Step 12

Continued Airworthiness

General Description

STEP	PROCEDURE
12.0	The Integrated Flight Systems air conditioning system covered by this report for the MD Helicopters, Inc. 369/500 series helicopters consists of five major components. The kit for which this report is applicable is P/N 500-00-011. The above kit is universal. It is designed to mate to the "Corporate or Utility versions of the helicopter.
12.1	The belt-driven compressor is located immediately aft of the main transmission attached to the upper deck.
12.2	The condenser coil and condenser blower are mounted in the nose of the helicopter.
12.3	Dual evaporator fan assemblies. Forward evaporator is mounted forward of the instrument panel.
12.4	Aft evaporator fan is mounted under the pilot’s seat.
12.5	Aft evaporator fan is mounted directly to the aft side of the evaporator.
12.6	The refrigerant plumbing lines/fittings required for the above.
12.7	The electrical power and control circuits for the above.
12.8	The forward evaporator is located at C.G. station 33.0, aft evaporator is mounted at C.G. station 72.0, the compressor is located at C.G. station 112.0, and the condenser is mounted at C.G. station 24.5.
12.9	The dual air distribution system consists of four outlets, two forward of the co-pilots' position and two to the right of the pilot from the forward evaporator. The aft evaporator provides airflow to a new duct system, which incorporates two automotive type air outlets for the aft cabin.

Specific Features

STEP	PROCEDURE
12.10	The condenser coil assembly is mounted in the nose of the helicopter. It is attached to a newly installed IFS designed shelf, which supports the condenser coil, forward evaporator, evaporator fan, and condenser blower.
12.11	Return air is drawn from the cabin through a new-screened return air inlet on the vertical part of the pilots seat. It leads to the aft evaporator and then to the evaporator/fan. No relocation of any cabin appointments is required.
12.12	The forward evaporator/fan is mounted above and aft of the condenser coil assembly. It is forward of the instrument panel. The entire evaporator assembly is contained within a fiberglass case. Air distribution is by way of four (4) each wemac type air outlets for the cockpit and two for the aft cabin.
12.13	The Cabin Environment Control Panel consists of a sheet metal component located at the bottom of the Instrument Console (unless a “slant avionics panel is added) which encloses all the switches, relays, and circuit breakers for the air conditioning system.
12.14	The Sankyo SD 507 compressor is mounted onto a steel plate, which is attached to the existing airframe.
12.15	A 1/8-inch thick 4130N steel bracket is attached to the airframe and supports the compressor. The bracket carries all fore and aft loads.
12.16	A flat belt is used to turn the compressor from the MD Helicopters, Inc. main output drive shaft. An IFS designed pulley mounted to this shaft drives the Sankyo SD-507 compressor pulley, which has been modified to accept the flat belt. Adjusting brackets allow for the tightening of the compressor drive belt.

12.17	The belt used to drive the compressor is manufactured by Habasit Belting, Inc. and is produced from A-2 type material. Should the drive belt fail for any reason the net result will simply be the loss of compressor drive and flow of refrigerant. Due to the IFS design of the wire mesh belt guard for the oil cooler blower, failure of the belt would not interfere with any other components or systems. Therefore, the belt is deemed to be "fail safe".
12.18	The electrical system for the air conditioning system consists of dual double throw rocker switches on the cockpit Environment Control Panel. The "Master" control switch has three positions: "A/C", "OFF" and "FAN".
12.19	The "FAN" position allows the evaporator fans to run for non-cooled air circulation. Evaporator fans are protected by two (2) each 15 amp circuit breakers. The "A/C" position turns on the condenser blower as well as the evaporator fans and provides electrical power to the compressor clutch for complete system operation. A 25-amp circuit breaker is provided for protection of the condenser blower.
12.20	A double throw rocker switch is mounted to provide "HIGH- MED-LOW" speed selection for the forward evaporator motor. A 50-amp circuit breaker is employed as "Master Air Conditioning System" protection. This is located on the Environmental Control Panel.
12.21	Plumbing of refrigerant lines is accomplished with a standard air conditioning hose covered under SAE standard J51C. The hose is manufactured by GoodYear under the Galaxy trade name. It is type 4860, which is referred to as a reduced size barrier hose. ATCO or other firms utilizing bubble crimp type connections produce the “O” ring fittings.

12.22	All lines are installed as per standard aircraft practice. Adel clamps or tie wraps are used as required. Butter flying of Adel clamps and the use of standoffs is provided where required. Plumbing from the compressor is run down through an existing hole in the transmission deck. Caterpillar grommet material is used in all aircraft lightning holes to protect refrigerant hoses from chafing, as required. The refrigerant hoses are routed from the compressor below the aircraft roof and along the side of the transmission. This can be next to existing wire bundles or airframe structure to the dual evaporators and condenser. They are secured in accordance with typical hose supporting as shown in AC43.13-1A and -2A. This type hose is STC'd on several aircraft applications.
12.23	Appropriate decals and placards are provided where required. These include switch and circuit breaker identification.
12.24	The vane axial blower used on the condenser is purchased under P/N 050084-5. Blower is 7" in diameter. Enviro Systems, Inc. is the vendor.

Scope: Charging, Servicing, Maintenance

STEP	PROCEDURE
12.25	It is assumed by the following instructions that the personnel engaged in Charging, Servicing, or Maintenance of the system will be either an experienced air conditioning mechanics under the supervision of a qualified A & P mechanic or an A & P mechanic possessing good air conditioning skills.
12.26	Prior to charging the system with R-134a, the evaporator fans and condenser blower should be checked for operation and direction of airflow. This is most easily done by utilizing a GPU unit for electrical power. Since the compressor is belt driven only those maintenance and operational functions that are electrically powered may be checked either in the hanger or on the ramp without running the engine.
12.27	After the GPU is connected to the aircraft and the Aircraft Master Switch is "ON", the air conditioning system may be turned "ON". Place the rocker switch on the Master Air Conditioning Control Panel to "A/C". It does not cause the compressor to run or refrigerant to be pumped. Aft fan and the forward fan should start immediately.
12.28	Check airflow of each evaporator fan. Determine that air is coming out of the cockpit and the cabin air outlets.
12.29	Check airflow into and out of condenser air openings.
12.30	All evaporator fans, condenser blowers and controls are 28 volt DC.

Charging Refrigerant (R-134a) Into System

STEP	PROCEDURE
12.31	Danger: R-134a, particularly liquid R-134a, should never be allowed to come in contact with the eyes or skin. Under normal conditions, R-134a as a gas or vapor is an inert substance and non-poisonous. However, the discharge of the gas into an open flame or near by one can produce phosgene gas, which is highly poisonous and can cause blindness and/or death. A flame-type leak detector should therefore Never be used for this reason and also because of the danger of fire or explosion around an aircraft. Several electronic leak detectors are available on the market, such as the Tiff Model 5500 and others. It is highly recommended that due to the time saved in locating leaks, that the money spent on an electronic leak detector is the best investment you can make.
12.32	Never heat a cylinder of R-134a to produce additional pressure or to squeeze that last bit of refrigerant from the cylinder. If the cylinder has become cooled to the point where additional refrigerant cannot be obtained from it, the only approved method is to place the entire cylinder in a container of warm water. Do not exceed 120 degrees Fahrenheit.
12.33	Never attempt to repair a leak requiring brazing or soldering within the aircraft structure as phosgene gas, fire, or explosion can result. Remove the entire assembly from the aircraft to a safe location before attempting such a procedure.
12.34	Caution: Should R-134a come in contact with the eyes or skin, Do Not attempt first aid beyond the immediate washing of the eye or skin with clear water. A doctor should be contacted immediately for diagnosis and treatment even though the injury may be considered slight.

Repeat - Do Not attempt first aid for this condition.

Charging Refrigerant (R-134a) Into System

STEP	PROCEDURE
12.35	The charging of the system should not be attempted unless two qualified individuals are present. The refrigerant used in this system is R-134a, and no other refrigerant is to be considered. Normal safety practices, such as wearing of gloves and the use of goggles, should be utilized as R-134a could freeze the eyeball instantly were it to come in contact with the eye. Also, frostbite could occur to areas of the skin if R-134a were allowed to come in contact.
12.36	Charging of the system is a simple procedure whether on initial or recharging after leakage repair. A set of refrigerant gauges with a minimum of three hoses should be connected to the high side and low side service ports provided.
12.37	The system is made up of two evaporator assemblies. One is mounted above the condenser forward of the instrument panel. The other is located under the pilot's seat. The compressor for this system is located aft and to the left of the main transmission. Service ports are provided in the right side baggage compartment. The high side and low side service ports are readily accessible. A sight glass is located in line with the high side service port.

Oil Charging: R-134a Refrigerant

STEP	PROCEDURE
12.38	Additional oil will not be required during the refrigerant charging phase of the operation due to type hoses utilized.

Initial Charging

STEP	PROCEDURE
12.39	After the system has had all lines completely installed, with the exception of the two (2) lines at the receiver/drier, connect the refrigerant charging manifold to a cylinder of R-134a. Connect an EPA approved R-134a recovery unit to any open lines. Allow R-134a, in the form of vapor, to flow through both sides of the manifold by opening each of the valves. This will flush any minor debris from the lines as well as expelling any air present and drying the system. Ensure that all R-134a is captured. Continue until a steady stream of vapor has been noted at both of the lines coming to the receiver/drier. Un-seal the receiver/drier. Place refrigerant oil on both line fittings and the male threads of the receiver/drier, and tighten the fittings. Open both charging manifold valves and pressurize the system. Allow approximately 50 to 70 pounds of refrigerant pressure to build up within the system. Close the valve on the cylinder of R-134a. An electronic leak detector should be utilized to check all fittings, hoses, and sockets. Tighten any leaking connections or make repairs as necessary to eliminate leaks. Shut off and disconnect hose from refrigerant cylinder. Connect to a regulator mounted on a cylinder of dry nitrogen. Purge regulator to center manifold hose. Close low side valve (left) at manifold. Failure to do so can cause high pressure to flow to the low side (left) gauge. Failure of gauge can result. Pressurize system to between 300 and 350 PSI.

12.40	After the system has been rechecked with a leak detector and it is determined that no leaks exist, disconnect the charging hose from the manifold set to the cylinder of nitrogen. Open the valves allowing the R-134a and nitrogen within the system to be captured by an EPA approved recovery unit.
12.41	Connect a vacuum pump to the center manifold hose. Open both valves and evacuate the system for a minimum of twenty minutes. After twenty minutes of vacuum pump operation, the low side gauges should read approximately 30" of vacuum at sea level. (Note: For each 1,000 foot rise in altitude above sea level a decrease below 30" of vacuum of 1" per one thousand feet will occur.)

Adding R-134a Refrigerant To The System

STEP	PROCEDURE
12.42	Close both the manifold valves and connects the center charging hose to a cylinder of R-134a. Open the valve on the cylinder. Purge the charging hose by loosening it at the charging manifold's center hose. Both the high side and low side valves of the charging manifold may now be opened. The combination of the vacuum still existing and the pressure in the R-134a cylinder transfers the R-134a from the cylinder into the system without the compressor running. If a scale is available, the cylinder may be pre-weighted and four pounds of refrigerant R-134a added to the system. A total of approximately 3 pounds will be required. Additional refrigerant should be added only, if required, after the system is in operation.
12.43	The system is now ready for operation. This must be performed on the flight line with the engine running at 100%. As soon as the "A/C" Master Control Switch is turned to "A/C" all 28 VDC evaporator blowers will immediately begin operation. The condenser blower and clutch have a time delay build in (soft start).
12.44	If, after the system has been in the "A/C" mode for at least 2 minutes and cooling is not being accomplished, then check all circuit breakers. Determine that DC power is available for control circuitry, and check the operation of the relays and contractors.

Adding R-134a Refrigerant To The System

STEP	PROCEDURE
12.45	After the compressor has come online, the entire system is operational. Close the manifold valve on the high side. The R-134a cylinder valve should be closed initially in order to get an accurate reading on the low side gauge of the "system pressure". The reading on the gauge should not be allowed to go below 10 PSI, as this will indicate that the low-pressure safety switch is possibly set too low. It will disconnect the electrical power to the compressor clutch if allowed to open. Open or close the cylinder valve as required to monitor the flow of R-134a from the cylinder into the low side of the system, until the low pressure is above 10 psi.
12.46	At this point, the minimum amount of R-134a is in the system and charging should cease temporarily. If the outside air temperature is 100 degrees F, or more, the amount of R-134a in the system. However, if the temperature is less than 100 degrees F, particularly if it is in the 60-70 degree F range, additional R-134a should be added into the system, by weight.

Adding R-134a Refrigerant To The System

STEP	PROCEDURE
12.47	**The optimum method of determining the correct charge is to obtain at least four digital thermometers and place them near the return air and the discharge air of each evaporator.** R-134a can then be added or deleted, as required, until the highest T.D. is noted, per the paragraph below. At that time, the correct amount of refrigerant is installed.
12.48	A test sheet should be completed noting the average cabin temperature, the temperature of the return or entering air to all evaporators, and the discharge air from the evaporators, at the nearest point. If a temperature differential (T.D) of less than 15 degrees Fahrenheit is recorded through the evaporators at sea level, the system should be considered as having possible defects which will need investigation. At altitudes above sea level, less than 15 degrees Fahrenheit temperature difference may be recorded. This is due to less dense air moving more rapidly through the evaporators.

Effect of Humidity on T.D.

STEP	PROCEDURE
12.49	It should be noted that if measurements are taken and entered on a test sheet in accordance with 6.10, that similar measurements made at a later date, when the humidity is considerably higher, will dramatically change the T.D. The higher the humidity, as compared to a previous T.D. reading taken with a low humidity, will result in a lower T.D. The reason for this lower T.D. measurement is that when a test is performed at lower humidity, only **"SENSIBLE HEAT"** is being removed. With higher humidity, a different condition exists. It requires that **"LATENT HEAT"** containing moisture borne heat must first be removed prior to the removal of the sensible heat.

Recharging the System

STEP	PROCEDURE
12.50	If the system is found to be completely empty of R-134a, a set of charging gauges should be connected to both the high and low side service ports and to a cylinder of R-134a. Purge the charging hoses from the cylinder to the service ports with R-134a vapor. Open both the low and high side charging valves and allow pressure from the cylinder to equalize through the system until at least 50 PSI is noted. Utilizing an electronic leak detector, check all fittings on the system to determine the point of leakage. Any fitting indicating an oily or dirty condition is a prime suspect.
12.51	. After the leaks have been found and corrected, pressurize the R-134a in the system with dry nitrogen as in 6.1. Re-check for leaks. Capture all of the R-134a in the system with an EPA approved recovery unit. Connect a vacuum pump to the center charging hose and evacuate the system for a minimum of 20 minutes from both the high and low sides. If the system has been allowed to become contaminated, then the receiver/drier should be replaced before recharging the system. In no case should the system be allowed to remain open for more than a few minutes without a new receiver/drier being installed.
12.52	It is always good air conditioning practice to replace the receiver/drier whenever it is suspected that moisture has contaminated the system.

Recharging the System

STEP	PROCEDURE
12.53	The balance of the recharging procedure is exactly the same as pointed out previously under the Initial Charging Operation. A judgment must be made as to the amount of oil, if any, lost at the point of leakage. Additional oil may be required to be added to the system. If the refrigerant has been expelled rapidly by the rupture of a line or similar situation, then two (2) ounces of refrigerant oil of the type previously specified should be applied to the system at this time and immediately prior to charging of the system with R-134a. No additional oil should be added during normal servicing.

Service

STEP	PROCEDURE
12.54	Normally service will not be required on a properly installed Integrated Flight Systems, Inc. unit. Routine and seasonally dictated operations, such as checking the R-134a refrigerant charge will be listed under the Maintenance section. The question is often asked, "How often should I add refrigerant to my system?" The answer is, "Never". Point is that either a system has a leak or it has none, therefore requiring no service. We recognize the fact that while the above is true, that due to aircraft vibration and the environment in which it is installed, leaks can occur, usually due to vibration. The location, type of equipment used, and other items will thus be addressed under the topic of maintenance.

Airworthiness Maintenance
(To Accomplish Continued Airworthiness)
CHECK LIST

STEP	PROCEDURE
12.60	An Integrated Flight Systems, Inc., unit is designed to be as maintenance free as possible. It incorporates in the design components that have proven themselves to be highly reliable after more than fifteen (15) years in the selection process. **"IN GENERAL" the IFS air conditioning system, is "on an as required" maintenance schedule.** Few components require specific hours of in Service Inspections or Time Life replacement of components for "Continued Airworthiness". It is suggested that at each periodic inspection, whether at 50 or 100 hour intervals, at least a visual inspection be accomplished to the following items: 1. Compressor and Belt 2. Compressor Clutch Bearing 3. Compressor Mount 4. Refrigerant Hose and Fittings 5. Evaporator Fans and Mounting 6. Condenser Blowers and Mounting 7. Condenser/Evaporator Coils
12.61	In addition to the above inspections, the compressor should be inspected for a true turning and free clutch. One mechanic should turn the tail rotor blade while another observes the belt and clutch faceplate. Turn system to "A/C" and check magnetic operation of clutch plate.
12.62	**The compressor mounts** should be inspected for possible cracks; deterioration and that all bolts are firmly attached.

Airworthiness Maintenance (Cont.)

STEP	PROCEDURE
12.65	Forward fan motor is a permanent magnetic type. No repair is recommended. If worn or de-graded, replace.
12.66	**Aft evaporator motor** has two (2) removable brushes. Inspect every 200 hours. Remove brushes one (1) at a time. Note position relative to curvature of armature. Inspect brush for wear. Replace if brush is 5/16" or less. Install new brushes and run at 12 VDC (utilizing an independent power source). Until seating occurs on 70% of the surface (this should be accomplished with motor assembly removed from aircraft). This action will greatly enhance brush life. Reconnect wires to aircraft system and reinstall insulated duct. Run both of the blower/fans in the "FAN" position and perform visual inspection of the assemblies to see that foreign materials have not been ingested into the blower/fan, which might cause blade damage. The blower/fan should also be run at the various speeds available to check the motor operation. **NOTE: TAKE CARE WHEN INSTALLING BRUSHES THAT BRAIDED POSITIVE LEAD DOES NOT CONTACT HOUSING, CAUSING A SHORT.**

Airworthiness Maintenance (Cont.)

STEP	PROCEDURE
12.67	**Condenser Blower:** 7" brush type motor P/N 050084-5 Two (2) brushes are located under a metal end cap on each motor. Inspect brushes every 300 hours for wear. Remove, replace and run in at 12 VDC until brushes are seated.
12.68	The fins of the condenser coil, as well as the evaporator coil, should be checked for cleanliness and that they are straight. If damage has occurred to the fins, a fin comb should be utilized to put them in like-new condition.