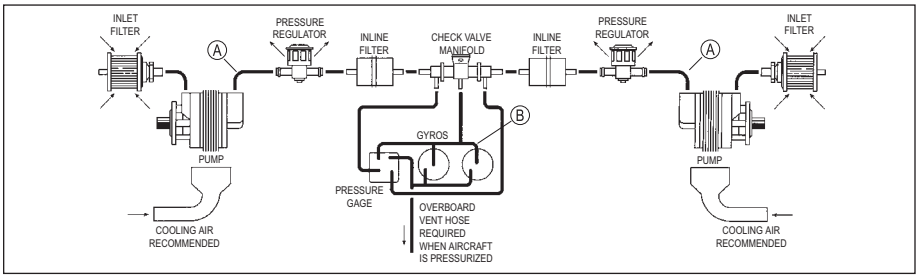

NOTES:

A. Each side of a dual pump pressure system is tested separately as if it was a single air pump system.

B. The check valve manifold integrates the two sides for a combined system and provides for isolation of a malfunctioning side.

WARNING: Mandatory Inspection Interval - Beginning five (5) years from date of manufacture, the serviceability of Airborne check valve manifolds, check valves and regulator check valve manifolds, must be verified every twelve (12) months in accordance with the procedure provided in Airborne Service Letter #39 (latest revision).

WARNING: Mandatory Replacement Time - Airborne pneumatic system check valve manifolds, check valves and regulator check valve manifolds must be replaced ten (10) years from date of manufacture. Refer to Airborne Service Letter #39 (latest revision).

C. It is important that each side of a dual pump system is maintained and adjusted so in the event of the malfunction of one side, the other will be in adjustment and capable of performing as intended by the airframe manufacturer.

D. If the aircraft is not equipped with an instrument panel pressure gage, insert the 1G31-1 Gage Probe in a gyro pressure line close to the gyro instruments to obtain instrument panel pressure gage readings. (See **WARNING**, General Instructions Note E, Page 20)

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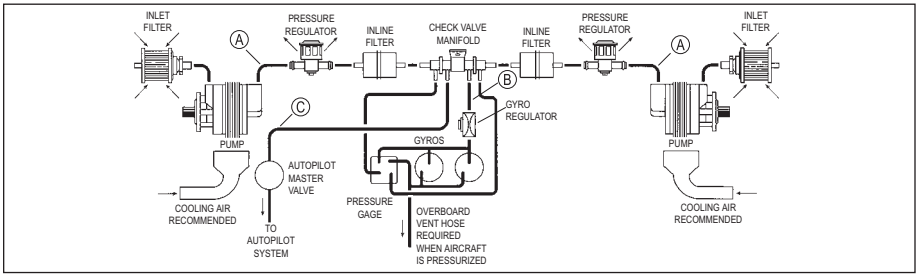
TEST PROCEDURE:

1. Remove one side system pressure hose from the air pump outlet shown by letter “A”. (Leave the opposite side pressure hose connected to its air pump or plug the end of the hose that connects to the air pump.)
2. Install the 1K99-1 Fitting on the system pressure hose “A” and connect to the 1H88-2 Regulator. The 1H88-2 Regulator handle should be backed off (counterclockwise) and the “ON-OFF” shuttle valve “OFF” (Slide toward shop air connection).
3. Connect clean shop air source to inlet of 1H88-2 Regulator.
4. Slide the ON-OFF shuttle valve to the “ON” position and increase air source at the 1H88-2 Regulator by slowly turning the regulator handle clockwise until the instrument panel pressure gage stabilizes. The instrument panel pressure gage should be reading at the aircraft manufacturer’s recommended setting (typically 4.7 to 5.2 In-Hg).
5. Turn the 1H88-2 Regulator handle two (2) more turns. The instrument panel pressure gage should remain stable at the aircraft manufacturer’s recommended setting and the system pressure regulator should be venting overboard.
6. Insert 1G31-1 Gage Probe into the hose at “A”, on the side being tested and observe the pressure reading. Convert the gage psi reading to In-Hg as follows: 1/2 psi = approx. 1.0 In-Hg; 1.0 psi = approx. 2.0 In-Hg.
7. Compare the instrument panel gage reading with the 1G31-1 Gage reading (converted to In-Hg). The difference should be less than 2.0 In-Hg.
8. The pneumatic source indicator for the side being tested should indicate positive pressure (indicator retracted or light off) and the opposite side should indicate no pressure, (indicator extended or light is visible). If the aircraft instrumentation does not provide for separate pneumatic source indicators for each side, insert the 1G31-1 Gage Probe in the opposite side at “A”. The reading should be zero.
9. Remove all test equipment from the first side tested and reinstall the system pressure hose on the air pump (or plug the end that attaches to the air pump).
10. Repeat steps 1 through 8 on the second (opposite) side of the system.
11. If any of the test point limits are exceeded or if the system does not operate as described, proceed to troubleshoot the system for dirty filters, excessive line losses, malfunctioning or misadjusted system regulators, leaking or malfunctioning check valve manifold and/or inoperative instrument panel pressure gage or pneumatic source indicator(s).
12. Correct all discrepancies before adjusting regulators to the aircraft manufacturer’s recommended setting.
13. Remove all test equipment and reinstall the system pressure hoses on the pumps.
14. Run the aircraft engine(s) to confirm proper air pump system operation. Refer to the Troubleshooting Pressure System Table (Page 39) as needed to troubleshoot discrepancies noted during engine run-up checks. For twin engine aircraft run each engine separately with the other shut down. In single engine/dual pump applications the opposite side pump pressure line **must** be disconnected during successive engine run-ups to check individual pump performance.

TWIN ENGINE AIRCRAFT • AUTOPILOT PRESSURE SYSTEM



NOTES:

A. Pressure systems incorporating an autopilot require a higher pressure than the gyro instruments and therefore may include a secondary "flow limiting" (adjustable orifice) gyro regulator to reduce gyro instrument pressure to proper levels.

B. Maintaining minimum pressure for satisfactory autopilot response will produce longest air pump service life.

C. The autopilot manufacturer's and/or aircraft manufacturer's air adjustment settings and tolerances **must** be strictly followed. Refer to the applicable Aircraft Service/Maintenance Manual or autopilot system manufacturer's supplemental service instructions prior to testing the system.

D. Each side of a dual pump pressure system with a pneumatic autopilot is tested separately as if it was a single pump system. After satisfactory function of the pressure system check valve manifold has been verified the autopilot system should be tested as follows:

WARNING: Mandatory Inspection Interval - Beginning five (5) years from date of manufacture, the serviceability of Airborne check valve manifolds, check valves and regulator check valve manifolds, must be verified every twelve (12) months in accordance with the procedure provided in Airborne Service Letter #39 (latest revision).

WARNING: Mandatory Replacement Time - Airborne pneumatic system check valve manifolds, check valves and regulator check valve manifolds must be replaced ten (10) years from date of manufacture. Refer to Airborne Service Letter #39 (latest revision).

TEST PROCEDURE:

1. Connect shop air source to the 1H88-2 Regulator and, with “ON/OFF” shuttle valve in the “ON” position, (slide toward regulator), adjust the pressure to 20.0 psi with the regulator handle. Slide shuttle valve “OFF”.
2. Disconnect pressure hose(s) from air pump(s).
3. Install the 1K99-1 Fitting in one side pressure hose at “A” and connect to the 1H88-2 Regulator.
4. Insert the 1G31-1 Gage Probe in the hose at “C” and slide the 1H88-2 Shuttle Valve “ON”. (See **WARNING**, General Instructions Note E, Page 20).
5. Check Aircraft Service/Maintenance Manual or autopilot system manufacturer’s supplemental service instructions for specific autopilot pressure requirements and setting. The 1G31-1 Gage should read at the manufacturer’s recommended setting.
6. Insert the 1G31-1 Gage Probe in the hose at “A”. The 1G31-1 Gage should not read more than 1.0 psi higher than the reading observed in step 5.
7. Check the instrument panel pressure gage. It should read at the aircraft manufacturer’s recommended setting (typically 4.7 to 5.2 In-Hg).
8. Energize the autopilot and verify function in accordance with the autopilot/aircraft manufacturer’s specified procedures.
9. When applicable repeat steps 3 through 8 on the second (opposite) side of the system.
10. If the autopilot fails to function in accordance with the manufacturer’s specifications or if any of the test point limits are exceeded, proceed to troubleshoot the system for improperly adjusted autopilot system components and/or restrictions or leaks in tubing, hoses and autopilot servos.
11. Correct all discrepancies before adjusting pressure regulators to the aircraft manufacturer’s and/or autopilot manufacturer’s recommended settings.
12. Remove all test equipment and reinstall system pressure hose(s) on air pump(s).
13. Run aircraft engine(s) to confirm proper air pump/autopilot operation. Refer to the Troubleshooting Pressure System Table (Page 39) as needed to troubleshoot discrepancies noted during engine run-up checks. For twin engine aircraft run each engine separately with the other shut down. In single engine/dual pump applications the opposite side pump pressure line **must** be disconnected during successive engine run-ups to check individual pump performance.

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TROUBLESHOOTING PRESSURE SYSTEMS

Problem	Most causes can be identified with a 343 Test Kit	Corrective Action(s)
• Frequent air pump replacement	• Incorrect air pump for application	• Check pump application, replace pump
	• Partially restricted (kinked) air pump discharge or inlet hose	• Replace hose, adjust regulator
	• High air pump inlet suction - plugged or partially plugged inlet filter	• Replace filter, adjust regulator
	• High discharge pressure - plugged or partially plugged inline filter	• Replace filter, adjust regulator
• Pressure gage indicates frequent need for regulator adjustment	• Inlet and/or inline filter nearly plugged	• Replace filters, adjust regulator
• No pressure at pressure gage with engine at low RPM and pressure OK at pressure gage with engine at high RPM	• Oil, solvent or other liquid contaminant in air pump	• Replace pump, adjust regulator
	• Pressure hose cut or crimped	• Replace hose, adjust regulator
	• Worn or overhauled air pump	• Replace pump, adjust regulator
	• Plugged or partially plugged inlet and/or inline filter	• Replace filters, adjust regulator
• Erratic gyro gage indication and/or air pump oily	• AND20000 pad seal leaking	• Replace AND20000 pad seal
	• Pump mounting gasket leaking	• Install new air pump mounting gasket
	• Oil, solvent or other liquid contaminant in the pump's drive coupling area (contaminated pump)	• Replace air pump, adjust regulator
• Pressure gage indication follows engine RPM	• Foreign material on regulator seat	• Release tension on pressure regulator adjusting screw, remove material, adjust regulator
	• Pressure regulator inoperative	• Replace regulator, adjust regulator
	• Worn or overhauled air pump	• Replace air pump, adjust regulator
• Pressure gage reading OK; gyros tumble/precess or won't erect	• Plugged filter in gyro	• Replace gyro filter, adjust regulator
	• Gyro(s) inoperative	• Replace gyro(s), adjust regulator
	• Omitted or loose hose clamps	• Install and/or tighten clamps, adjust regulator
	• Kinked hose	• Replace hose, adjust regulator
• High pressure gage indication	• Improperly set pressure or gyro regulator	• Readjust regulator
• No or low gyro gage pressure indication and/or low pressure to autopilot servos	• Air pump inoperative	• Replace air pump, adjust regulator
	• Pressure gage inoperative	• Replace gage, adjust regulator
	• Totally or partially plugged inlet and/or inline filter	• Replace filters, adjust regulator
	• Collapsed or kinked hose	• Replace hose, adjust regulator
	• Omitted or loose hose clamps	• Install and/or tighten clamps, adjust regulator
	• Improperly set pressure regulator	• Adjust pressure regulator
	• Gyro regulator inoperative	• Replace gyro regulator, adjust regulator(s)
• Pressure gage indication drops with increase in engine RPM and/or air speed	• Restricted overboard discharge hose	• Replace hose
	• No overboard discharge hoses with tightly sealed cabin	• Install overboard discharge hose
• Both pneumatic source indicators retract with only one engine in operation	• Inoperative check valve manifold	• Replace check valve manifold, adjust regulator(s)
• Autopilot response slow	• Improperly set regulator	• Adjust regulator to proper setting
• Autopilot response too rapid	• System pressure high	• Adjust pressure regulator to proper setting
• Pressure source OK; no autopilot response	• Autopilot control valve inoperative	• Repair or replace valve, adjust pressure regulator
	• Hose disconnected	• Reconnect hose, adjust pressure regulator

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DEICE SYSTEMS

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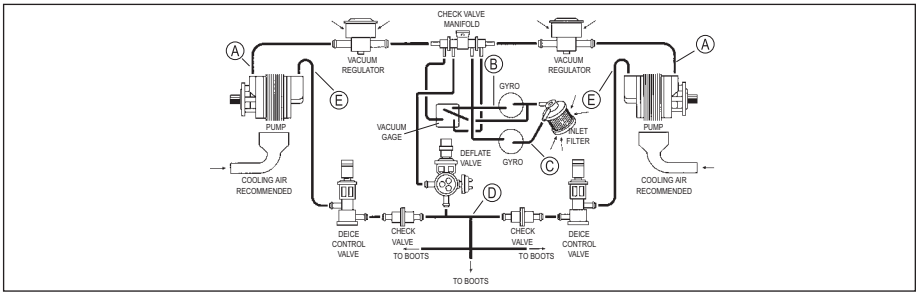


NOTES:

A. Each side of the twin engine vacuum instrument system and each side of the deice system is tested separately as if each individual circuit was a single system.

B. A malfunctioning component on the opposite side of the system can cause unsatisfactory operation of the side being checked.

C. System vacuum requirements differ with make and model aircraft. It is therefore imperative that the aircraft manufacturer's or STC'd system maintenance manual specifications are strictly followed.

WARNING: Mandatory Inspection Interval - Beginning five (5) years from date of manufacture, the serviceability of Airborne check valve manifolds, check valves and regulator check valve manifolds, must be verified every twelve (12) months in accordance with the procedure provided in Airborne Service Letter #39 (latest revision).

WARNING: Mandatory Replacement Time - Airborne pneumatic system check valve manifolds, check valves and regulator check valve manifolds must be replaced ten (10) years from date of manufacture. Refer to Airborne Service Letter #39 (latest revision).

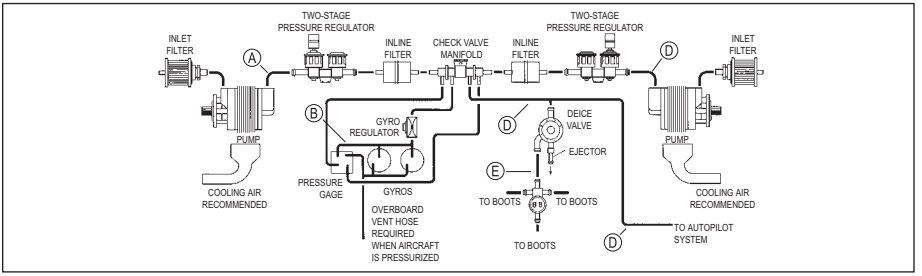
TEST PROCEDURE:

A. **VACUUM INSTRUMENT SYSTEM**

Test each side of the vacuum gyro instrument system.

B. **DEICE SYSTEM**

1. Connect shop air source to the 1H88-2 Regulator and, with "ON-OFF" shuttle valve in the "ON" position, (slide toward regulator), adjust the pressure to 20.0 psi with the regulator handle. Slide shuttle valve "OFF".
2. Disconnect pressure and suction hoses from both air pumps, install the 1K99-1 Fitting in one side pressure hose at "E" and connect to the 1H88-2 Regulator. Insert the 1G31-1 Gage Probe in the hose at "E" (See **WARNING**, General Instructions Note E, Page 20).
3. Slide the "ON-OFF" shuttle valve on the 1H88-2 Regulator to the "ON" position and check the following:
   (a) The deice control valve on the side being tested should be venting air overboard thereby reducing the line pressure to less than 1.5 psi on the 1G31-1 Gage (less than 3.0 psi for B.F. Goodrich Deice Control Valves).
   (b) No air should be heard venting from either side air pump suction hose and no air should be heard venting from the opposite side deice control valve or pressure hose.
4. Turn the aircraft electrical master switch "ON" and activate the deice boot switch. System pressure should build to approximately 17 psi as indicated by the 1G31-1 Gage and then cycle to the "OFF" mode at which point the 1G31-1 Gage indication should return to the original reading noted in step 3(a) above.
5. Shut off air flow to the 1H88-2 Regulator and disconnect the 1K99-1 Fitting from the system pressure hose.
6. Remove system suction hose from the air pump inlet shown by letter "A". Connect the 1H89-1 Ejector to the 1H88-2 Regulator. Install at "A" with system suction hose connected to the 1H89-1 Ejector. Insert the 1G31-1 Gage Probe in the hose at "D".
7. Slide the 1H88-2 Regulator "ON-OFF" shuttle valve to the "ON" position and adjust (if required) regulator handle to ensure the 1H89-1 Ejector Gage indicates between 5.0 and 7.0 In-Hg. The instrument panel vacuum gage should read at the aircraft manufacturer's recommended setting (typically 4.7 to 5.2 In-Hg). The 1G31-1 Gage should indicate between 4.0 and 6.0 In-Hg and all deice boots should be firmly sucked against the airfoil surfaces when in the deactivated mode.
8. Repeat steps 2 through 7 on the second (opposite) side of the system.
9. If the deice system does not operate as described proceed to troubleshoot the deice system for air leaks from boots hoses, hose connections and/or malfunctioning control valves, check valves, pressure regulators, switches and relays.
10 Correct all defects and discrepancies before adjusting deice system pressure regulators and/or control valves to aircraft manufacturer's and/or STC'd system specifications.
11. Remove all test equipment and reinstall the system hoses on the air pumps.
12. Run aircraft engines one at a time to confirm proper operation of the deice system with each air pump. Refer to the Troubleshooting Deice Systems Table (Page 47) as needed to troubleshoot discrepancies noted during engine run-up checks.



NOTES:

A. Each side of the twin engine pressure gyro instrument system and each side of the deice system is tested separately as if each individual circuit was a single system.

B. A malfunctioning component on the opposite side of the system can cause unsatisfactory operation of the side being checked.

C. System pressure requirements differ with make and model of aircraft. It is therefore imperative that the aircraft manufacturer's or STC'd system maintenance manual specifications are strictly followed.

WARNING: Mandatory Inspection Interval - Beginning five (5) years from date of manufacture, the serviceability of Airborne check valve manifolds, check valves and regulator check valve manifolds, must be verified every twelve (12) months in accordance with the procedure provided in Airborne Service Letter #39 (latest revision).

WARNING: Mandatory Replacement Time - Airborne pneumatic system check valve manifolds, check valves and regulator check valve manifolds must be replaced ten (10) years from date of manufacture. Refer to Airborne Service Letter #39 (latest revision).

TEST PROCEDURE:

A. **PRESSURE INSTRUMENT SYSTEM**

Test each side of the pressure gyro instrument system. Verify that the primary (two-stage) system pressure regulator and the gyro system regulator are properly adjusted to the values specified in the applicable Aircraft Service/Maintenance Manual and the autopilot/deice system manufacturer's supplemental service instructions.

B. **DEICE SYSTEM**

1. Connect shop air source to the 1H88-2 Regulator and, with "ON-OFF" shuttle valve in the "ON" position, (slide toward regulator), adjust the pressure to 20.0 psi with the regulator handle. Slide shuttle valve "OFF".
2. Disconnect pressure hose from both air pumps, install the 1K99-1 Fitting in one side pressure hose at "A" and connect to the 1H88-2 Regulator. Insert the 1G31-1 Gage Probe in the hose at "A" (See **WARNING**, General Instructions Note E, Page 20).
3. Slide the "ON-OFF" shuttle valve on the 1H88-2 Regulator to the "ON" position and check the following:
   (a) The two stage pressure regulator on the side being tested should be venting air overboard thereby reducing the line pressure (as shown by the 1G31-1 Gage) to the value specified in the applicable Aircraft Service/Maintenance Manual and/or STC'd system manufacturer's supplemental service instructions.
   (b) No air should be heard venting through the opposite side two stage pressure regulator or pressure hose.
4. Turn the aircraft electrical master switch "ON" and activate the deice boot switch. System pressure should build to approximately 17 psi as indicated by the 1G31-1 Gage and then cycle to the "OFF" mode at which point the 1G31-1 Gage indication should return to the original reading noted in step 3(a) above.
5. Insert the 1G31-1 Gage Probe in the hose at "D". The 1G31-1 Gage reading should not be more than 1 psi lower than the reading at "A" when the deice system is activated.
6. Insert the 1G31-1 Gage Probe at "E" . The 1G31-1 Gage should indicate between 4.0 and 6.0 In-Hg and all deice boots should be firmly sucked against the airfoil surfaces when in the deactivated mode.
7. Repeat steps 2 through 6 on the second (opposite) side of the system.
8. If the deice system does not operate as described proceed to troubleshoot the deice system for air leaks from boots hoses, hose connections and/or malfunctioning control valves, check valves, pressure regulators, switches and relays.
9. Correct all discrepancies before adjusting deice system pressure regulators and/or control valves to aircraft manufacturer's and/or STC'd system specifications.
10. Remove all test equipment and reinstall the system hoses on the air pumps.
11. Run aircraft engines one at a time to confirm proper operation of the deice system with each air pump. Refer to the Troubleshooting Deice Systems Table (Page 47) as needed to troubleshoot discrepancies noted during engine run-up checks.

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TROUBLESHOOTING DEICE SYSTEMS

Problem	Most causes can be identified with a 343 Test Kit	Corrective Action(s)
• Boots do not inflate	• Open circuit breaker • Faulty deflate valve Solenoid inoperable: 1. Improper voltage @ solenoid 2. Blocked air vent in solenoid 3. Inoperative plunger Diaphragm not seated 1. Blocked vent orifice located in rivet bottom at center of diaphragm 2. Dirty diaphragm seal area 3. Diaphragm ruptured • Two faulty deice control valves or faulty two stage regulators • Faulty check valve • Relay not functioning • Leak in system boots	• Reset circuit breaker • Check Airborne deflate valves as follows: Solenoid inoperable: 1. Correct electrical system 2. Clean with alcohol or replace 3. Clean with alcohol or replace Diaphragm not seated 1. Clean with .010 diameter wire and alcohol 2. Clean with blunt instrument and alcohol 3. Replace valve • Clean or replace valve assembly as noted above • Replace check valve • Check wiring or replace relay • Repair as needed
• Slow boot inflation	• Lines blocked or disconnected • Low air pump capacity • One or more deice control valves not functioning properly • Deflate valve not fully closed • Ball check in deflate valve inoperative • Leaks in system or boots	• Check and replace lines • Replace air pump • Clean or replace valve assembly as noted above • Clean or replace valve assembly as noted above • Clean check valve or replace deflate valve • Repair as needed
• System will not cycle	• Pressure in system not reaching specified psi to activate pressure switch • Leak in system or boots • Pressure switch on deflate valve inoperative	• Clean or replace deice control valve as noted above • Clean or replace deflate valve as noted above • Repair as needed, tighten all hose connections • Replace switch
• Slow deflation	• Low vacuum • Faulty deflate valve (indicated by temporary reduction in suction gage reading)	• Repair as needed • Clean or replace valve assembly as noted above
• No vacuum for boot hold down	• Malfunctioning deflate valve or deice valve • Leak in system or boots	• Clean or replace valve assembly as noted above • Repair as needed
• Boots will not deflate during cycle	• Faulty deflate valve	• Check and replace valve
• Boots appear to inflate on aircraft climb	• Vacuum source for boot holddown inoperative • Lines running through pressurized cabin loose or disconnected	• Check operation of ball check in deflate valve • Check for loose or disconnected vacuum lines and repair

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APPENDIX

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SUMMARY OF MANDATORY SERVICE INSTRUCTIONS FOR AIRBORNE PNEUMATIC COMPONENTS

Airborne has published various Service Letters defining the **mandatory** inspection intervals and **mandatory** replacement times for its pneumatic components used in single-engine and mutli-engine piston aircraft pneumatic gyro flight instrument systems and de-ice systems. The purpose of this document is to provide a summary reference for these **mandatory** service instructions and to identify the specific detailed Service Letter documents which can be printed from Airborne's website or ordered from Airborne. The Airborne Service Letters (latest revision) identified in this summary are as follows.

Service Letter No.	Service Letter Subject
38A	**Mandatory** Replacement of Airborne Engine-Driven Air Pumps That Have Been Subjected to Sudden Engine Stoppage
39A	**Mandatory** Inspection Intervals and Replacement Times for Airborne Check Valve Manifolds, Check Valves and Regulator Check Valve Manifolds
43A	**Mandatory** Inspection Intervals for Airborne Air Pumps for Oil Contamination and **Mandatory** Replacement of Oil Contaminated Airborne Air Pumps
53C	**Mandatory** Inspection Intervals and Replacement Times for Airborne Model 28C444CW-4 and 28C444CW-6 Engine-Driven Clutch-Operated Air Pumps (Piper PA-46-310P Aircraft)
54D	**Mandatory** Inspection Intervals and Replacement Times for Airborne Model 28C214CW-2 Engine-Driven Clutch-Operated Air Pumps (Mooney M20M and M20R Aircraft)
57	Revision of Installation and Maintenance Instructions Manuals and Associated Aircraft Flight Manual Supplements for Installation of Airborne Auxiliary Air Pump System Kits
58	**Mandatory** Replacement Times for Airborne Air Pumps
59B	**Mandatory** Replacement Times for Airborne Air Filters and Air Filter Elements

Airborne Model Number	Mandatory Inspection Intervals*	Mandatory Replacement Times*	Service Letter No.
Engine Driven Air Pumps			
• Any model no. beginning with 200 through 216	-	500 aircraft hrs. or 6 yrs. from date of manufacture, whichever comes first	58
• E211CC or E212CW	-	500 aircraft hrs. or 6 yrs. from date of manufacture, whichever comes first	58
• Any model no. beginning with 220 through 242	-	500 aircraft hrs. or 6 yrs. from date of manufacture, whichever comes first	58
• Any model no. beginning with 28C214 (clutch-operated)	Every 100 aircraft hrs. for 28C214CW-2	500 aircraft hrs. or 6 yrs. from date of manufacture, whichever comes first	54D, 58
• Any model no. beginning with 28C444 (clutch-operated)	Every 50 aircraft hrs. for 28C444CW-4 and -6	500 aircraft hrs. or 6 yrs. from date of manufacture, whichever comes first	53C, 58
• Any model no. beginning with 420 through 442	-	400 aircraft hrs. or 6 yrs. from date of manufacture, whichever comes first	58
• 832CW or 842CW	-	300 aircraft hrs. or 6 yrs. from date of manufacture, whichever comes first	58
• Any model subjected to sudden engine stoppage	-	Before next flight	38A
• Any model (inspection for oil contamination)	100 aircraft hrs. or annually, whichever comes first	-	43A
• Any model subjected to oil contamination	-	Before next flight	43A

Airborne
Air & Fuel Products

Airborne Division • Parker Hannifin Corporation
711 Taylor Street • Elyria, Ohio 44035 • 440 284-6215 • Fax:440 284-6208
Email: techhelp@parker.com • Website: www.parker.com/ag/nad
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SUMMARY OF MANDATORY SERVICE INSTRUCTIONS FOR AIRBORNE PNEUMATIC COMPONENTS (Continued)

Airborne Model Number	Mandatory Inspection Intervals*	Mandatory Replacement Times*	Service Letter No.
Auxiliary Motor-Driven Air Pumps and Elapsed Time Indicators			
• Any model no. beginning with 4A2 or 4A3	Check elapsed time indicator (ETI) at 100 aircraft hrs. or annually, whichever comes first	500 pump hrs. or 10 yrs. of service, whichever comes first	57,58
Vacuum System Air Filters			
• B3-5-1 Garter Filter Element for Vacuum Regulator	-	100 aircraft hrs. or annually, whichever comes first, and each pump replacement	59B
• D9-14-3 Air Filter Element • D9-14-5 Air Filter Element • D9-18-1 Air Filter Element • 1J10-1 Air Filter	-	500 aircraft hrs. or annually, whichever comes first, and each pump replacement	59B
Pressure System Air Filters			
• B3-5-1 Garter Filter Element for Inlet Filter • D-9-14-3 Air Filter Element • D-9-14-5 Air Filter Element • D-9-18-1 Air Filter Element	-	100 aircraft hrs. or annually, whichever comes first, and each pump replacement	59B
• 1J4-4 Inline Air Filter (Replaced by 2J4-4) • 1J4-6 Inline Air Filter (Replaced by 2J4-6) • 1J4-7 Inline Air Filter (Replaced by 2J4-7) • 2J4-4 Inline Air Filter • 2J4-6 Inline Air Filter • 2J4-7 Inline Air Filter	-	500 aircraft hrs. or annually, whichever comes first, and each pump replacement	59B
Check Valve Manifolds, Check Valves and Regulator Check Valve Manifolds			
• 1H5 Series (all dash numbers) • 1H24 Series (all dash numbers) and 2H24-8 • 1H37 Series (all dash numbers) • 2H3-39 and 2H3-47	5 yrs. from date of manufacture, every 12 months thereafter until 10 yrs.	10 yrs. from date of manufacture	39A
*NOTE: The above components **must** not be operated beyond the Airframe Manufacturer's specification for **mandatory** inspection intervals or **mandatory** replacement times or Airborne's **mandatory** inspection intervals or **mandatory** replacement times, whichever comes first.			

The date of manufacture is encoded in the serial number located on the nameplate of Airborne Air Pumps, Check Valve Manifolds, or Regulator Check Valve Manifolds. The date of manufacture is ink stamped on the body of Airborne's Check Valves. The first numbers (1 through 12) of the serial number indicate the month (January through December) of manufacture. The following letter combinations of the serial number indicate the year of manufacture:

T = 1972	E = 1979	AB = 1986	AJ = 1993	AT = 2000	BC = 2007
V = 1973	F = 1980	AC = 1987	AK = 1994	AU = 2001	BD = 2008
W = 1974	H = 1981	AD = 1988	AL = 1995	AV = 2002	BE = 2009
A = 1975	J = 1982	AE = 1989	AM = 1996	AW = 2003	BF = 2010
B = 1976	K = 1983	AF = 1990	AN = 1997	AY = 2004	BG = 2011
C = 1977	M = 1984	AG = 1991	AP = 1998	BA = 2005	BH = 2012
D = 1978	AA = 1985	AH = 1992	AR = 1999	BB = 2006	BJ = 2013

If the product nameplate has been lost, obliterated, or for any reason the date of manufacture cannot be substantiated, replace the air pump, check valve manifold, check valve, or regulator check valve manifold.

Any questions concerning this **SUMMARY OF MANDATORY SERVICE INSTRUCTIONS FOR AIRBORNES PNEUMATIC COMPONENTS** or requests for copies of the referenced Service Letters (can also be printed from Airborne's website) should be directed to Airborne's Customer Support Team as follows

Toll Free Phone Number: 800-382-8422
Direct Phone Number: 440-284-6215
FAX Number: 440-284-6208
E-mail: techhelp@parker.com
Website: www.parker.com/ag/nad

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PNEUMATIC SYSTEM TIPS

- Use silicone spray on fitting threads - do not use teflon tape, pipe dope or thread lube.
- Failure to correct oil leaks may allow oil to enter the pneumatic system and cause premature system failure.
- Check and/or change regulator setting only after maintenance and troubleshooting cycles have been completed.
- Do not wiggle hoses from side to side while installing, wiggling could cause particles to be cut from inner wall of hose which could contaminate the pneumatic system and cause premature system failure.
- Change all pneumatic system filters when installing a new air pump, don't forget the vacuum regulator garter filter or system inlet filter, normally under the instrument panel. They are hard to get to, however they are important to the health of the pneumatic system.
- Any Airborne engine-driven air pump which has been subjected to sudden engine stoppage (e.g. from a propeller strike during a gear-up landing), **must** be replaced before next flight.
- When adding instruments to your pneumatic system, check with the airframe manufacturer or the air pump manufacturer. You may be overloading the systems power source.

  For Example, With Airborne Pumps:
  - Any model no. beginning with 200 through 242 and E211CC or E212CW will only adequately power two (2) air-driven gyros.
  - Any model no. beginning with 420 through 442 will adequately power three (3) or four (4) air-driven gyros.
- Debris left on the engine pad, when replacing an air pump, will inhibit proper gasket sealing.
- Always replace all washers when installing a new air pump, torque mounting nuts per instructions provided by the airframe manufacturer in the appropriate maintenance publication.
- Inspect, clean or replace all pneumatic system hoses when replacing an air pump.
- MS fittings are not recommended for use within the pneumatic system due to excessive pressure drop.
- Replace hard, cracked, oil soaked or brittle hoses with new hose.
- Use only the component part numbers called out in the aircraft or STC'd systems manufacturer's part list.

Airborne 343 Test Kits Available For Loan

For questions about the 343 Test Kits, available for loan, please contact Airborne's Customer Service Support Team as follows:

Toll Free Phone Number:	800-382-8422
Direct Phone Number:	440-284-6215
FAX Number:	440-284-6208
E-mail:	techhelp@parker.com
Website:	www.parker.com/ag/nad

Reference Materials

Copies of referenced FAA Publications, Airborne Service Letters and Safety Literature may be printed from Airborne's website listed above. They can also be obtained by calling 440-284-6215 or 1-800-C-PARKER.

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