

**REPORT NAME:**  
INSTALLATION INSTRUCTIONS  
AND INSTRUCTIONS FOR  
CONTINUED AIRWORTHINESS



1585 Aviation Center Parkway  
Hangar 804  
Daytona Beach, FL 32114

**REPORT NUMBER:** PFS-13850-00

**KIT NUMBER:** PFS-13804, PFS-14152

**REVISION:** C

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**PREPARED BY:** Tom Strohmayer

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Submitted to FAA ACO

By: Tom Strohmayer Date: 10/4/07

REVISION CONTROL

REVISION	DATE	REMOVE PAGES	INSERT PAGES
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A	04/10/07	ALL	ALL
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C	07/18/07	2, 5, 6, 8, 16	2, 5, 6, 8, 16

10/19/07 Initials [Signature]

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*Installation Instructions and  
Instructions for Continued Airworthiness  
Kit: PFS-13804, PFS-14152*

## **1.0 Introduction**

**Note:** PFS is the abbreviation for Power Flow Systems, Inc.

**Description:** The PFS exhaust consists of an exhaust pipe from each cylinder to the collector assembly located beneath the engine. The collector assembly is enclosed in a shroud, which captures ram air from the engine compartment baffle to be heated by passing around the collector assembly's inner tubes. This heated air is used to heat the aircraft cabin. A separate compartment captures heated air for carb heat. A tailpipe from the collector assembly routes exhaust gases to a muffler that directs gases out of the cowling.

***Please read these directions and the Instructions for Continued Airworthiness completely before starting installation.***

**Please call us at 386-253-8833 during normal business hours if you have any questions regarding the installation of this kit.**

**Please Note:** The Power Flow Systems Exhaust has been designed and FAA certified to be installed in accordance with these instructions. Any modification to the exhaust system or its components, or any deviation from these instructions without express written permission from Power Flow Systems, Inc. invalidates the design and the FAA approval. Any such modifications or deviations will also void the exhaust system warranty.



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## 2.0 Kit Contents

<b>Quantity</b>	<b>Part Description</b>	<b>O320 Part Number</b>	<b>O360 Part Number</b>
1	#1 Header	11630	11800
1	#2 Header	12630	12800-O360
1	#3 Header	13630	13800
1	#4 Header	14630	14800-O360
1	Shrouded Collector Assembly	41510	<del>Same</del> <span style="border: 1px solid black; padding: 2px;">41500</span>
1	Intermediate Tube	78103	Same
1	Tailpipe	80061	Same
1	Support Rod	90862	Same
1	Wide Exhaust Clamp (2" with pin)	7022	Same
1	Muffler Clamp (3 1/2" without pin)	8030	Same
1	Balljoint Flange	510	Same
1	Reducer Flange	6585	Same
1	Splitter	6586	Same
4	No-blow Header Gasket	77611	Same
8	Exhaust Nut	SL-STD-1410	Same
8	Lock Washer	MS35333-41	Same
8	Plain Washer	AN960-516	Same
2	Drilled Bolt	AN4C5	Same
2	Castle Nut	AN310C4	Same
5	Cotter Pin	MS24665-153	Same
4	Flat Washer	AN960C416	Same
3	Drilled Bolt	AN3C12	Same
3	Castle Nut	AN310C3	Same
3	Balljoint Springs	33703	Same
3	Stainless Washers	AN960C10	Same
1	#6 Adel Clamp	MS21919WH6	Same
1	#12 Adel Clamp	MS21919WH12	Same
1	Aluminum Strap	201	Same
2	Stainless Screw	MS51958-63	Same
4	Stainless Washers	AN960C10	Same
2	Locknut	MS21045C3	Same
<b><u>OPTIONAL PARTS</u></b>			
1	Nosebowl Flange	6525	N/A
6	Blind Rivets	CCCP-32	N/A

Equivalent hardware may be used throughout



### **3.0 PREPARATION**

Verify that all contents listed on page 4 of this instruction set are included in your kit. Read all instructions before attempting installation, to become familiar with the procedure. If you have any questions regarding the installation, please call (386) 253-8833 *before* attempting installation.

- 3.1 - Remove stock exhaust system in accordance with the latest approved revision of the aircraft service manual.
- 3.2 - If the oil drain is on the pilot side of the engine sump (O-360 Engines Only), relocate it to the passenger side in accordance with the latest revision of the Engine Service Manual. It may also be necessary to modify the fuel drain on the pilot side of the sump with an angle fitting between the sump and the check valve.

### **4.0 INSTALLATION OF PFS EXHAUST SYSTEM**

#### **4.1 - Installing Collector Box Assembly and Exhaust Pipes**

- 4.1.1 - Insert the exhaust header pipes into the collector assembly as per the numbering on the collector and headers. Be sure to use the alignment marks. A minimum of 1 1/2" penetration is required for proper operation.
- 4.1.2 - Put new gaskets into position on each cylinder. It is suggested that you keep them in place temporarily with either a loop of safety wire or a large cotter pin. Lift and hold the assembly into position. Start a nut on each header to hold the entire assembly in place. See Detail "A".
- 4.1.3 - Install a washer, a lock washer and a nut on each stud (there are 8 sets of these). If utilized, remove the loops of safety wire or cotter pins. Do not torque to value yet.
- 4.1.4 - Be sure the collector assembly is not in contact with the engine sump. If necessary, pull down on the 4-1 collector to rotate the assembly away from the sump. Torque header pipes in accordance with the latest revision of the aircraft or engine service manual. See Detail "A".
- 4.1.5 - If installing EGT probes, install them in accordance with their manufacturer's recommendations (typically 2 to 4 inches from the exhaust port, ensure they are all the same).
- 4.1.6 - Connect all SCAT hoses to their respective inlets/outlets. The 2.5" diameter flange on the passenger side of the heat shroud is for carb heat only. This flange has a screen attached beneath it. The other two flanges can be used interchangeably for cabin heat in and cabin heat out. Depending on the number and size of connections, the included reducers and/or splitters may be used.

#### **4.2 - Nosebowl Modification (See Detail E)**

**This section only applies to Aircraft Serial Numbers MB-1 through MB-480 where the SCAT tube routing is difficult due to the proximity of the exhaust system to the forward section of the lower cowling. All others skip to Section 4.3.**

- 4.2.1 - Remove the lower cowling. (If you have a split cowl or the prop has been removed, you can remove just the nosebowl instead).
- 4.2.2 - Using a cutoff wheel or handsaw, cut off the outlet tube causing the interference.



- 4.2.3 - Align the included flange (P/N 6525) over the hole and rivet into position using the included blind rivets.
- 4.2.4 - Re-Install hoses and recheck clearances.

### **4.3 - Installing Support Rod P/N 90862**

- 4.3.1 - Loosen and remove the lower right engine Lord Mount bolt. Install the teardrop shaped end of the support rod under the bolt head, on top of the existing large area washer (if applicable, omit the washer if the bolt is too short). See Detail "D". Ensure that the rod clears all engine compartment parts. Re-assemble Lord Mount, but do not torque to value yet.
- 4.3.2 - Slide the ball joint flange, P/N 510 over the intermediate tube P/N 78103, then slide the intermediate tube over the 4-1 outlet.
- 4.3.3 - Temporarily assemble the balljoint that attaches the tailpipe, P/N 80061 to the intermediate tube. See Detail "F". The tailpipe should be pointed straight back, and pass approximately 4-6 inches forward of the firewall.
- 4.3.4 - Rotate the support rod until the pointed end is centered over the tailpipe.
- 4.3.5 - Install the #6 Adel clamp on the support rod, approximately in the middle of the rod.
- 4.3.6 - Install the #12 Adel clamp on the tubular engine mount member that passes nearest the support rod.
- 4.3.7 - Install the aluminum strap (P/N 201) to join the two Adel clamps. The strap should be located as to center the support rod end tab over the tailpipe.
- 4.3.8 - Tighten the Adel Clamps and torque the engine mount bolt to the manufacturer's recommended torque, making sure the support rod doesn't rotate while tightening. Make sure that you have at least one to two threads showing through the nut on the engine mount. It may be necessary to install a longer bolt or remove the original large area washer (if originally installed).

### **4.4 - Installing Intermediate Tube and Tailpipe**

- 4.4.1 - Take two or three measurements to reference the tailpipe location with respect to a fixed point on the airframe.
- 4.4.2 - Using the measurements taken in the previous step and the included template as a guide cut an opening in the passenger side cowl scoop for the tailpipe to exit.
- 4.4.3 - Trim and fit as many times as necessary to obtain ½" to 1" clearance around the perimeter of the tailpipe. When fitting the cowling, be sure to install enough fasteners to ensure the correct cowling position. Make sure the tailpipe is up against the bottom of the support rod.
- 4.4.4 - It may be necessary to cut a larger opening to remove the louvers on some aircraft. If a larger opening was cut, install a doubler to decrease the opening size.
- 4.4.5 - Once the cutout is finished and the tailpipe aligned, make a mark at the junction of the 4-1 outlet and intermediate tube to record the intermediate tube rotation.
- 4.4.6 - Remove the cowling and install the pinned clamp P/N 7022 by drilling a ¼" hole in the flared end of the intermediate tube and into the 4-1 collector (be sure to line up the marks made in the previous step). The hole should be drilled approximately one inch



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from the end of the flare. See Detail “B”.

- 4.4.7 - Perform final assembly of the balljoint and clamps. See Details “B”, “C”, and “F”. Do not over-tighten the balljoint, as it may deform the surfaces and cause damage that could result in an exhaust leak.
- 4.4.8 - Patch the hole the original exhaust system used to exit the cowling (if applicable) in accordance with the latest approved revision of AC43.13.

## 5.0 INSPECTION AND PAPERWORK

- 5.1 - Any deviation in muffler and/or support rod alignment may cause carbon monoxide to enter the aircraft cabin. The muffler must be pointed slightly down—not parallel to the fuselage—in order to ensure that no exhaust gases enter the aircraft cabin.
- 5.2 - Be sure that the final installation allows a minimum of 2” clearance between exhaust system components and fuel and oil lines.
- 5.3 - After performing run-up, inspect the tailpipe and cowling for rubbing or chafing. Any holes cut in the cowling may need to be enlarged based on the amount of motion caused by engine start and shutdown. The motion of the tailpipe will be greatest during engine start and shutdown. Excessive motion could be an indication of worn engine Lord mounts.
- 5.4 - Install the placard (enclosed) in clear view of the pilot that reads:  
“The Power Flow Systems, Inc. tuned exhaust system may cause the aircraft to burn more fuel at high power settings when running a rich mixture. It is the Pilot’s responsibility to determine what, if any, change in fuel flow exists and to plan accordingly.”
- 5.5 - Make appropriate entries in the logbook and on FAA Form 337. This modification is considered a major *airframe* change. The STC is located at the back of this instruction set for easy removal.
- 5.6 - Typical Weight and Balance Information: The PFS System weighs 21.25 lbs at station 48.0 -- It is recommended that the installer weigh both the stock and Power Flow systems for an exact differential.



## **6.0 INSTRUCTIONS FOR CONTINUED AIRWORTHINESS**

**It is the responsibility of the aircraft owner/technician to ensure that the most recent revision of these instructions is followed. The most recent revision of this report can be obtained by calling Power Flow Systems, Inc. at (386) 253-8833 or online at [www.powerflowsystems.com](http://www.powerflowsystems.com)**

### **6.1 - Basic Operation**

Basic operation of the airplane remains the same. The pilot must watch to ensure that redline of the RPM is not exceeded.

### **6.2 - Airworthiness Limitations**

**“The Airworthiness Limitations section is FAA approved and specifies maintenance required under §§43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.”**

6.2.1 - Mandatory Replacement Time – None. Any collector assembly that is damaged and/or fails the pressure test described below must be replaced.

6.2.2 - Structural Inspection Interval – At 100 hour or Annual intervals, depending on the service regime of the aircraft. **WARNING: Carbon Monoxide gas present in exhaust gases can lead to pilot incapacitation and/or death. A damaged exhaust system has the potential to allow Carbon Monoxide into the aircraft cabin. To prevent such an occurrence, it is imperative that the exhaust system is inspected using the intervals and procedures described in this report. It is recommended that in-cabin carbon monoxide levels be measured periodically. Concentrations of greater than 50ppm will require immediate exhaust system repair or replacement.**

6.2.3 - Structural Inspection Procedure – See Section 6.6 Below.





### 6.3 - Troubleshooting

Problem	Possible Cause	Solution
Exhaust smell in cockpit	Exhaust Leak	Immediately inspect exhaust system for leaks, <b>do not return to service until problem is resolved.</b>
Excessive vibration	Collector not centered on header pipes	Reposition collector -- ensure minimum of 1 ½” Penetration per header into central collector system
	Propeller not properly balanced	Have propeller dynamically balanced
	Tailpipe contacting cowling	Check Tailpipe for wear, the opening in the lower cowl may need to be increased.
	Ball Joint Too Loose	Tighten Ball Joint
Excessive noise	Muffler insert damaged or missing	Contact PFS, Inc. for a new muffler insert, P/N 8016

### 6.4 - Maximizing Service Life

To get the maximum possible service life from your Power Flow Systems Tuned Exhaust, follow the following steps.

- 6.4.1 - Dynamically balance your propeller to below 0.2 ips (inches per second) every 2 years or 1000 hours (whichever occurs first).
- 6.4.2 - Dynamically balance your propeller to below 0.2 ips after modifying, overhauling, dressing, or replacing any rotating component on the engine or propeller.
- 6.4.3 - Keep slip joints lubricated with a high temperature anti-seize.
- 6.4.4 - Maintain even engine compressions above 70/80 psi.
- 6.4.5 - Keep magnetos in good working order and ensure that mag drops are even and less than the maximum recommended by the aircraft manufacture.

PLEASE NOTE THAT FAILURE TO COMPLY WITH ONE OR MORE OF THESE STEPS MAY IMPACT THE PRODUCT WARRANTY. PLEASE CONSULT YOUR WARRANTY DOCUMENTATION FOR FURTHER DETAILS.

### 6.5 - Removal

Follow the above instructions in reverse order.

### 6.6 - Inspection

The exhaust system must be thoroughly inspected, especially within the heat exchanger section. A detailed visual inspection of the exhaust system must be performed in



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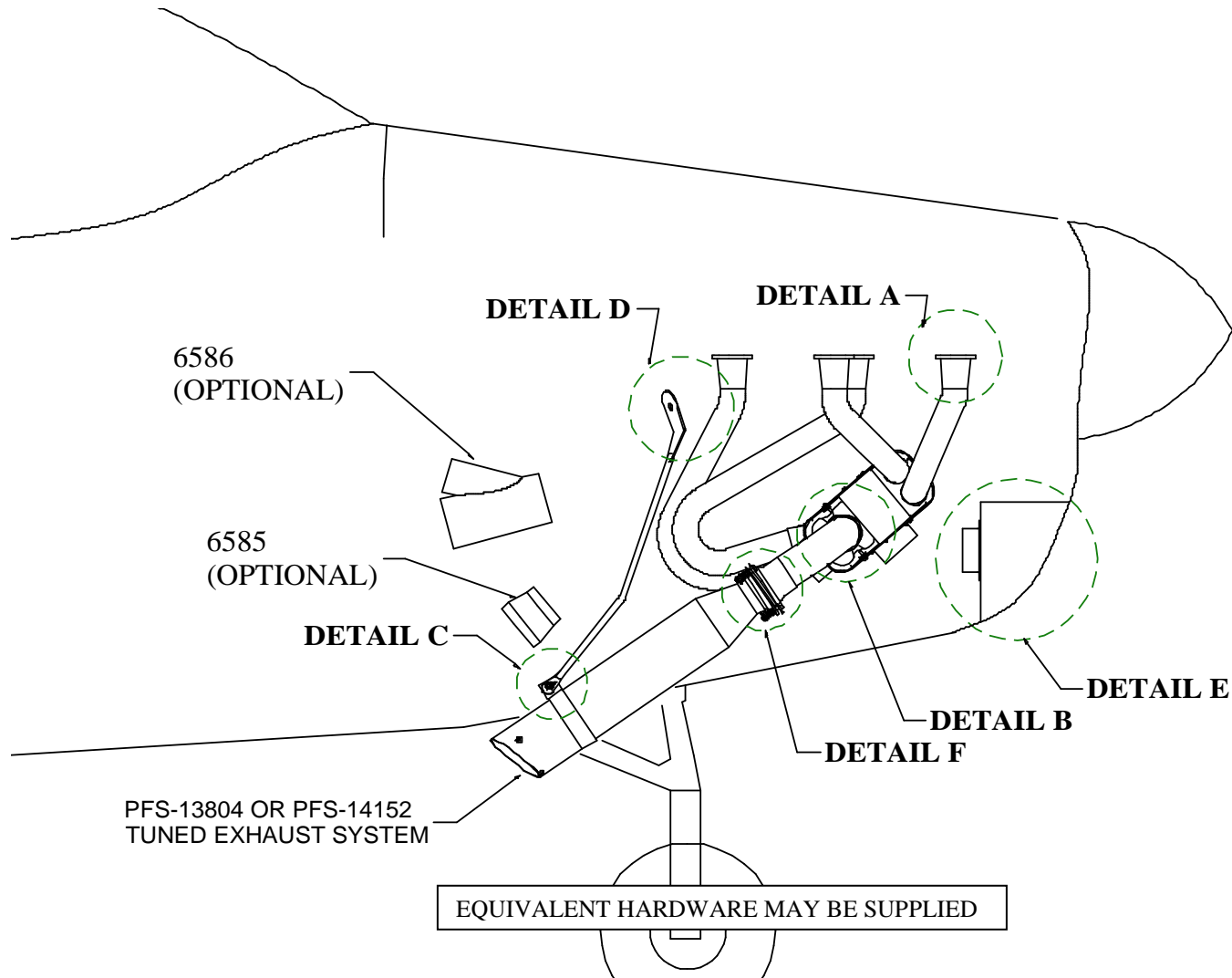
accordance with the latest revision of the Aircraft Service Manual at either 100 hour or annual intervals.

All components displaying cracking or general deterioration must be replaced with new parts or repaired in accordance with the latest approved revision of AC 43.13.

- 6.6.1 - Check for holes, cracks, and burned spots. Especially check areas adjacent to welds. Look for exhaust gas deposits in surrounding areas. Look for unusual tube discoloration. This may indicate an exhaust leak.
- 6.6.2 - Inspect screen covering carb heat outlet. Screen must be secure with no risk of material falling off.
- 6.6.3 - Inspect packing material in the muffler body. If the packing is missing or deteriorated, it will require replacement. New packing inserts are available from Power Flow Systems, Inc.
- 6.6.4 - Inspect for ball joint freedom of movement by disconnecting the support rod. The tailpipe should be free to move by applying minimal force. If the tailpipe isn't free to move:
  - Disassemble the ball joints and inspect for surface abnormalities such as galling or wear marks.
  - Rework the ball joints as required to correct noted discrepancies.
  - Reassemble the ball joints. Do not over tighten the clamp as this may distort ball surfaces.
- 6.6.5 - **All slip joints must be disassembled and lubricated with a high-temperature anti-seize compound (Only necessary at 500hr or annual intervals, whichever comes first). While disassembled, inspect for wear or galling. This should be performed more frequently if headers seize between inspections.**
- 6.6.6 - **Be sure to remove heat shroud to inspect within the collector assembly.** *If any defects on the collector assembly (other than on the shroud) are noted during the visual inspection, then the collector needs to be pressure tested using the procedure below:*
  - Remove shroud.
  - Seal four of the openings (tubes) with rubber expansion plugs.
  - Submerge the collector assembly in water.
  - Using a manometer or pressure gauge, apply 3.0 to 3.5 PSI (approximately 7" Hg) of air pressure to the fifth opening.
  - Let the unit sit pressurized for 10 to 30 seconds. The leak rate should be zero.
  - If a leak is found in the collector assembly, replace before further flight.

All components displaying cracking or general deterioration must be replaced with new parts or repaired in accordance with the latest approved revision of AC 43.13.

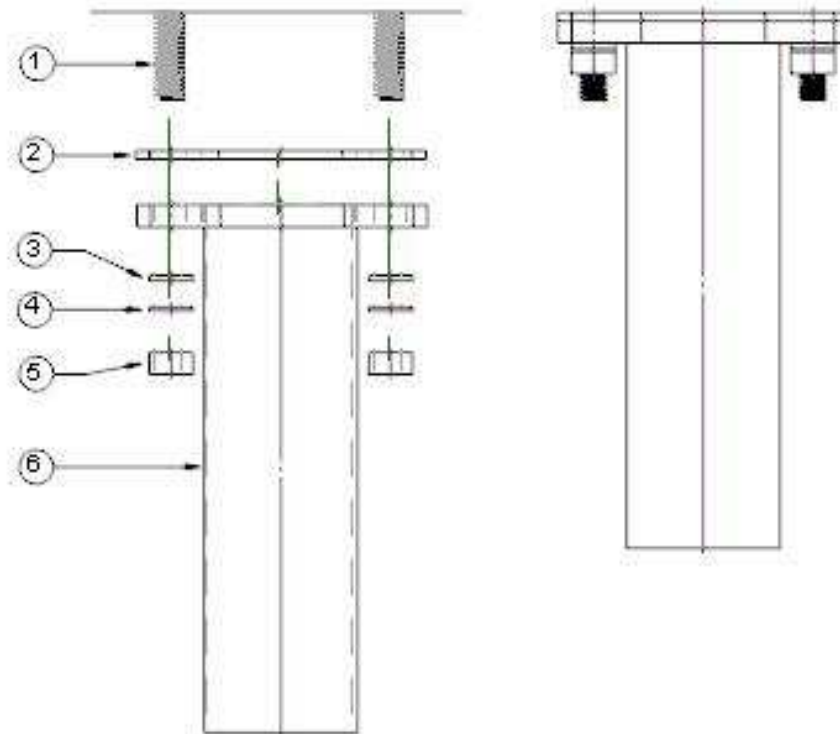
## INSTALLATION OVERVIEW



**DETAIL "A"**

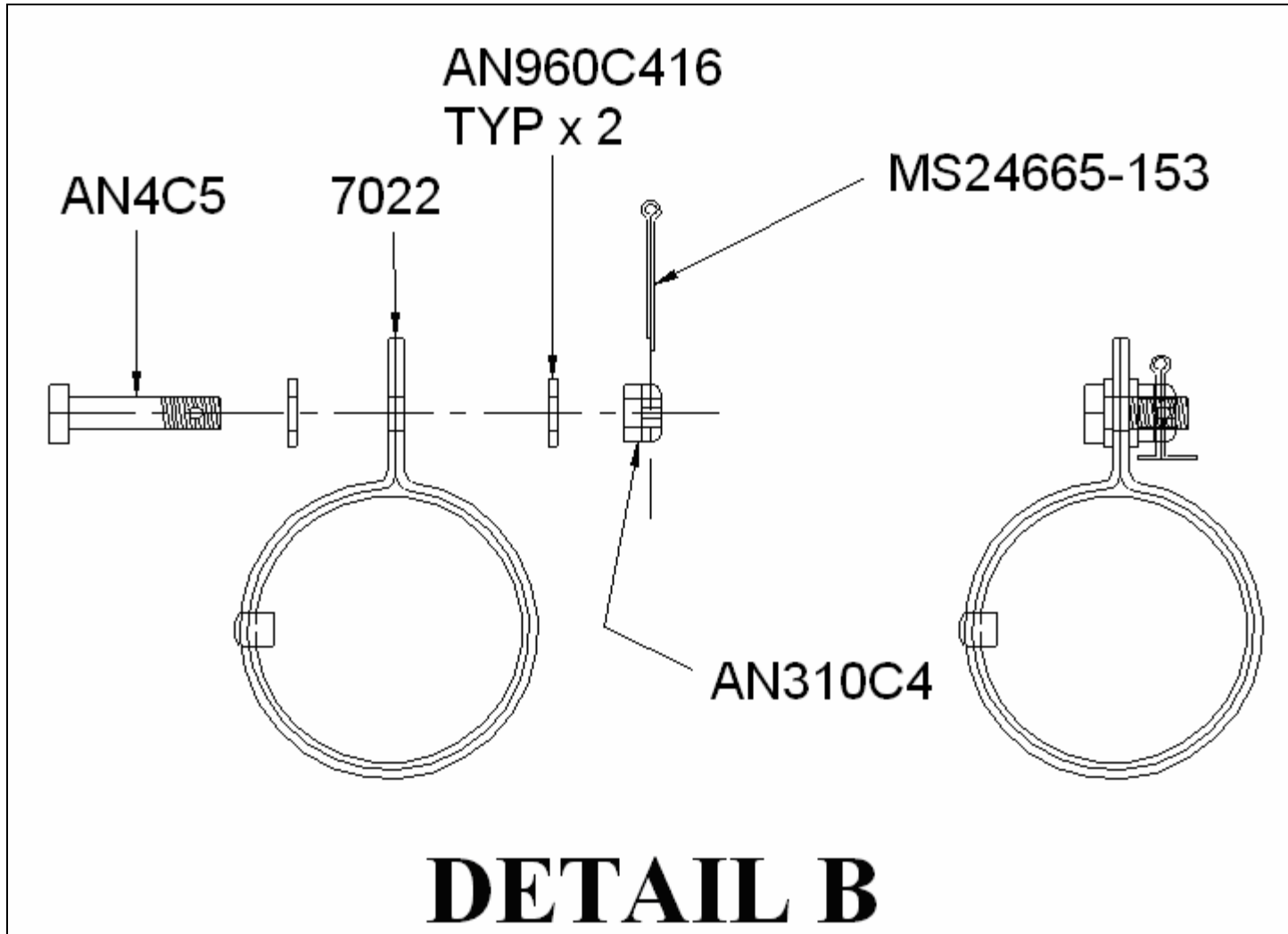
# DETAIL A

- |                    |                 |
|--------------------|-----------------|
| 1 - EXHAUST STUD   | LYCOMING ENGINE |
| 2 - NO-BLOW GASKET | 77611           |
| 3 - FLAT WASHER    | AN960-516       |
| 4 - LOCK WASHER    | MS35333-41      |
| 5 - NUT            | SL-STD-1410     |
| 6 - HEADER         | VARIOUS         |

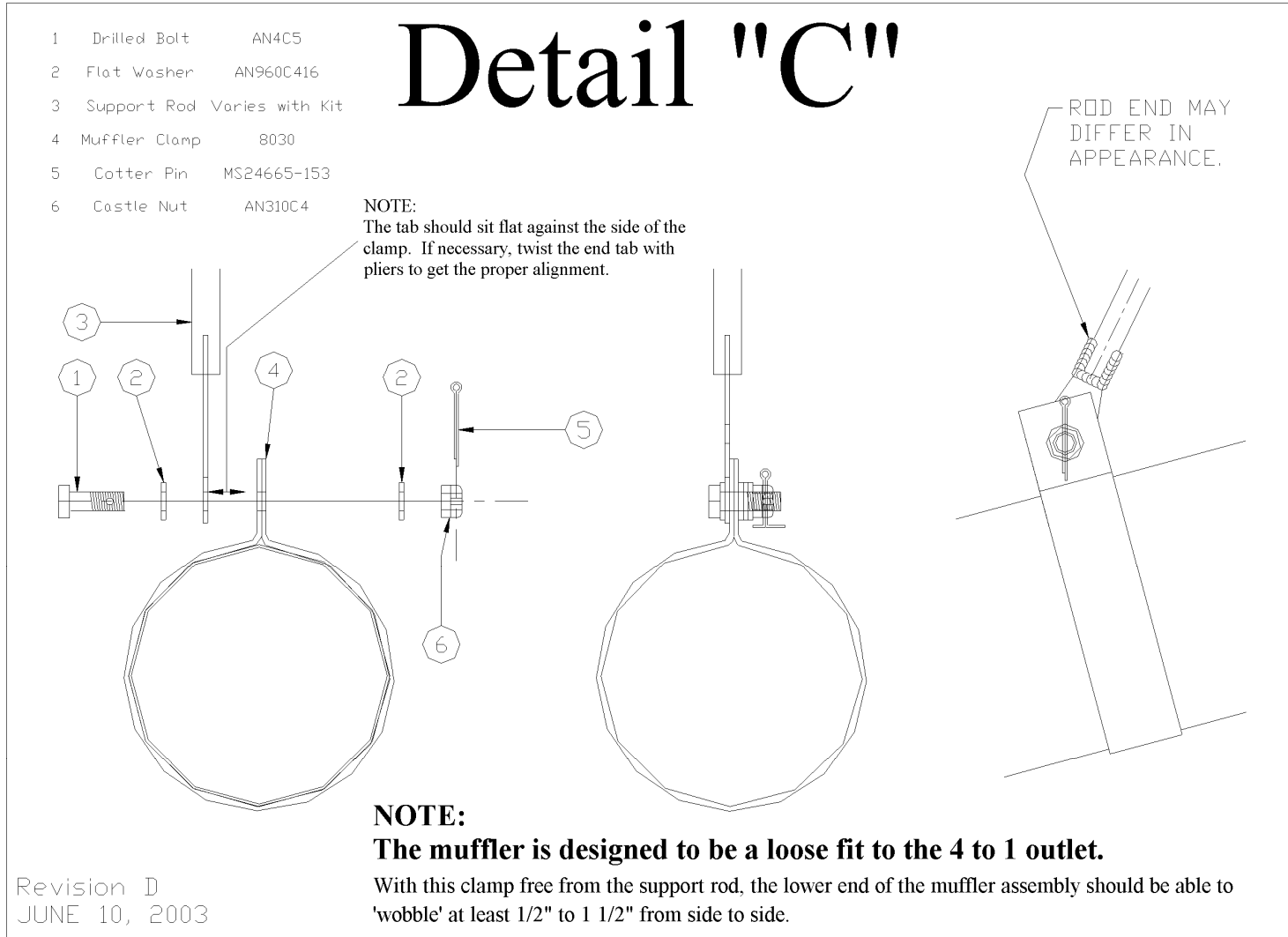


Equivalent Hardware May Be Used Throughout

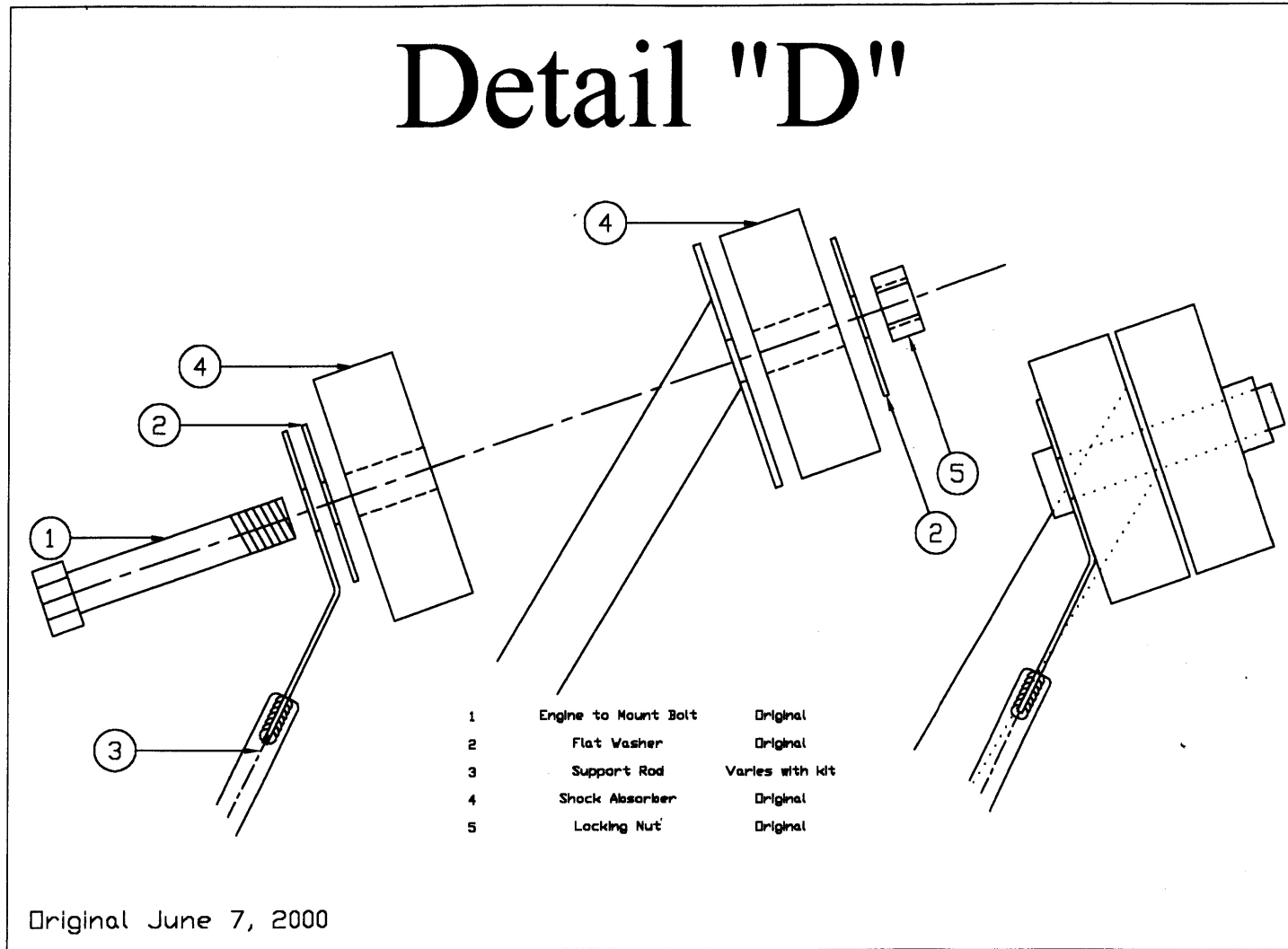
**DETAIL "B"**



## DETAIL "C"



**DETAIL "D"**

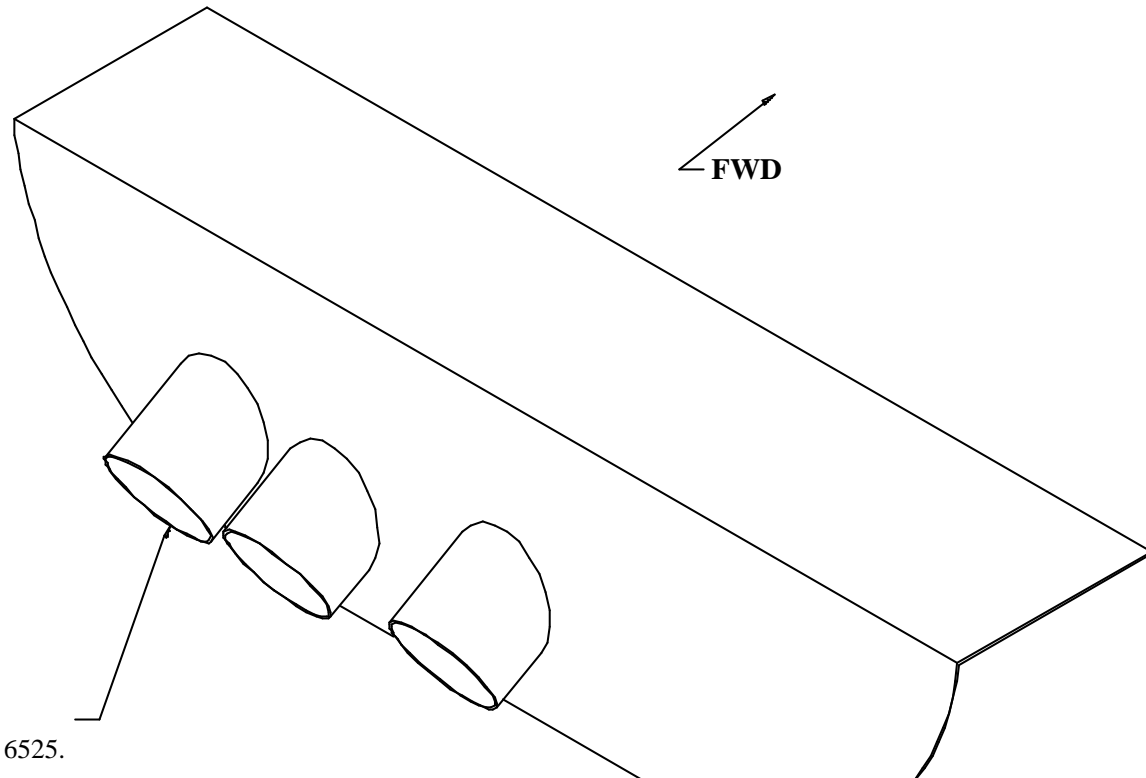


**DETAIL "E"**

# DETAIL E

## NOSEBOWL MODIFICATION

Aircraft S/N MB-1 through MB-480 Only



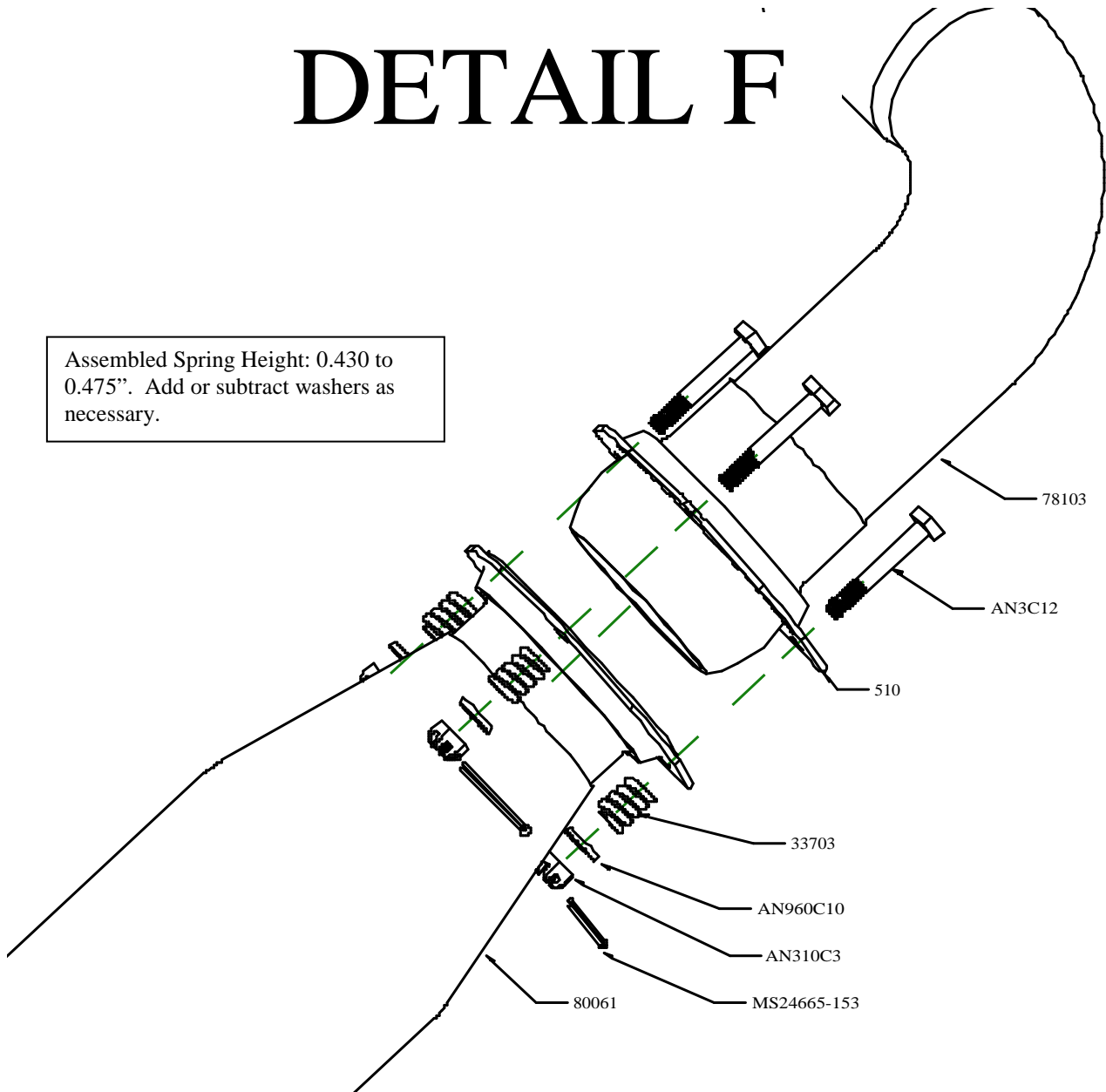
CUT OFF IF REQUIRED  
FOR SCAT CLEARANCE  
AND REPLACE WITH P/N 6525.



**DETAIL "F"**

# DETAIL F

Assembled Spring Height: 0.430 to 0.475". Add or subtract washers as necessary.



PHOTOCOPY OF STC

United States of America  
Department of Transportation -- Federal Aviation Administration  
Supplemental Type Certificate

Number SA03231AT

This certificate issued to Power Flow Systems, Inc.  
1585 Aviation Center Parkway.  
Hangar 804  
Daytona Beach, FL 32114

NOT VALID WITHOUT LETTER  
OF AUTHORIZATION FROM  
POWER FLOW SYSTEMS, INC.

certifies that the change in the type design for the following product with the limitations and conditions therefore as specified hereon meets the airworthiness requirements of Part 3 of the Civil Air Regulations.

Original Product - Type Certificate Number : AICE

Make : Raytheon (Beech)

Model : 19A ; 23 ; A23 -19; B19 ; B23  
; C23 ; M19A

Description of Type Design Change:

Installation of a improved performance exhaust system per Power Flow Systems, Inc. , Installation Instructions and Instructions for Continued Airworthiness, Report no. PFS-13850-00, Rev. 1R, dated 03/01/06 or later FAA approved revision

Limitations and Conditions:

"This approval should not be extended to other aircraft of this model on which other previously approved modifications are incorporated, unless it is determined by the installer that the interrelationship between this change and any other previously approved modifications will produce no adverse effect upon the airworthiness of that airplane. If the holder agrees to permit another person to use this certificate to alter the product, the holder shall give the other person written evidence of that permission."

This certificate and the supporting data which is the basis for approval shall remain in effect until surrendered, suspended, revoked or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.

Date of application : March 01, 2006

Date received :

Date of issuance : April 24, 2006

Date amended :



By direction of the Administrator

*Christina L. Marsh*  
(Signature)

Melvin D. Taylor  
Manager  
Atlanta Aircraft Certification Office

(Title)

Any alteration of this certificate is punishable by a fine of not exceeding \$1,000, or imprisonment not exceeding 3 years, or both.