REPORT NAME: PFS-18101 Tuned Exhaust System Installation Instructions and Instructions for Continued Airworthiness

REPORT NUMBER: PFS-18150-00

REVISION: B

REPORT DATE: August 3, 2010

AIRCRAFT APPLICABILITY: Aviat A-1, A-1A, A-1B, A-1C-180 with Lycoming O-360 Engines

PREPARED BY: T. STROHMAYER

DISTRIBUTION: FAA ATL ACO, FAA MKC AEG, END USER

STC NUMBER: SA03858AT

REVISION CONTROL

REVISION	DATE	REMOVE PAGES	INSERT PAGES
IR	JAN/27/2010	N/A	N/A
A	APR/06/2010	4,5,7,9,10	4,5,7,9,10
B	AUG/03/2010	1,3,9,17,18	1,3,9,17,18

Revision Notes:

Rev A: Changed all anti-seize references to reference specific minimum standard. Added paragraph 4.1.1 and 6.5.10. Renamed section 6.5. Fixed quantity error in section 2.0.

Rev B: Added A-1 and A-1A to applicability. Reordered Sections 2 and 3. Added paragraphs to Preparation Section regarding cabin heat vents and mixture cable. Changed recommended prop balance interval.

F. A. A.
APPROVED
ATLANTA AIRCRAFT CERTIFICATION
OFFICE CENTRAL REGION
BY:
DATE: 5-9-2011
* Sections 4.0 & 6.2

TABLE OF CONTENTS

1.0 INTRODUCTION

- PFS is the abbreviation for Power Flow Systems.
- Please read these instructions 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.
- 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.
- If your cowling has been modified at all to be different than when it was originally built, please ensure our modification will be compatible before installation or flying.

2.0 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.

Caution: If you have plastic eyeball vents as part of your cabin heat system, you must replace them with aluminum eyeball vents prior to using the cabin heat of your Power Flow Equipped Husky or the plastic vents will deform from the additional heat. Approved parts (P/N 63918 or equivalent) are available from Aviat or Power Flow Systems, Inc.

It is also recommended that you install a Vernier-Style mixture cable (p/n 60652 or equivalent, also available from Aviat or from Power Flow Systems) to better experience the leaning benefits associated with your new exhaust installation.

2.1 Remove lower cowling in accordance with the latest approved revision of the Aircraft Service Manual. It is not necessary to remove the top cowl or nosebowl.

2.2 Disconnect flexible ducts (SCAT hose) from muffler assembly.

2.3 Cover carb heat inlet on airbox to prevent debris from entering the carburetor.

2.4 Remove EGT probe(s), if installed.

2.5 Remove nuts attaching exhaust pipes to exhaust studs.

2.6 Remove exhaust pipes, muffler and exhaust gaskets.

3.0 KIT CONTENTS

Quantity	***Part Description***	***Part Number***
1	#1 Header	11680
1	#2 Header	12680
1	#3 Header	13680
1	#4 Header	14680
4	No-blow Header Gasket	77611
8	Exhaust Nut	SL-STD-1410
8	Lock Washer	MS35333-41
8	Plain Washer	AN960-516
1	Shrouded Collector Assembly	40810
1	Exhaust Clamp (2” with pin)	7022
1	Bolt	AN4C5A
1	Lock Nut	MS21045C4
2	Flat Washer	AN960C416
1	Adel Clamp size 5	MS21919WH5
1	Adel Clamp size 12	MS21919WH12
1	Lock Nut	MS21045C3
1	Screw	MS51958-63
2	Flat Washer	AN960C10
1	Muffler Assembly	80081(-CER)
16”	Carb Heat SCAT Tubing	SCAT-8
16”	Cabin Heat SCAT Tubing	SCAT-8
20”	Cabin Heat SCAT Tubing	SCAT-8

Equivalent hardware may be supplied.

4.0 INSTALLATION OF THE PFS EXHAUST SYSTEM

4.1 Installing Collector Box assembly and Header Pipes:

4.1.1 Header slip joints come lubricated from the factory; if reinstalling the exhaust system, lubricate the header slip joints with high temperature anti-seize meeting or exceeding MIL-A-907E. Nickel based anti-seize is recommended.

4.1.2 Insert the number 2 and number 4 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 ½ " penetration is required for proper operation. 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", Installation Overview and Left Side View.

4.1.3 Insert the number 1 and number 3 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. Be sure to use the new gaskets provided. If the system is being re-installed and alignment marks are not visible, set the collector box to a 20 degree up-angle with respect to the engine centerline (not horizontal) and make sure all headers are inserted equally (about 1.6 inches).

4.1.4 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. Torque I.A.W. the latest revision of the aircraft or engine service manual. See Detail "A".

4.1.5 Install EGT Probes (If Applicable) I.A.W. the manufacturer's recommendations. All probes should be the same distance from the port, typically 2-4 inches. Be sure to angle the probe forward or aft. If the probe is installed pointed directly outboard, it may contact the engine cowling.

4.1.6 Install flexible tubing to shroud connections. The cabin heat outlet is on the aft-left side of the shroud. The carb heat outlet on the aft-right side of the shroud. The cabin heat inlet is on the front of the shroud. See the SCAT hose routing diagram.

4.2 Tailpipe Installation

4.2.1 Slide the tailpipe, PN 80081 all the way onto the end of the 4-to-1 collector. DO NOT drill for clamp installation, yet. Point the end of the pipe straight down.

4.2.2 Position the lower cowl onto the airplane. Attach the cowl with enough screws to ensure the proper angle of the cowl. The tailpipe can be repositioned slightly to pass cleanly through the exhaust pipe opening.

4.2.3 Depending on your aircraft, it may be necessary to slightly increase the size of the tailpipe opening in the cowling. A minimum of 3/8" clearance should exist on all sides of the tailpipe.

4.2.4 Once the tailpipe is centered in the cowl outlet hole, mark the junction of the slip joint to indicate the proper rotation angle.

4.2.5 Remove the cowling.

4.2.6 Verify the pipe has not moved by checking the mark made in step 4.2.4. Drill a 0.25" hole through the pilot hole in the flared end of the tailpipe.

4.2.7 Install clamp PN 7022 using provided hardware. See Detail B. The pin should insert with no more than moderate hand pressure. If binding exists the hole may need further reaming.

5.0 INSPECTION AND PAPERWORK

5.1 Be sure that the final installation allows a minimum of 2" clearance between unshielded exhaust tubes and fuel and oil lines or battery cables. Verify that fuel, oil, and electrical lines are properly supported. Nylon, plastic, or rubber ties can melt and cause fuel, oil, or electrical lines to fall onto exhaust system components. Verify that ignition leads are properly fastened and unable to fall on an exhaust pipe if the nylon ties melt. The number 4 cylinder, bottom spark plug lead may need to be re-routed.

5.2 Using the provided Adel clamps, securely attach the starter cable to the engine mount tube (on the left side of the engine, near the firewall). The cable may have been fastened with nylon ties which may melt in service.

5.3 After installing the cowling and performing run-up, inspect the tailpipe and cowling for rubbing or chafing. The hole that the tailpipe passes through 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 original Husky Exhaust System weighs 11.5 lbs.
- The Power Flow Systems, Inc. tuned exhaust system weighs 17.5 lbs at station 19.5.

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 obtained by calling Power Flow Systems, Inc. at (386) 253-8833 or online at www.powerflowsystems.com

6.1 Basic Operation

Basic operation of the airplane remains the same.

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 rebuilt or replaced with new.

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, rebuild, or replacement.**

6.2.3 All slip joints must be disassembled and lubricated with a high-temperature anti-seize compound meeting or exceeding MIL-A-907E (Nickel based anti-seize is recommended) 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.

6.2.4 Structural Inspection Procedure – See Section 6.6 Below.

6.3 Troubleshooting

Problem	Possible Cause	Solution
Exhaust smell or carbon monoxide in cockpit	Exhaust Leak, opening in firewall or fuselage	Immediately inspect exhaust system and airframe for leaks, **do not return to service until problem is resolved.**
Excessive vibration	Tailpipe contacting cowling	Check for wear marks on the engine cowling, reposition tailpipe or trim opening as necessary.
	Collector not centered on header pipes	Reposition collector -- ensure minimum of 1 1/2" penetration per header into central collector system
	Broken Clamp	Replace Broken Clamp
	Propeller not properly balanced	Have propeller dynamically balanced to at or below 0.2 ips.
	Worn Engine Mounts	Inspect Engine mounts and replace if necessary. Verify that mounts are shimmed in accordance with the Aviat Service Manual.
Excessive noise	Muffler insert damaged or missing	Contact PFS, Inc. for new muffler insert kit, PN PFS-8011.
Staining at or near slip joints.	Exhaust Leak or Anti-Seize stain.	Anti-Seize will creep from slip joints and appear as a stain, this is not a problem. Exhaust leaks from slip joints are extremely rare, but if stains are determined to be from exhaust, the slip joints should be reworked for better fit.

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 4 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 meeting or exceeding MIL-A-907E (Nickel based anti-seize is recommended).

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 / Replacement

6.5.1 Remove lower cowl IAW the latest FAA approved revision of the Aircraft Service Manual (it is not necessary to remove the top cowl or the nosebowl).

6.5.2 Disconnect exhaust clamp P/N 7022 and remove muffler assembly P/N 80081.

6.5.3 Disconnect flexible ducts from collector assembly.

6.5.4 Mark each of the header pipes with their respective cylinder number with a felt tipped pen or marker. Also mark the insertion depth and rotation angle of the header slip joints. DO NOT MARK EXHAUST PIPES WITH A PENCIL OR ANY OTHER GRAPHITE OR CARBON BASED MARKING DEVICE.

6.5.5 Remove EGT probes if installed.

6.5.6 Loosen all of the nuts attaching the headers to the engine studs.

6.5.7 Remove exhaust pipes from cylinders 1 and 3 and separate them from the collector assembly.

6.5.8 Remove the collector assembly by pulling out from the 2 and 4 cylinder side.

6.5.9 Remove the 2 & 4 headers from the collector assembly.

6.5.10 To reinstall the system, see sections 4.0 and 5.0 above.

6.6 Inspection

The exhaust system must be thoroughly inspected, especially within the heat exchanger section. A detailed inspection of the exhaust system must be performed in accordance with the latest revision of the Aircraft Service Manual and this document 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 Open heat shroud so that all surfaces of the exhaust system are visible.

6.6.2 Check for holes, cracks, and burned spots. Especially check areas adjacent to welds. Look for exhaust gas deposits in surrounding areas. This may indicate an exhaust leak.

6.6.3 Inspect the baffling (cone) in the tailpipe. If the baffling is missing or deteriorated, it will require replacement. New inserts are available from Power Flow Systems, Inc.

6.6.4 Inspect screen covering carb heat outlet. Screens must be secure with no risk of material breaking off.

6.6.5 Inspect the pin on the clamp. The pin should not indicate excessive wear or cutting. If worn or cut contact Power Flow Systems, Inc. for replacement.

6.6.6 Inspect the hole that pin is inserted through. If the hole is elongated the tailpipe may need to be reworked for a tighter fit.

6.6.7 All slip joints must be disassembled and lubricated with a high-temperature anti-seize compound meeting or exceeding MIL-A-907E at 500hr or annual intervals, whichever comes first. This should be performed more frequently if headers seize between inspections. While disassembled, inspect slip joints for wear or galling.

6.6.8 Ensure Placard is visible to pilot that states "The Power Flow Systems, Inc. tuned exhaust system installed on this aircraft may cause the aircraft to burn more fuel at certain power settings. It is the Pilot's responsibility to determine what, if any, change in fuel flow exists and to plan accordingly.

If any defects (cracks, burns, etc.) 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:

6.6.9 Remove exhaust pipes and heat exchanger assembly.

6.6.10 Remove shrouds.

6.6.11 Seal openings with expansion rubber plugs.

6.6.12 Submerge the collector assembly in water.

6.6.13 Using a manometer or pressure gauge, apply 3.0 to 3.5 PSI (approximately 7" Hg) of air pressure.

6.6.14 Let the unit sit pressurized for 10 to 30 seconds. The leak rate should be zero.

6.6.15 If a leak is found in the collector assembly, replace or repair before further flight.

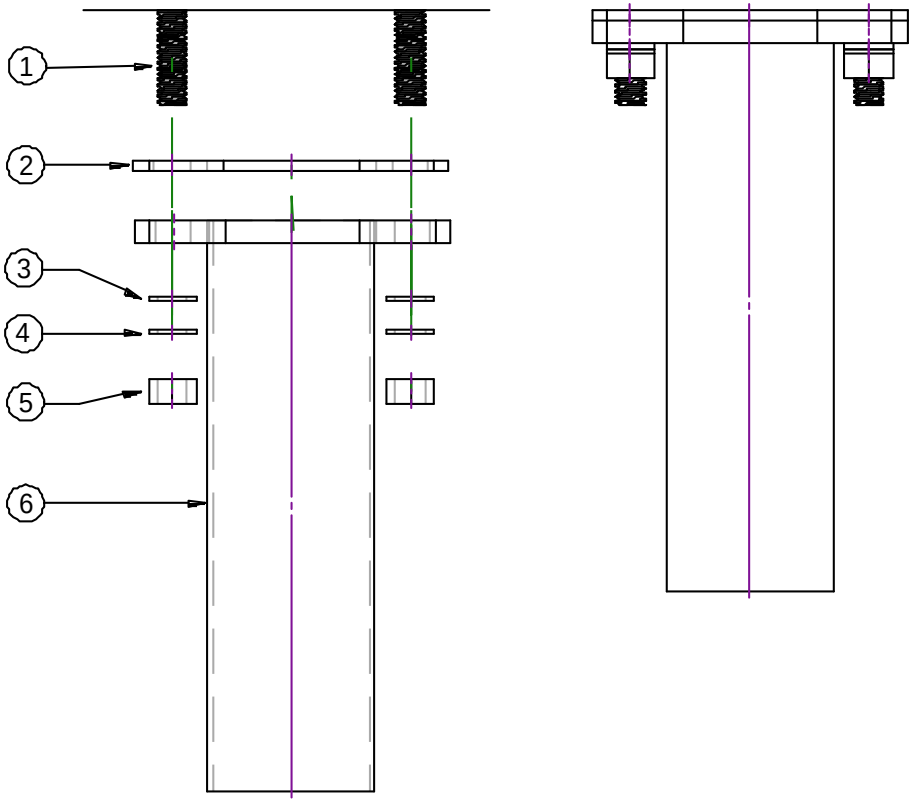
6.6.16 If no leaks are found, dry components and install on airplane.

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.

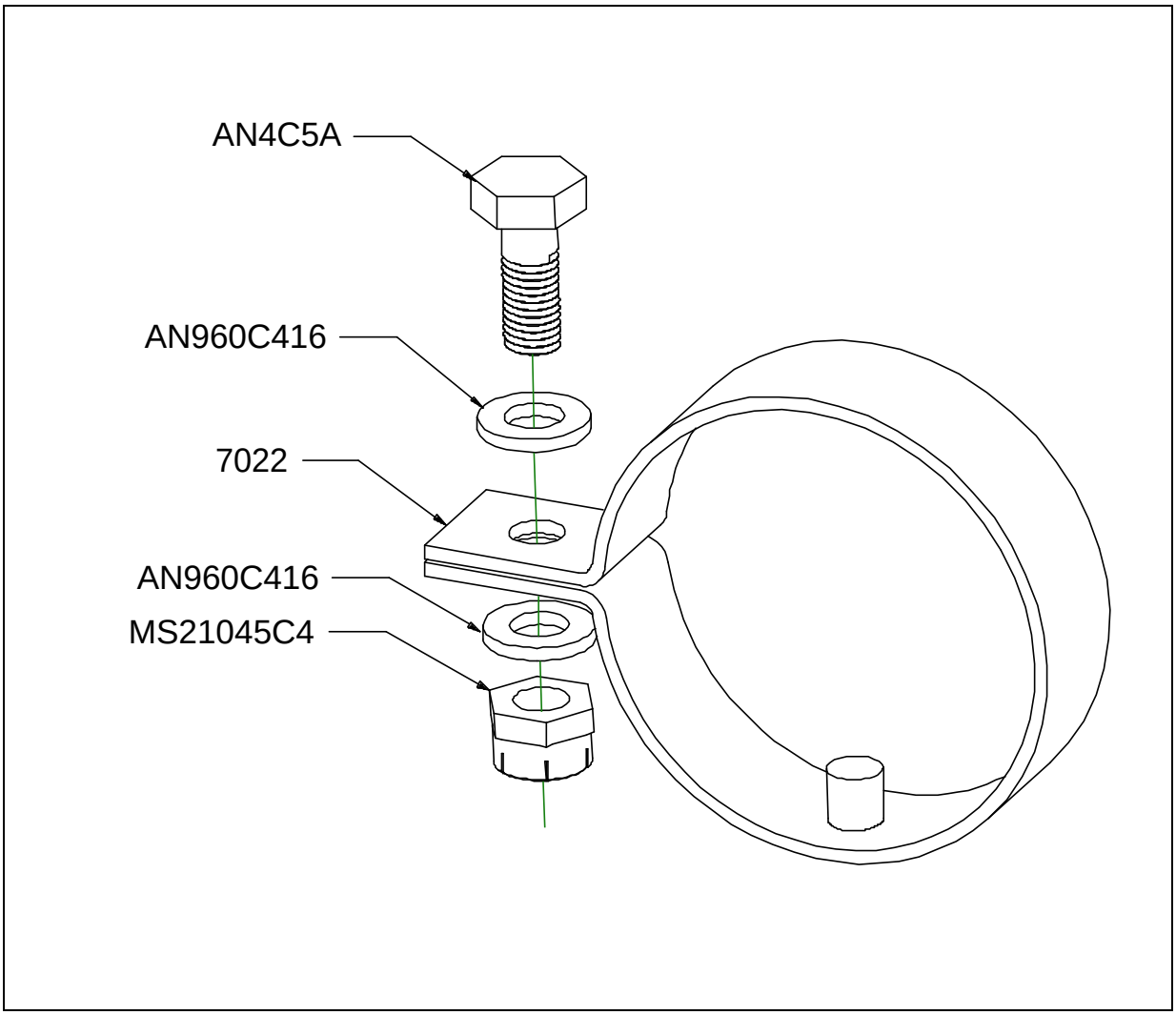
DETAIL A

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 Supplied.

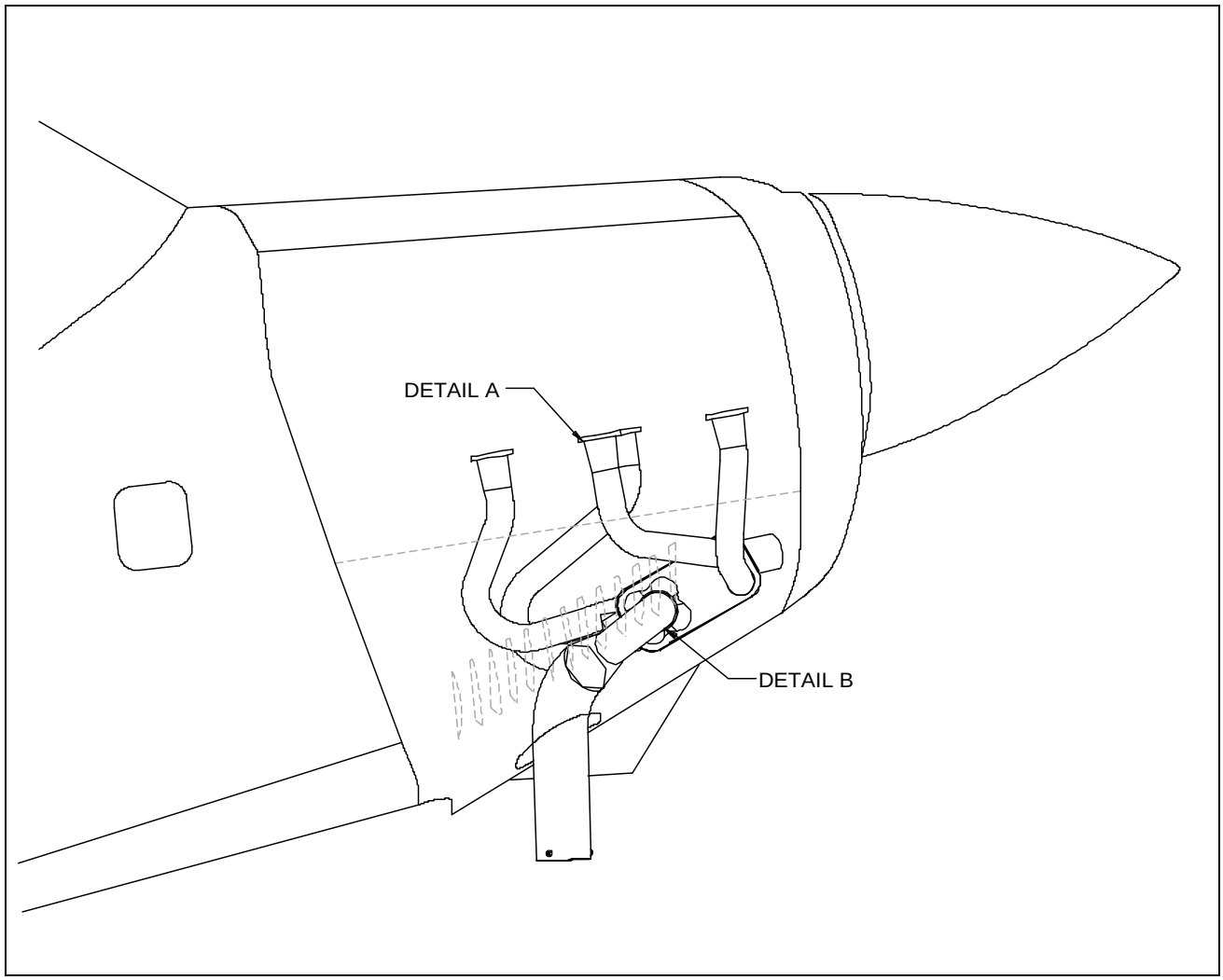


DETAIL B

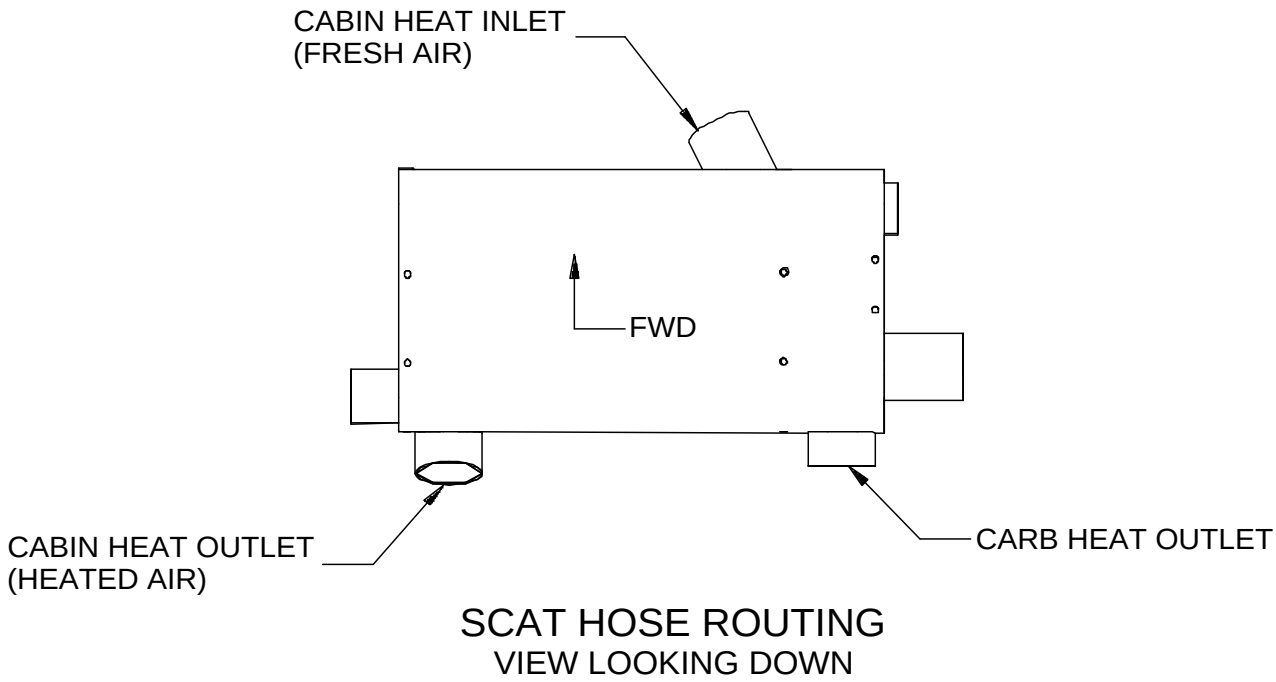


Equivalent Hardware may be supplied.

INSTALLATION OVERVIEW

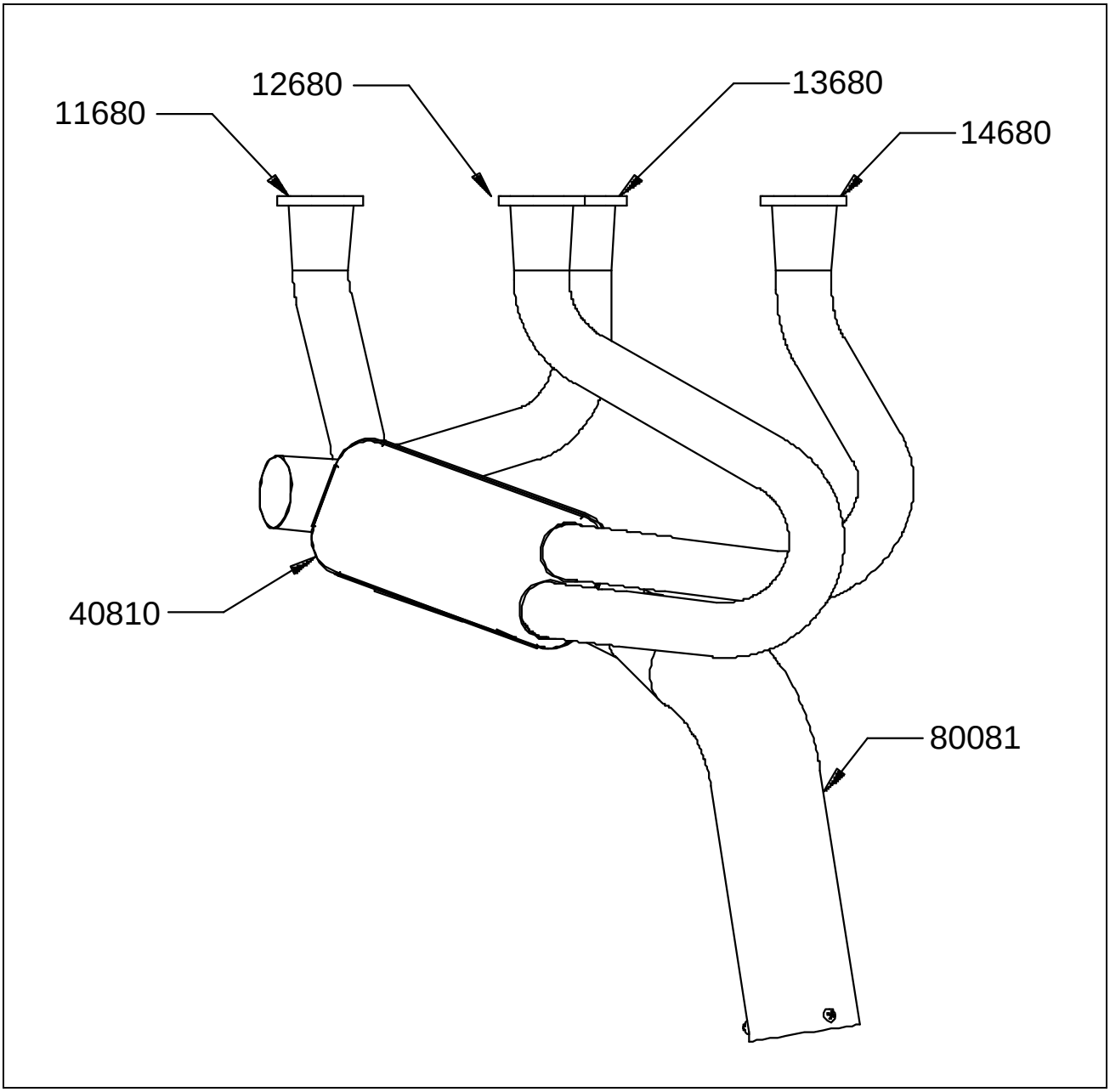


SCAT HOSE ROUTING

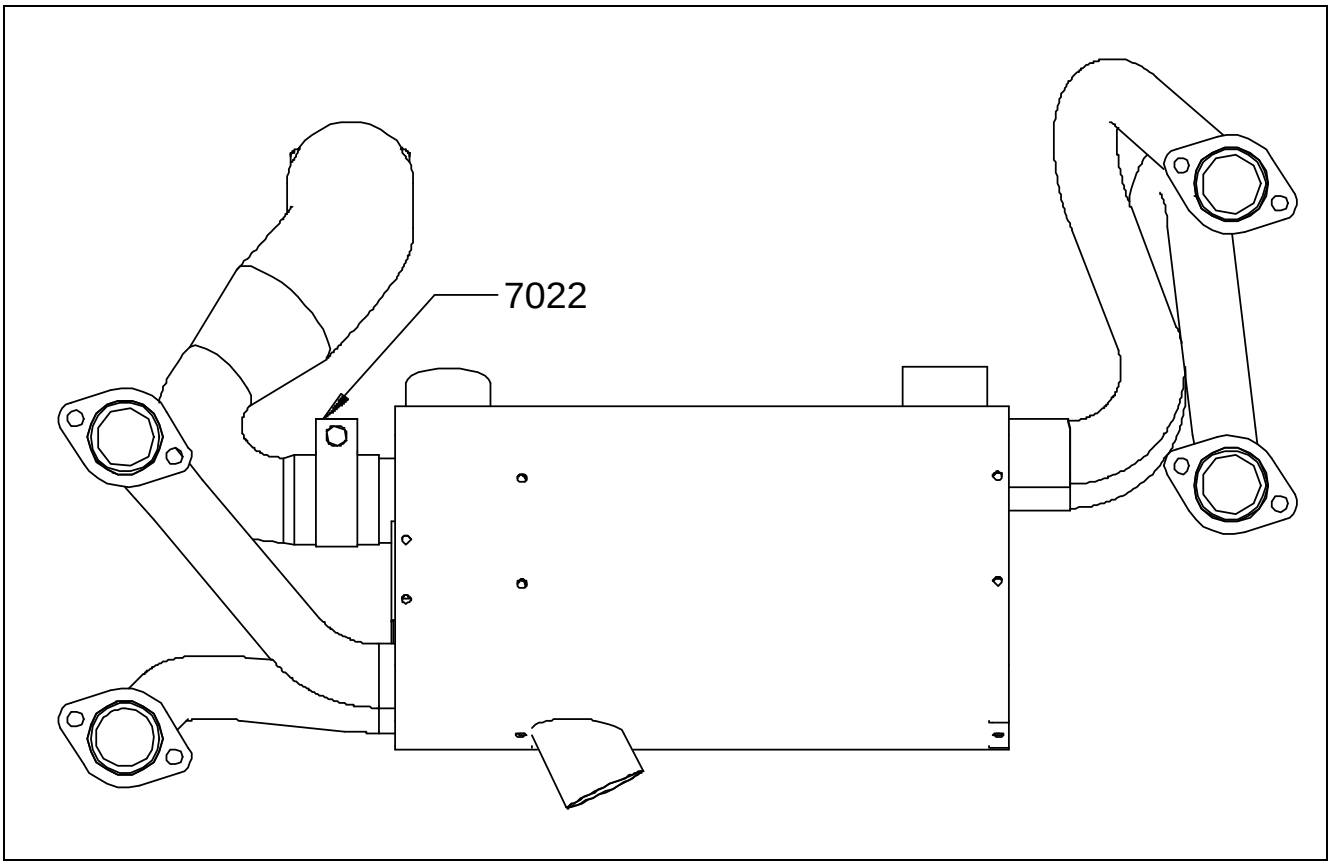


SCAT HOSE ROUTING
VIEW LOOKING DOWN

LEFT SIDE VIEW



TOP VIEW



United States of America

Department of Transportation -- Federal Aviation Administration

Supplemental Type Certificate

Number SA03858AT

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

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

certifies that the change in the type design for the following product with the limitations and conditions thereof as specified hereon meets the airworthiness requirements of Part 23 of the Regulations.

Original Product - Type Certificate Number: A22NM

Make: Sky International

Model: A-1, A-1A, A-1B, A-1C-180

Description of Type Design Change: Installation of Power Flow Systems, Inc. (PFS) tuned exhaust system drawing PFS-18101, rev IR dated 10/14/2009 or later FAA approved revisions. Installed per Power Flow Systems, Inc. drawing 118101, rev IR, dated 10/14/2009 or later FAA approved revisions and Tuned Exhaust System Installation Instructions and Instructions for Continued Airworthiness, PFS-18150-00, rev A, dated 4/6/2010 or later FAA approved revisions.

Limitations and Conditions: Instructions for Continued Airworthiness contained in Tuned Exhaust System Installation Instructions and Instructions for Continued Airworthiness, PFS-18150-00, rev A, dated 4/6/2010 or later FAA approved revisions must be made available to the operator at the time of installation. Airplane Flight Manual Supplement AFMS-18101, Revision IR, dated June 21, 2010, or later FAA approved revision, is a required part of this STC.

(See continuation sheet 3 of 3)

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: February 16, 2010

Date of issuance: June 21, 2010

Date reissued:

Date amended: December 01, 2010

By direction of the Administrator

(Signature)

Melvin 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.

This certificate may be transferred in accordance with FAR 21.47.

Supplemental Type Certificate

Number SA03858AT

Date of Issuance: June 21, 2010
Date Amended: December 01, 2010

Limitations and Conditions (Continued):

The engine performance effects of this STC were evaluated and were found to be within the limitations of the engine, propeller and aircraft Type Certificates. Any additional modifications that contribute to HP increases could adversely affect the aircraft, engine or propeller airworthiness. 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.

Certification Basis:

Based on 14CFR §§ 21.115 and 21.101, this STC modification to the type design is considered not to be a major or significant change.

Original Certification Basis: Based on 14CFR §§ 23 effective February 1, 1965 as amended by 23-1 through 23-31, 14CFR §§ 36 through 36-28 and 14CFR §§ 21 through 21-57.

Regulations Addressed: At current amendment: 23.21, 23.65, 23.609, 23.907, 23.1101, 23.1105, 23.1123, 23.1152, G36.

Regulations at an intermediate amendment: At amendment 23-7: 23.611, 23.1041, 23.1091(2), (3); At amendment 23-10: 23.1; At amendment 23-14: 23.1017(2); At amendment 23-17: 23.607; At amendment 23-18: 23.1121; At amendment 23-20: 23.1301 At amendment 23-21: 23.51, 23.1043, 23.1047; At 23-23 amendment: 23.603, 23.605, 23.863; At amendment 23-29: 23.901, 23.1093 (a)(1); At amendment 36-14: 36.3; At amendment 36-15: 36.1501; At amendment 36-19: 36.9, 36.501(a)(1).

END