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PREPARED BY: Tom Strohmayer

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Date: 1/17/03  By: [Signature]

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DATE: 12/13/02

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DATE: 12/13/02

F.A.A.
APPROVED

By: [Signature]
Date: 1/17/03

ATLANTA AIRCRAFT CERTIFICATION
OFFICE CENTRAL REGION
### REVISION CONTROL

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Introduction

Your exhaust muffler has been chemically polished to remove manufacturing marks and provide an attractive finish. The tubular components are manufactured from 321 Stainless Steel and can be further polished for an extremely high shine.

After installation and before running engine, we highly recommend wiping clean the exhaust muffler to remove all finger-prints, grease, and other contaminants with Alcohol, MEK, Lacquer thinner, or similar liquid degreaser.

After installation and cleaning exhaust muffler, run engine and let it warm up then run at full power for a short period. This will create a “Bluing” of the exhaust and a golden yellow color of the muffler.

To maintain this “Blued” finish keep exhaust free from oil, fingerprints, and any other contaminates by normal cleaning or polishing.

Carbon Monoxide testing was performed with the muffler positioned as described in these instructions. Repositioning the muffler and/or support rod may cause carbon monoxide to enter the aircraft cabin.

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 forward 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 of the collector assembly furnishes heated air for carburetor heat. A detachable tailpipe from the collector assembly routes exhaust gases to a muffler through an opening in the lower cowling. A support rod attached to the lower right engine mount supports the muffler.

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

Please read these directions 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.

Weight and Balance Information

- Typical Weight and Balance Information: The Power Flow Systems, Inc. tuned exhaust weighs between 1.0 pounds less and 2.0 pounds more than the stock exhaust system at station 28. Since the weight of stock exhaust systems can vary, it is recommended that you weigh both the old exhaust system and the new exhaust system to obtain an exact weight differential.
Kit Contents

Each Power Flow exhaust kit is shipped with:

<table>
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<th>PN Description</th>
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<tr>
<td>4 Headers</td>
<td>PN: 11100, 12100, 13100, 14100</td>
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<td>8 Exhaust Nut</td>
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<tr>
<td>8 Lock Washer</td>
<td>PN: MS35333-41</td>
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<tr>
<td>8 Plain Washer</td>
<td>PN: AN960-516</td>
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<tr>
<td>1 Support Rod</td>
<td>PN: 90140</td>
</tr>
<tr>
<td>1 Adel Clamp size 6</td>
<td>PN: MS21919WH6</td>
</tr>
<tr>
<td>1 Adel Clamp size 12</td>
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<td>1 Bolt</td>
<td>PN: MS51958-63</td>
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<tr>
<td>2 Flat Washer</td>
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<td>1 Muffler Clamp</td>
<td>PN: 8030</td>
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<td>1 Shrouded Collector Assembly</td>
<td>PN: 41140(S)</td>
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<tr>
<td>2 1”X44” Scat Tubing (Defroster)</td>
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<td>1 2”X26” Scat Tubing (Cabin Heat)</td>
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<td>12 Clip Nuts</td>
<td>PN: BACN10FX83</td>
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<td>12 Countersunk Washer</td>
<td>PN: DW08SS</td>
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<td>1 ¼-20 Bolt</td>
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<tr>
<td>1 ¼ Washer</td>
<td>PN: 1/420WW</td>
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NOTE: Your kit may be shipped with either an aluminum or stainless steel heat shroud. PN 41140S indicates stainless steel.
PREPARATION

REMOVAL OF OLD EXHAUST SYSTEM

1) Remove lower cowl components in accordance with the latest approved revision of the Aircraft Service Manual.
2) Disconnect Landing light wiring and remove landing light assembly and air filter.
3) Disconnect flexible ducts from muffler assembly and exhaust pipe.
4) Remove EGT probe(s) if installed.
5) Remove nuts, bolts, and clamps attaching exhaust pipes to muffler assembly.
6) Loosen nuts attaching exhaust pipes to cylinders and remove muffler assembly.
7) Remove exhaust pipes and gaskets.
8) Cover carb inlet to prevent debris from entering the carburetor.

OIL LINE MODIFICATIONS
(Do not replace 45° fittings if present)

1) Remove the oil feed and return lines from the oil cooler at the front left of the engine.
2) Plug ends of lines to prevent oil loss and spillage.
3) Install the AN823-8D fittings into the oil cooler.

MODIFYING SHROUDED COLLECTOR ASSEMBLY (P/N: 41140(S))
(This section applies only if the airplane has 2 defroster outlets.)
(See “Rear View” for location and details.)

A.) Aluminum Heat Shrouds (PN 41140)
1) Cut a 1” circle in the shroud, just above the flange, inboard of the 3” cabin heat inlet (see picture).
2) Drill three holes through the 1” flange and the heat shroud, being careful not to damage the tubes underneath.
3) Secure using the supplied rivets.

B.) Stainless Steel Heat Shrouds (PN 41140S)
1) If the aircraft only has one defroster vent, cap the secondary outlet using a non-flammable material and a stainless steel hose clamp.
INSTALLATION

A. Installing Collector Box assembly and Exhaust pipes:

1) Unscrew and remove the end piece from the shroud assembly (the part with the Identification tag on it). Insert the #1 & #3 exhaust header pipes into the collector assembly. Be sure to use the alignment marks. A minimum of 1 1/2” penetration is required for proper operation. Re-secure the shroud end piece onto the collector unit. See Passenger Side View.

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” and Passenger Side View.

3) Insert the #2 & #4 exhaust header pipes into the collector assembly. Ensure that the #2 & #4 exhaust headers do not rub where they bend before entering the collector box. You can maneuver the headers to have a minimum .25” clearance between #2 & #4. Be sure to use the alignment marks. A minimum of 1 1/2” penetration is required for proper operation. See Pilot Side View.

4) Install a washer, a lock washer and a nut on each stud (there are 8 sets of these). Torque I.A.W. the latest FAA approved revisions of either AC43.13 or manufacturer’s service manual. If utilized, remove the loops of safety wire or cotter pins. See Detail “A” and Pilot Side View.

5) The correct angle of the PFS collector box is for the outlet tube to be oriented towards the tail at approximately 15 degrees. You can rotate the box by grasping the outlet and rotating. The exhaust headers have a slip fit, which allows for this. See Side Views.

6) Screw the oil lines to the AN823-8D fittings. Torque I.A.W. the latest FAA approved revisions of either AC43.13 or manufacturer’s service manual.

7) Adjust, tighten and secure as necessary both oil lines. Adjust, tighten and secure so that the lines DO NOT CONTACT the exhaust headers or collector box. A minimum of 2” clearance is required. Reattach and secure the Adel clamps on the oil lines.
NOTE: Re-clamping of the oil lines to the bottom screw on the pilot side of the collector box may be needed to prevent chafing of the lines against the collector box. This is done with the supplied #14 Adel clamp. If the lines are too short, they may need replacement with new assemblies (These are not supplied with the kit.)

NOTE: If the fuel lines are less than 2” from any header pipe, they must be re-located with a combination of fittings and clamps or a replacement of the fuel lines. (These are not supplied with the kit.)

B. Installing Support Rod P/N 90140:

1) Examine the right lower engine mount bolt and nut. If you have one to two threads showing at the nut, it may be necessary to install the next dash number longer bolt after installing our support rod adapter. See Detail “D”.

   a) Loosen and remove the lower right engine Lord mount bolt. Our support rod adapter (the teardrop shaped piece of metal welded to the support rod) goes under the bolt head, on top of the existing large area washer. Ensure that the rod clears all engine compartment parts, and will exit the cowl near the firewall, inboard of the engine mount and directly behind the exhaust pipe exiting the collector assembly. Also make sure that the pointed end of the support rod will clear the bottom of the aircraft cowl. See Detail “D”.

   b) Tighten, but DO NOT TORQUE TO VALUE YET. You will fully torque the mount once the position and adjustment of the support rod is complete.

2) Slide the muffler assembly, P/N 80140, over the collector outlet. It should be pushed up as far it can go, oriented straight back. The support rod should be contacting the unit at the muffler.

3) Position the large support clamp, P/N 8030, around the muffler so that the holes in the clamp will align with the hole in the support rod. See Detail “C”.

Any deviation in muffler and/or support rod alignment may cause carbon monoxide to enter the aircraft cabin. The muffler must be pointed down and away from the aircraft—not parallel to the fuselage—in order to ensure that no exhaust gases enter the aircraft cabin.
If your airplane has a nose wheel pant, turn the nose gear fully to the left and ensure that the muffler assembly does NOT strike the pant. If needed, rotate the muffler outward. The support rod can be carefully bent to assist in assuring that the support rod and muffler clamp stay in alignment. If the end tab does not align flat against the clamp, twist the tab with pliers until it lays flat.

4) Secure the support rod to the engine tubular mount with supplied ADEL clamps. Position the smaller clamp approximately 2/3 of the way down the support rod. Position the larger ADEL clamp around the engine tubular mount that comes closest to the support rod. The objective here is not to change the angle of the support rod, but just to help dampen any lateral motion that can occur. Secure the ADEL clamps with the supplied hardware. Remove the muffler.

5) Now that all of the support mechanism for the muffler is correct, tighten the engine mount to manufacturer’s specified torque.
   a) Be sure that the support rod doesn’t rotate when tightening

   **CAUTION**
   - 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.

C) Modifying Lower Cowl:
1) Stand the cowl on its rear edge, on a padded flat surface, and secure it to prevent it from falling.
   a) Securely tape the template labeled “Exhaust hole template” on the rear of the cowl, lining up the holes as indicated. These holes are from the passenger edge of the cowl.

   ![Exhaust hole template]

   b) Cut out the hole as indicated using a jigsaw, cutting wheel, or snips.

2) The exhaust will exit the cowl on the right side. Temporarily install the lower cowl and check for correct positioning of the exhaust outlet. It should come through the hole in the cowl without touching the sides of the cowl.
Check that the outlet of the collector fits through the forward hole with a minimum .25” clearance on all sides. If it does not, trim as needed

- You can rotate the collector by gripping the outlet of the collector and rotating the entire collector to orient it in the cowl. The desired angle is approximately 15 degrees from the vertical.
- Remove the cowl.

D) Installing the Muffler:

1) Position the muffler so that it will be in the correct position for clamping to the support rod. Using the hole in the Muffler Assembly as a guide, drill a 9/32”, 17/64”, “F”, or 6.8mm to 7.2mm hole through the collector outlet so that the exhaust clamp P/N 7020 holds the upper portion of the muffler assembly onto the collector outlet. The fit of the pin into the hole should not be tight. See Detail “B”.

**NOTE**

The muffler and clamp are designed to be a loose fit to the 4 to 1 outlet.

2) With the large clamp free from the support rod, the lower end of the muffler assembly should be able to ‘wobble' 1/2” to 1 1/2” from side to side.

3) Remove muffler assembly to re-install the cowl.

**MODIFICATION OF COWL**

**NOTE:** READ INSTRUCTIONS FULLY BEFORE PROCEEDING WITH THIS SECTION. CAUTION: WHEN DRILLING OR CUTTING FIBERGLASS, EXCESSIVE PRESSURE MAY CAUSE DE-LAMINATION.

A. Modifying Front (or Nose) Cowl:

1) Cover the carb air intake to ensure that no debris enters this area.

2) Using the provided template, cut through the cowl around the existing filter bowl, without damaging the filter bowl.

3) Set the new filter bowl assembly (PN: 60028) into the cowl. This piece may be moved up to provide the greatest collector clearance and best fit to the cowl contour. Ensure that the new filter bowl is aligned to the cowl vertical centerline.

4) When the desired position is attained, mark the outline of the new assembly with a felt tipped pen.
NOTE: Ensure that Main Power and Mags are off, remove the keys and swing the prop across the front of the filter bowl assembly. There should be ½” minimum of clearance when the bowl is properly positioned.

5) Remove the filter bowl assembly and measure and draw lines ½” and 1” inside the contour line. The 1” line is for the final cutting of the hole, and the ½” line is for the screw hole centers.

6) Tape the new filter bowl securely to the cowl.

*When performing the following steps, heat may be applied to re-shape the assembly for best fit. If heat is applied, do so cautiously, as not to burn the materials.*

7) Drill an 1/8” (#30) hole through one of the pilot holes on the new filter bowl, ensuring that both the filter bowl and cowl are pierced.

8) Secure with a Cleco.

9) Repeat, in order, with the other holes, drilling and securing with Clecos. Ensure that the holes are on the ½” line.

10) Remove Clecos and filter bowl.

11) Step up the holes to 3/16” (.190”) on both the cowl and the filter bowl.

12) Attach supplied clip-nuts (PN: BACN10FX83) to the rear face of the cowl. See Detail “E”.

13) Route the landing light wiring through the grommet in the air-box.

14) See Detail “F”. Using the supplied 3.5” bolt and washer, attach the air filter and landing light to the filter bowl. The landing light assembly bolt should be tight enough to ensure that the landing light assembly cannot move more than in the original air filter assembly installation. Some deflection of the fiberglass may occur when tightening the bolt. **CAUTION: Excessive tightening of the bolt may crack the fiberglass.**

15) Attach the supplied carb fresh air SCAT tube to the new nose bowl outlet.
16) See Detail “E”. Attach the filter bowl to the cowl using the supplied screws (PN: MS24693C51) and countersunk washers (PN: DW08SS). The screws should be tightened enough to ensure that the assembly is conforming to the cowl contours and cannot be moved. **CAUTION: Excessive tightening of the screws may crack the fiberglass.**

17) After removing the carb inlet covering, attach the carb fresh air SCAT tube to the carb inlet.

18) Attach the remaining supplied SCAT tubes as replacements for the original parts.

19) Re-install the cowl IAW the latest approved version of the Aircraft Service Manual.

20) If removed, re-install the propeller IAW the latest approved version of the Aircraft Service Manual.

**MUFFLER INSTALLATION**

1) Re-install the muffler. Secure the exhaust clamp [see notes below] with the pin (p/n 7020) using a supplied AN4C5, washers, nut and cotter pin. We suggest positioning the bolt head on the inboard side of the clamp with the nut on the outboard side (for ease of cotter pin installation and removal.) The fit of the pin into the hole should not be tight. **See Detail “B”.**

**NOTE**

The muffler and clamp are designed to be a loose fit to the 4 to 1 outlet

2) With the large clamp free from the support rod, the lower end of the muffler assembly should be able to 'wobble' 1/2" to 1 1/2" from side to side.

This movement de-couples the vibrations from the upper part of the exhaust system from the vibrations of the lower part of the system. See Detail “B”.

3) After verifying that the end of the muffler is free to “wobble” ½ to 1 ½ inches from side to side, attach the muffler assembly to support rod with muffler clamp P/N 8030. **See Detail “C”.** We suggest positioning the bolt head on the inboard side of the clamp with the nut on the outboard side (for ease of cotter pin installation and removal.)

4) Secure the clamp using a supplied AN4C5, washers, nut and cotter pin. **DO NOT SEPARATE EITHER SIDE OF THE CLAMP WITH THE SUPPORT ROD.**

The clamp ends must come together to correctly work. The support rod should be on whichever side of the clamp that seems to fit best.

The support rod should not be under any side-load at this point.

Any deviation in muffler and/or support rod alignment may cause carbon monoxide to enter the aircraft cabin. The muffler must be pointed down and away from the aircraft—not parallel to the fuselage—in order to ensure that no exhaust gases enter the aircraft cabin.

Please Note:

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.
Make appropriate entries in the logbook and on an FAA Form 337. The STC is located at the back of this instruction set for easy removal.

- Typical Weight and Balance Information: The Power Flow Systems, Inc. tuned exhaust weights between 1.0 pounds less and 2.0 pounds more than the stock exhaust system at station 28. Since the weight of stock exhaust systems can vary, it is recommended that you weigh both the old exhaust system and the new exhaust system to obtain an exact weight differential.

**REMOVAL OF PFS EXHAUST SYSTEM**

A) Disconnect muffler support rod P/N 90140 from muffler clamp P/N 8030.
B) Disconnect exhaust clamp P/N 7020 and remove muffler assembly P/N 80140 from collector assembly.
C) Remove lower cowl as per the latest approved Aircraft Service Manual.
D) Disconnect flexible ducts from collector assembly.
E) Remove EGT probes if installed.
F) Remove exhaust pipes from cylinders 2 & 4 and separate them from the collector assembly.
G) Remove the collector assembly by pulling out from the 1 & 3 cylinder side.

**INSPECTION**

See accompanying report, PFS-0006-00 for Instructions for Continued Airworthiness.
This STC is not valid without a letter of authorization for a specific aircraft registration number from Power Flow Systems, Inc.

United States of America
Department of Transportation -- Federal Aviation Administration

Supplemental Type Certificate

Number SA02168AT

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

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

Original Product-Type Certificate Number: 2A13
Make: Piper
Model: PA-28-140, -180, -181

Description of Type Design Change:
Modification of engine exhaust system for improved engine performance by installation of a Laminar Flow System Extractor

Limitations and Conditions:
Airplane Flight Manual Supplement is not required for this STC. 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: May 20, 1999
Date of issuance: August 08, 2000

By direction of the Administrator

Melvin D. Taylor
Manager
Atlanta Aircraft Certification Office

Punishable by a fine not exceeding $1,000, or imprisonment not exceeding 3 years, or both.
Note: Kits using stainless steel shrouds do not require the addition of the second defroster vent shown above; however, if the aircraft only requires a single defroster outlet, the second outlet on the stainless shrouds must be capped using a non-flammable material and a stainless steel hose clamp.
Detail "A"

1. Exhaust Stud
2. No-Blow Gasket
3. Flat Washer
4. Lock Washer
5. Nut
6. Header

Lycoming Engine

- 77611
- AN960-516
- MS35333-41
- SL-STD-1410
- Various
NOTE:
The muffler and clamp are designed to be a loose fit to the 4 to 1 outlet. With the large clamp free from the support rod, the lower end of the muffler assembly should be able to ‘wobble’ 1/2” to 1 1/2” from side to side.

CAUTION
The muffler to 4-1 junction is designed to be loose.

NOTE:
The pin should NOT be a tight fit. The holes in the Muffler and the 4-to-1 Collector should be drilled with a size 17/64", 6.8 to 7.2mm, "F", or 9/32" drill bit.
Detail "C"

NOTE:
The tab should sit flat against the side of the clamp. If necessary, twist the end tab with pliers to get the proper alignment.

CAUTION
Overtightening the nut and bolt assembly WILL result in damage to the clamp.

NOTE:
The muffler is designed to be a loose fit to the 4 to 1 outlet.
With this clamp free from the support rod, the lower end of the muffler assembly should be able to 'wobble' at least 1/2" to 1 1/2" from side to side.
Detail "D"

1. Engine to Mount Bolt
2. Flat Washer
3. Support Rod
4. Shock Absorber
5. Locking Nut

Original June 7, 2000
Detail "E"

This detail shows the installation of these assemblies (total of 12)

Revision A October 04, 2000