KELLY AEROSPACE

Thermal Systems

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The latest revision of the maintenance manual can be obtained from the Kelly Aerospace website at www.kellyaerospace.com.

In the event Internet access is not available, please contact the Customer Service Office for inquiry or a copy of the latest revision:

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1. SECTION: INTRODUCTION

This document identifies the instructions for continued airworthiness (ICA) for the modification of the above aircraft by installation of the Kelly Aerospace Air Conditioning System.

Applicability: Applies to aircraft altered by installation of Kelly Aerospace Air Conditioning System

Distribution: This document should be a permanent aircraft record.

2. SECTION: DESCRIPTION OF THE ALTERATION

The Kelly Aerospace Thermacool Air Conditioning System is installed in the aircraft as a remote-mount unit in the tail cone of the aircraft. Conditioned air is ducted through the headliner and hat rack block off assembly. Pilot control of the air conditioning is through the climate control unit, located on the copilot's instrument panel. The air conditioning system is powered off the main electrical bus in 28VDC aircraft with G1000. The air conditioning system is powered by a separate 28VDC Aux Bus STC on 14VDC aircraft.

3. SECTION: CONTROL / OPERATION INFORMATION

The system is operated through temperature selection on a climate controller located on the right side of the instrument panel. There is both a fan mode only and a cooling mode.

Before testing the air-conditioning system, assure that all electrical connections are tight and all loose items are secured. With an external source of power connected to the aircraft control the operation of the air conditioning system using the Climate Controller located on the instrument panel.

Monitor the system voltage and amperage. In a properly charged and properly installed system, the voltage should be approximately 28 VDC. The condenser fan should draw approximately 4.8 amps, the evaporator fan should draw approximately 4.0 amps, the compressor should draw approximately 33 amps and the entire system should draw approximately 44 Amps at maximum output. The current draw will vary with temperature.

With the engine running, the operator may select the operation mode of the air-conditioning by adjusting the Climate Controller located in co-pilots side of the instrument panel. See the appropriate system normal checklist below.

The Climate Controller can be toggled to vary the Temperature Set Point and the Fan Speed to control the evaporator fan and the air circulation in the cabin.

The Climate Controller will be illuminated when the system is operating. The SNOWFLAKE symbol will be visible when the Air Conditioning System is operating. The FAN symbol and fan speed bar graph will be visible when the circulating fan is operating. The FAIL symbol (exclamation point in a triangle) will be visible if the compressor controller senses a fault condition. The system may be operated during level flight or on the ground during taxi. Air Conditioning shall NOT be operated during takeoff and landing.

The air-conditioning system may be operated on the ground and without the engine running by connecting an APU or GPU to the ground power receptacle on the aircraft. The GPU or APU must be of sufficient capacity to run the A/C system with a minimum capacity of 45 amps at 28 volts.

4. SECTION: MAINTENANCE / SERVICING INSTRUCTIONS

There are no maintenance requirements for the Air-conditioning System outside of normal 100hr/Annual inspection intervals or during routine maintenance.

4.1. 14 VDC with an Aux Bus:

If the aircraft is 14 VDC with an Aux Bus: Perform a system functional test after any maintenance is performed on the air-conditioning system. Functional check should be performed following NC-10-088, AFMS Section 4.0 (summarized here for Reference).

AIR CONDITIONING SYSTEM NORMAL CHECKLIST

1) Prior to engine startup ensure "AUX BUS" switch is in the "OFF" position.

2) Follow normal procedures for engine start-up

3) To operate Air Conditioning move the "AUX BUS" switch to the "ON" position. Power will be applied to the Climate Controller.

4) Press the lower right button on the CB-2 Climate Controller, the display will first show the logo and software version; then it will show temperature set point, fan speed bar graph, and mode display.

5) Press the bottom left button and toggle between modes with the middle right button.

6) Select the AC mode; then either press the bottom right button to enter or wait 3 seconds and the display will return to the main screen. The snow flake symbol in the bottom center of the display will indicate Air Conditioning mode.

7) The default setting is for the fan is low speed, whenever a mode is changed.

8) Select the Fan only mode; then either press the bottom right button to enter or wait 3 seconds and the display will return to the main screen.

9) Press the middle left button to bring up the fan speed screen.

10) Toggle the fan speed up or down using the middle and upper right buttons. Speed Range is 1 to 3.

11) After selecting the desired fan speed press the bottom right button to enter or wait 3 seconds and the display will return to the main screen.

CB-2 Climate Controller

Set Air Conditioning System to a temperature that causes cool air to exhaust from the aircraft interior ducting. Temperature drop across evaporator coils should be 20 degrees Fahrenheit when system is operating correctly.

Note: Before inspections or maintenance are performed it is the responsibility of the owner/operator and maintenance agency to assure that they are in possession of the latest revision of the applicable documentation and drawings.

4.2. 28 VDC with G1000

If the aircraft is 28 VDC with G1000: Perform a system functional test after any maintenance is performed on the air-conditioning system. Functional check should be performed following NC-13-029, AFMS Section 4.0 (summarized here for Reference).

AIR CONDITIONING SYSTEM NORMAL CHECKLIST

1) Prior to engine startup ensure Air Conditioning is Off; by verifying that the AC annunciator is not illuminated.

2) Follow normal procedures for engine start-up

3) To operate Air Conditioning: Press the lower right button on the CB-2 Climate Controller, the display will first show the logo and software version; then it will show temperature set point, fan speed bar graph, and mode display**.**

4) Press the bottom left button and toggle between modes with the middle right button.

5) Select the AC mode; then either press the bottom right button to enter or wait 3 seconds and the display will return to the main screen. The snow flake symbol in the bottom center of the display will indicate Air Conditioning mode.

6) The default setting is for the fan is low speed, whenever a mode is changed.

7) Select the Fan only mode; then either press the bottom right button to enter or wait 3 seconds and the display will return to the main screen.

8) Press the middle left button to bring up the fan speed screen.

9) Toggle the fan speed up or down using the middle and upper right buttons. Speed Range is 1 to 3.

10) After selecting the desired fan speed press the bottom right button to enter or wait 3 seconds and the display will return to the main screen.

CB-2 Climate Controller

Set Air Conditioning System to a temperature that causes cool air to exhaust from the aircraft interior ducting. Temperature drop across evaporator coils should be 20 degrees Fahrenheit when system is operating correctly.

Note: Before inspections or maintenance are performed it is the responsibility of the owner/operator and maintenance agency to assure that they are in possession of the latest revision of the applicable documentation and drawings.

4.3. Charging - Summary

The Air Conditioning System should contain 18 oz of R-134A Refrigerant. There are no substitutions permitted. The service ports are located inside the air conditioning system plenum located in the tail cone of the aircraft. The side wall of the plenum can be removed to access these components. The small service port is the high pressure side and the large service port is the low pressure side.

Caution: It is vital that the compressor is NOT operated while the system is under vacuum. Doing so will instantly damage the compressor.

Reduce system to atmospheric pressure (Bleed off nitrogen charge slowly to prevent condensation if the system has been pressure checked). Evacuate system with a vacuum pump to 29-inches Hg or better for at least two hours. Weigh in the required amount of R-134A refrigerant.

4.4. Charging Procedure

4.4.1. Tools & Equipment

The following tools and equipment are required for charging the refrigerant system:

a. Gaseous dry nitrogen, regulated source (0-500 psig or 35 bar).

b. R-134A refrigerant

c. Refrigerant oil, Ester RL-500s or equivalent.

d. R-l34a refrigerant charging manifold with gauges and hoses with quick disconnect couplers. The coupler has a knob on top which is used to engage and disengage the aircraft service ports.

e. R-134A charging station and recovery/recycling station (SAE standard J2210).

f. Air conditioning vacuum pump.

g. Nitrogen bottle hose adapter to connect to system.

h. Vacuum pump hose adapter to connect to system.

i. Electronic leak detector.

j. Hose adapter, for nitrogen bottle.

k. Torque wrench capable of reading inch – pounds or Newton meter.

l. Small hand tools and socket set.

m. Thermometer, 0-150 deg F

n. Adjustable inspection mirror

o. Service Light or flashlight.

p. Shop hand towels

q. Weight scale, 0-50 lbs (0-25 kg) capable of .1 pound (5-gram) precision.

4.4.2. System Evacuation Procedure

CAUTION: Do **NOT** over tighten plumbing connections. Stripped threads or cracked flanges may result. If the air conditioning system has been open to the atmosphere, it must be evacuated before the system can be charged. Moisture and air mixed with refrigerant will raise the compressor head pressure above acceptable operating levels. This will reduce the performance of the air conditioning system and damage the compressor. Moisture will also boil at near room temperature when exposed to vacuum. An approved Recovery/Recycling Station must be used to evacuate the refrigerant system. Refer to the operating instructions provided with the equipment for proper operation.

a. Connect the charging manifold to the service ports.

b. Connect the manifold charging hose to the vacuum pump and turn on the pump.

c. Open both valves of the charging manifold gauge set.

d. Open both valves of the charging hose.

e. Observe the charging manifold gauges to verify vacuum.

f. Evacuate the system until at least 29 inches Hg is obtained.

g. Close all valves and turn off the vacuum pump.

h. If the system maintains the specified vacuum for 2-hours, start the vacuum pump, open the suction and discharge valves, and evacuate the system for additional 40-minutes.

i. If the specified vacuum is not maintained, locate and repair the refrigeration system leak before continuing.

j. Close all valves and turn off the vacuum pump.

k. Disconnect the manifold service hose from the vacuum pump. The system is now ready for refrigerant charging.

CAUTION: Any change in vacuum pressure, or failure to achieve a system pressure of 29 inches Hg vacuum indicates the presence of a plumbing leak. Locate and fix all leaks.

4.4.3. System Charging

NOTE: There are numerous procedures for charging the system including those included in Refrigerant recovery/recycle units. This procedure uses the manifold pressure gauge and weight method. Only R-134A refrigerant is to be used. Other refrigerants will damage the system. Overcharging of the system will result in reduced performance, reduced service life, and potential damage to the system components.

a. Evacuate the system as described earlier in the system evacuation procedure.

b. Connect the manifold charging hose to the R-134A cylinder and open the valve.

c. Crack open the charge hose fitting at the manifold gauge set, and vent air from the hose until refrigerant is evidently escaping.

d. Place the refrigerant bottle on a 0-50 lb (0-25 kg) scale and record the weight.

e. Open both manifold gauge set valves. Add refrigerant to the system until pressure stabilizes.

f. Close the manifold valves and verify that system pressure is 50 psi (3.4 bar) or greater.

g. Attach a GPU plug to the aircraft and turn on the air conditioning system.

h. Set cabin temperature controller to 55 Degrees F (13 Degrees C)

CAUTION: Do NOT open the high pressure valve on the manifold gauge set.

i. With the system operating, observe the system discharge and suction pressures.

j. With the R-134A cylinder connected to the charging hose, charging container shutoff valve open and hose purged of air, then slowly open the suction manifold valve. The suction pressure will increase.

k. Continue to adds refrigerant until 18 oz of refrigerant has been added.

l. Close the suction manifold valve and let the system operate for 5 to 10 minutes to evaluate performance.

m. NOTE: The system must run to allow the expansion valve to stabilize system pressure.

n. Run the system for another 5-minutes after system pressure is stable.

o. Turn off the air conditioning system. Suction and discharge pressures will then equalize.

p. Close the refrigerant container shutoff valve. Record the refrigerant container final weight and compare beginning weight with final weight to determine refrigerant charge.

q. Turn the suction and discharge charging hose valves to closed and disconnect the hoses from the service ports.

r. Remove the charging hose from the refrigerant container and store the manifold gauge set.

s. Install service port caps.

5. SECTION: TROUBLESHOOTING

Reference current Revision AC-01537 (Sheet 1 for 14V aircraft with Aux Bus) (Sheet 2 for 28V aircraft with G1000) Wiring Schematic for troubleshooting. Failures of the Kelly Aerospace Thermacool Air Conditioning System can include but may not be limited to the following items:

5.1. Fan motor failure, characterized by no or little airflow. Corrective action: Troubleshoot the fan motor wiring, relay and fan for proper operation, repair or replace as necessary.

5.2. Compressor failure, characterized by low amp draw, or little cold air output. Corrective action: Troubleshoot compressor and compressor controller and wiring, repair or replace as necessary.

5.3. Switch failure, characterized by inability to operate any or all components of the system. Corrective Action: Trouble shoot switch and switch wiring, repair or replace as necessary.

5.4. Low or no refrigerant, characterized by little or no cold air. Corrective Action: Inspect system for leaks, repair as necessary, and service system appropriately with R-134A refrigerant.

5.5. Any or all of these probable failures require inspection as necessary, or system must be secured and placarded until repaired

6. SECTION: REMOVAL AND REPLACEMENT INFORMATION

Refer to the Kelly Aerospace Thermacool Air Conditioning System Installation Manual.

6.1. SYSTEM OVERVIEW

The intake plenum consists of a Doubler, Bulkhead, Intake Manifold and a Mounting Plate. The Doubler, Bulkhead, Intake Manifold and Mounting Brackets are going to be riveted to the skin and bulkhead of the plane. The Mounting Plate is removable and is secured using flathead screws.

The air conditioning system is a self-contained unit. This unit consists of an electric hermetically sealed compressor, condenser, evaporator all located on or behind the hat rack. The system is operated through temperature selection on a climate controller located the instrument panel. R-134A is used as a refrigerant for the system. All R-134A lines are located in the Air Conditioning unit. Power is run from the alternator mounted on the left engine.

6.2. MATERIAL INFORMATION

The following documents list the materials required for compliance with this Installation Manual. Parts can be obtained from Kelly Aerospace Thermal Systems. The following documents list the materials required for compliance with the Installation Manual. Parts can be obtained from Kelly Aerospace Thermal Systems Drawing List NC-10-085 and Kit List NC-11-024.

14 volt PA-44 aircraft will require Air Conditioning Kit Number KATS-11-002 and an Auxiliary Bus Kit Number KATS 11-001.

28 volt PA-44 aircraft will require Air Conditioning Kit Number KATS-13-002.

6.3. Preparation

6.3.1. Ensure all documentation is the latest revision.

6.3.2. Conduct a parts inventory to ensure all required items are present.

6.3.3. Remove aircraft battery per the Piper Aircraft Maintenance Manual (AMM).

6.3.4. Remove the engine cowling per AMM.

6.3.5. Secure external power receptacle to prevent unwanted power on aircraft busses (e.g. tape over receptacle with nonmetallic masking tape with label warning of hazard).

6.4. Removal

6.4.1. Remove the following components utilizing the AMM and store securely:

6.4.1.1. Rear seats

6.4.1.2. Hat rack close out panels and carpet

6.4.1.3. Cabin carpet

6.4.1.4. Rear air circulation intake cover

6.4.1.5. Air circulation blower and assembly

6.4.2. Removal of Air Outlet

Refer to Drawing No. AC-00423

6.4.3. Removal of the Intake Plenum, Rear Bulkhead, and Mounting Supports

Refer to Drawing No. AC-00299

6.4.4. Removal of the Air Conditioning System

6.4.4.1. Refer to drawing no. AC-00298

6.4.4.2. Follow Instructions of Section 4.4.2 System Evacuation Procedure, of this document to evacuate refrigerant charge from the air conditioning system.

6.5. Replacement

6.5.1. For all references to wire stripping, crimping and tying procedures refer to AC 43.13-1B chapter

6.5.2. For all references to riveting procedures refer to AC 43.13-1B chapter 4.

6.5.3. Torque Specifications

Unless otherwise specified, use the following torque values.	
6-32 UNC	7-9 inch-lbs
8-32 UNC	17-19 inch-lbs
10-24 UNC	20-22 inch-lbs
10-32 UNF	28-31 inch-lbs
1/4-20 UNC	70-75 inch-lbs
1/4-28 UNF	90-94 inch-lbs
5/16-24 UNF	220-230 inch-lbs
3/8-24 UNF	445-455 inch-lbs
7/16-20 UNF	760-780 inch-lbs
Table 1 – Torque Specifications	

6.5.4. Replace Controller

6.5.4.1. Refer to drawing CB-2.

6.5.4.2. Pull Controller from cockpit panel.

6.5.4.3. Disconnect electrical connector plugs from back.

6.5.4.4. Replace Controller.

6.5.4.5. Reconnect electrical connector.

6.5.4.6. Reinstall controller.

6.5.5. Replace the Air Conditioning System

Refer to drawing no. AC-00298

6.5.6. Replace the Intake Plenum, Rear Bulkhead , and Mounting Supports

Refer to Drawing No. AC-00299

6.5.7. Replace Air Outlet

Refer to Drawing No. AC-00423

6.5.8. Follow Instructions of Section 4.3 Charging Procedure to restore refrigerant charge to air conditioning system.

6.5.9. Perform operational tests of air conditioning system.

6.5.9.1. Plug in external power and energize.

6.5.9.2. (For 14 Volt PA-44 only) Ensure cabin temp controller master switch is in the on position.

6.5.9.3. Press the bottom left button of the CB-2 controller and toggle between modes with the middle right button. Select fan mode.

6.5.9.4. Press the middle left button to bring up the fan speed screen. Toggle the fan speed up or down using the middle and upper right buttons speed range is 1 to 3. The fan speed should correspond.

6.5.9.5. Press the lower right button on the CB-2 controller, the display will first show the logo and software version; then it will show the temperature set point, fan speed bar graph and mode display. Press the bottom left button and toggle between modes with the middle right button. Select AC mode, either press the bottom right button to enter or wait 3 seconds and the display will return to the main screen. The snow flake symbol on the bottom center of the display will indicate AC mode.

6.5.9.6. Press the top or middle right buttons to adjust the temperature set point down by at least 10 degrees F.

6.5.9.7. Press the middle left button to bring up the fan speed screen. Toggle the fan speed up to maximum using the upper right button.

6.5.9.8. Headliner outlets should flow air 20-30 degrees cooler than ambient.

6.5.9.9. Press and hold lower right button to turn the AC off. (Leaving air conditioning master switch in the "on" position for 14 Volt PA-44)

6.5.9.10. Unplug external power and air conditioning will turn off.

6.5.9.11. Check that water is coming from evaporator drain line, water will not be present only if atmosphere is extremely dry, so if no water is flowing check for hose continuity to evaporator plenum. A steady stream of air should be felt at the evaporator drain line also as the evaporator fan pressurizes the plenum and forces condensed water out.

6.5.10. Reassembly of aircraft

6.5.10.1. Reinstall the following components utilizing the AMM.

6.5.10.2. Hat rack close out panels and carpet

6.5.10.3. Cabin carpet

6.5.10.4. Rear seats

6.5.10.5. Aircraft will need to be located in a run up area to complete this section

6.5.10.5.1. Utilizing qualified personnel operate the aircraft engine per the Pilot Operating Handbook

6.5.10.5.2. Ensure operation of the secondary alternator.

6.5.10.5.3. If further assistance is needed contact Kelly Aerospace Thermal Systems Technical support @ 440-951-4744

6.5.11. Return to service

6.5.11.1. Update aircraft Weight and Balance records.

6.5.11.2. Install Approved Flight Manual Supplement.

6.5.11.3. Complete FAA form 337.

6.5.11.4. Make aircraft log book entry.

NOTE: When replacement of any refrigerant containing device is necessary, i.e. compressor or evaporator, it is necessary to evacuate the refrigerant prior to removal. An EPA approved refrigerant evacuation machine is required. Prior to recharging the system with refrigerant, the system must be evacuated. Allow the vacuum source to remain connected for a minimum of one hour to assure there are no leaks and verify system integrity.

7. SECTION: DIAGRAMS

A list of all applicable diagrams can be found in top level document NC-10-085. Applicable diagrams include:

Drawing Number	Description
AC-00298	AC Evaporator Condenser Installation Details
AC-00299	Intake Plenum Installation Details
AC-00359	AC Evaporator Condenser Assy
AC-00415	Intake Doubler Installation Details
AC-00423	Air Outlet Installation Details
AC-00659	Installation Details Outlet Doubler Condenser
AC-01537	Air Conditioning Electrical Schematic, CB-2
AC-01542	Control Harness
AC-01543	Climate Control Panel Harness
AC-01544	Climate Control Panel Harness
CB-2	Temperature Control Panel

Detail drawings and diagrams will be provided by Kelly Aerospace Thermal Systems. These may be obtained by contacting Kelly Aerospace by calling 440-951-4744 or fax 440-951-4725

8. SECTION: SPECIAL INSPECTION REQUIREMENTS

Inspect the system during 100 Hr and/or Annual inspections. There are no servicing requirements for the Air-conditioning System outside of normal 100hr/Annual inspection intervals or during routine maintenance.

8.1. Remove necessary access covers per the ASM.

8.2. During the annual or 100 hr inspections check for the following items:

8.3. Security of attachment of all components.

8.4. Evidence of any leaks.

8.5. Fretting or cracking of any sheet metal structures.

8.6. Insect or animal nests in condenser or evaporator sections.

8.7. Bent or obstructed fins on the condenser and evaporator coils.

8.8. Loose or missing hardware.

8.9. Loose or chaffing tubing.

8.10. Loose or chaffing wires.

9. SECTION: APPLICATION OF PROTECTIVE TREATMENTS

Plenum installation should match factory rivet spacing and reference AC43.13-1B. Also, refer to Piper Maintenance Manual.

10. SECTION: OVERHAUL PERIOD

No additional overhaul time limitations.

11. SECTION: AIRWORTHINESS LIMITATIONS

The Airworthiness Limitations Section is FAA APPROVED and Specifies maintenance required under FARs parts 43.16 and 91.403 unless an alternate program has been FAA APPROVED. There are no additional Airworthiness Limitations as a result of this alteration.