

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

REPORT NAME: CESSNA 177, A, B
KIT NUMBER PFS-13704, PFS-13705
INSTALLATION INSTRUCTIONS AND
INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

REPORT NUMBER: PFS-13751-00

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PREPARED BY: T. Strohmayer

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END USER

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Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

TABLE of CONTENTS

<u>Section</u>	<u>Pages</u>
Introduction	3
Kit Contents	4
Kit Contents (Internal Tailpipes)	5
Preparation	6
Removal of old exhaust system	6
Installation	6
Installing Collector Box Assembly and Exhaust Assembly	6
Installing Support Rod	7
Installing Exhaust Extension and Muffler	8
Installing Internal Tailpipe	8
Instructions for Continued Airworthiness	10
Installation Overview (PFS-13704, External Tailpipe)	13
Installation Overview (Internal Tailpipe)	14
Passenger Side View (PFS-13704, External Tailpipe)	15
Passenger Side View (Internal Tailpipe)	16
Pilot Side View (PFS-13704)	17
Pilot Side View (PFS-13705)	18
Rear View (PFS-13704)	19
Detail "A"	20
Detail "B"	21
Detail "C"	22
Detail "D"	23
STC	24

Introduction

NOTE:

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.

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 to be heated by exhaust gases passing through the tubes of the collector assembly. 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 (kits with external tailpipes only).

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.

Note: PFS is the abbreviation for Power Flow Systems.

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.

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.

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

Kit Contents

External Tailpipe Contents Shown

Quantity	Part Description	Cessna 177, 177A	Cessna 177B
1	#1 Header	11600	Same
1	#2 Header	12600**	Same
1	#3 Header	13600	Same
1	#4 Header	14600**	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
1	Shrouded Collector Assembly	41780	Same
<i>1</i>	<i>Exhaust Extension Assembly</i>	<i>78102</i>	<i>Same</i>
<i>2</i>	<i>Exhaust Clamp (2" with pin)</i>	<i>7020</i>	<i>Same</i>
<i>3</i>	<i>Drilled Bolt</i>	<i>AN4C5*</i>	<i>Same</i>
<i>3</i>	<i>Castle Nut</i>	<i>AN310C4*</i>	<i>Same</i>
<i>3</i>	<i>Cotter Pin</i>	<i>MS24665-153*</i>	<i>Same</i>
<i>6</i>	<i>Flat Washer</i>	<i>AN960C416*</i>	<i>Same</i>
<i>1</i>	<i>Adel Clamp size 6</i>	<i>MS21919WH6*</i>	<i>Same</i>
<i>1</i>	<i>Adel Clamp size 12</i>	<i>MS21919WH12*</i>	<i>Same</i>
<i>1</i>	<i>Locknut</i>	<i>MS21044C3*</i>	<i>Same</i>
<i>1</i>	<i>Bolt</i>	<i>MS51958-63*</i>	<i>Same</i>
<i>2</i>	<i>Flat Washer</i>	<i>AN960C10</i>	<i>Same</i>
<i>1</i>	<i>Muffler Assembly</i>	<i>80177</i>	<i>Same</i>
<i>1</i>	<i>Support Rod</i>	<i>90030</i>	<i>90077</i>
<i>1</i>	<i>Muffler Clamp (3 1/2" without pin)</i>	<i>8030</i>	<i>Same</i>
1	3" Flange	N/A	6520***
A/R	3/32 Blind Rivets	N/A	AD32ABS***
2	Hose Clamps	N/A	QS200M40H***
16"	SCAT Tubing	N/A	SCAT-12***
1	45 Degree Fuel Fitting	AN915-D1	Same

*Please note that equivalent hardware may be supplied.

**Aircraft with O320 Engines will receive 12600-1 and 14600-1 headers.

***Optional, for installation on forward baffle to attach SCAT tube to the cabin heat inlet (1975 & later model years).

Part numbers in italics are for external tailpipes only, see next page for internal tailpipe components.

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

Kit Contents

Kits Shipped with Internal Tailpipes receive these components in place of those in italics above

Quantity	Part Description	Cessna 177, 177A, 177B
1	Internal Tailpipe Assembly	80011
1	Exhaust Clamp (2" with pin)	7020
1	Drilled Bolt	AN4C5*
1	Castle Nut	AN310C4*
1	Cotter Pin	MS24665-153*
2	Flat Washer	AN960C416*

*Please note that equivalent hardware may be supplied.

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 flexible ducts from muffler assembly.
- 3) Remove EGT probe(s), if installed.
- 4) Cover carb heat inlet to prevent debris from entering the carburetor.
- 5) Remove nuts attaching exhaust pipes to exhaust studs.
- 6) Remove exhaust pipes and exhaust gaskets.

INSTALLATION

NOTE: Our Carburetor heat adapter is designed to accept 2 common sizes of SCAT hose. If your hose is large (2.5" diameter), cut off and deburr the reducer portion of the adapter.

A. Installing Collector Box assembly and Exhaust pipes:

- 1) Insert the number 1 and number 3 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", Passenger and Pilot Side Views.
- 2) Insert the number 2 and number 4 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.
- 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. Torque I.A.W. the latest approved revision of the aircraft or engine service manual. See Detail "A" and Pilot Side View.
- 4) Slide the exhaust extension PN: 78102 (external tailpipes) or tailpipe PN: 80011 (internal tailpipes) onto the end of the 4-to-1 collector. DO NOT drill for clamp installation, yet.
- 5) Install flexible tubing to shroud connections. The cabin heat outlet is on the aft-pilot side of the shroud and the carb heat outlet is on the passenger side of the shroud PN 41780. On the Cessna 177B aircraft it may be necessary to attach the 6520 flange to the front baffle with rivets. Put the flange through the air inlet hole from the front of the aircraft to create an attachment for the SCAT tube and rivet in place. The supplied SCAT tube for the fresh air inlet should be trimmed as short as possible and oveled if necessary for clearance to the landing light tunnel.
- 6) A minimum of 2" is required between any exhaust pipe and any fuel or oil line. Use the supplied fuel fitting if necessary to obtain proper clearances.

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

B. Installing Support Rod P/N 90030 or 90077 (Skip this section for internal tailpipes):

- 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 remove the large area washer from the aft side of the mount (the support rod tab is the same thickness as this washer). 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. This large area washer may be omitted if the bolt is too short. See Detail “D”. Ensure that the rod clears all engine compartment parts. The support rod will exit the cowl on the right side, through the bottom cowl air outlet.
 - b) Temporarily install the lower cowl and check for correct positioning of the support rod. You should also verify that the support rod will not interfere with the muffler assembly, the cowling or the cowl flaps (if installed). Check that the outlet of the collector fits through the forward (cowling) hole (where the old exhaust exited) with a minimum .25” clearance on all sides.

NOTE: If you have an exhaust fairing installed, ensure that the exhaust does not interfere with it. If so, move the fairing to accommodate the PFS exhaust system. Remove the lower cowl.
 - c) Tighten the Lord mount bolt, but **DO NOT TORQUE TO VALUE YET**. You will fully torque the mount once the position and adjustment of the support rod is complete.
 - d) 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.

Note: MODIFYING THIS SUPPORT ROD OR FABRICATING ADDITIONAL SUPPORT MAY CAUSE PARTS TO FAIL AND WILL VOID YOUR WARRANTY.

- 2) Slide the muffler assembly, P/N 80177, over the exhaust extension outlet. It should be pushed up as far it can go, oriented straight back. The support rod should be contacting the muffler. You may have to make minor adjustments in alignment and rotation of both the muffler assembly and the exhaust extension assembly.

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.

- 3) Position the large support clamp, P/N 8030, around the muffler so that it will attach to the support rod with a bolt.
- 4) If a nose pant is installed, 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.

Warning: Fuel strainer outlet must be redirected so that it does not spray fuel on tailpipe during fuel strainer drain operation.

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

C. Installing Exhaust Extension and Muffler (Skip this section for internal tailpipes)

- 1) Install the large clamp (without the pin) so that the holes will align with the hole in the support rod. See Detail "C".
- 2) Drill a 0.25" hole through the pilot hole in the muffler through the exhaust extension. If your muffler does not have a pilot hole, drill on the outboard side 1.0" from the top of the flare.
- 3) Remove the muffler.
- 4) Remove the lower cowl.
- 5) Reattach the muffler and temporarily install the large clamp.
- 6) Drill a 0.25" hole through the flared end of the exhaust extension, about one inch from the end of the flare. Drill through the exhaust extension and the 4 to 1 collector. Be sure to de-burr all the holes or later removal of muffler components will be difficult.
- 7) Clamp the exhaust extension to the 4 to 1 using one of the provided 2" clamps (PN 7020). See Detail "B". The pin should insert with minimal force. If any binding exists, the hole may need further reaming.
- 8) Remove the muffler and re-install the lower cowl. Install the muffler assembly and clamp to the exhaust extension with the other 2" clamp. See Detail "B". Again, if the pin is a tight fit, further reaming of the hole may be necessary.
- 9) Clamp the muffler assembly to the support rod with the provided 3.5" clamp. See Detail "C".
- 10) Now that all of the support mechanism for the muffler is correct, tighten the engine mount to manufacturer's specified torque. *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.

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.

D. Installing Internal Style Tailpipe (Skip this section for External Tailpipes)

- 1) Install the lower cowl with enough fasteners to obtain the correct cowl angle.
- 2) Rotate the tailpipe about the axis of the slip fit to obtain maximum clearance to the outlet hole in the cowl.
- 3) If insufficient outboard clearance (less than 0.5") exists, up to 0.5" may be trimmed from the end of the 4-1 outlet and the slip-fit end of the tailpipe. This would allow the tailpipe to be positioned up to 0.5" further inboard.
- 4) Once the proper tailpipe angle is obtained, mark the slip joint in a manner to allow returning to the proper angle, were to tailpipe to move during cowl removal.
- 5) Remove the lower cowl.
- 6) Drill a 0.25" hole through the slip joint, about one inch from the end of the flare in the tailpipe. Drill through the tailpipe and the 4 to 1 collector. Be sure to de-burr all the holes or later removal of muffler components will be difficult.

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

- 7) Clamp the exhaust extension to the 4 to 1 using the provided 2" clamp (PN 7020). See Detail "B". The pin should insert with minimal force. If any binding exists, the hole may need further reaming.

Create a placard and place in clear view of the pilot that reads:

"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."

Make appropriate entries in the logbook and on 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 system with the external tailpipe weighs approximately 24lbs at station 42.
- The Power Flow Systems, Inc. tuned exhaust system with the internal tailpipe weighs approximately 22lbs at station 40.
- Since the weight of stock exhaust systems can vary, it is recommended that the installer weigh both the stock and Power Flow systems for an exact differential.

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

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

1.0 BASIC OPERATION

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

2.0 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.”

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

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.**

2.3 Structural Inspection Procedure – See Section 5.0 Below.

3.0 TROUBLESHOOTING

<i>Problem</i>	<i>Possible Cause</i>	<i>Solution</i>
Exhaust smell in cockpit	Exhaust Leak	Immediately inspect exhaust system for leaks, do not return to service until problem is resolved.
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
Excessive Noise	Muffler insert damaged or missing	Contact PFS, Inc. for new muffler insert

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

4.0 REMOVAL

1. Disconnect muffler support rod P/N 90030 or 90077 from muffler clamp P/N 8030. (External tailpipes only)
2. Disconnect exhaust clamp P/N 7020 and remove muffler assembly P/N 80177 from exhaust extension P/N 78102. (External tailpipes only)
3. Remove lower cowl IAW the latest FAA approved revision of the Aircraft Service Manual
4. Disconnect flexible ducts from collector assembly.
5. Remove EGT probes if installed.
6. Remove exhaust pipes from cylinders 2 and 4 and separate them from the collector assembly.
7. Remove the collector assembly by pulling out from the 1 and 3 cylinder side.
8. Remove the 1 & 3 headers.
9. Remove the engine mount bolt and support rod if necessary (external tailpipes only).

5.0 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 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.

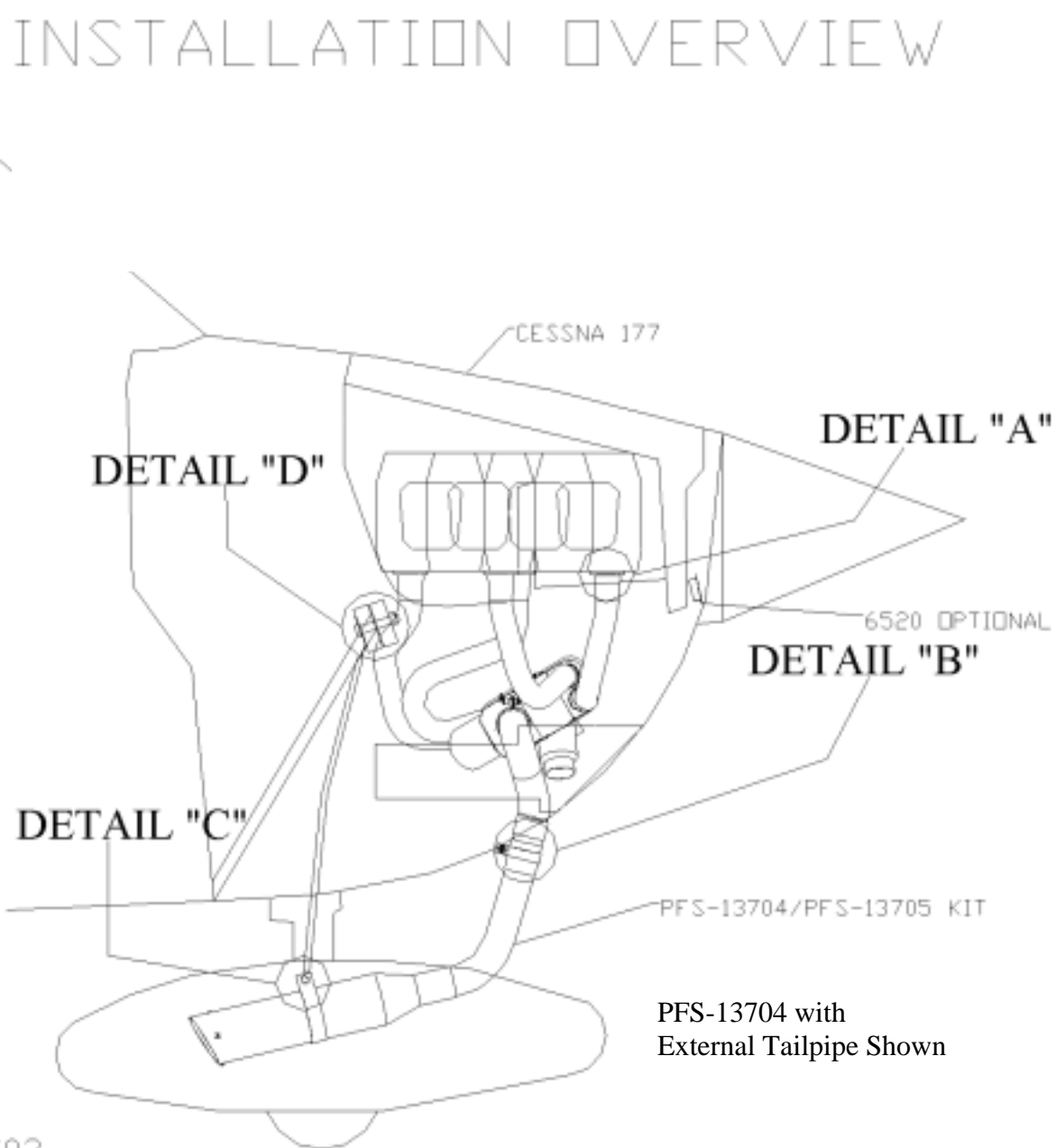
- 1) Remove engine cowl
- 2) Loosen and remove shrouds so that all surfaces of the exhaust system are visible
- 3) Check for holes, cracks, and burned spots. Especially check areas adjacent to welds. Look for exhaust gas deposits in surrounding areas. Look for unusual tube discoloration. This may indicate an exhaust leak.
- 4) Inspect the packing material in the muffler body. If the packing (or silencer cone on internal tailpipes) is missing or deteriorated, it will require replacement. New packing inserts and silencer cones are available from Power Flow Systems, Inc.
- 5) Inspect the ball joint for freedom of movement (external tailpipes only). A seized ball joint may cause other components to crack. If penetrating lube won't free a seized ball joint, please contact Power Flow Systems, Inc. for a replacement.
- 6) Verify that a placard is installed in clear view of the pilot that reads: ***"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."***
- 7) Inspect screen covering carb heat outlet. Screens must be secure with no risk of material breaking off.
- 8) Inspect pins on clamps. Pins should not indicate excessive wear or cutting. If worn or cut contact Power Flow Systems, Inc. for replacement.
- 9) Inspect holes that pins are inserted in for elongation. If elongated contact Power Flow Systems, Inc. for replacement.

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

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:

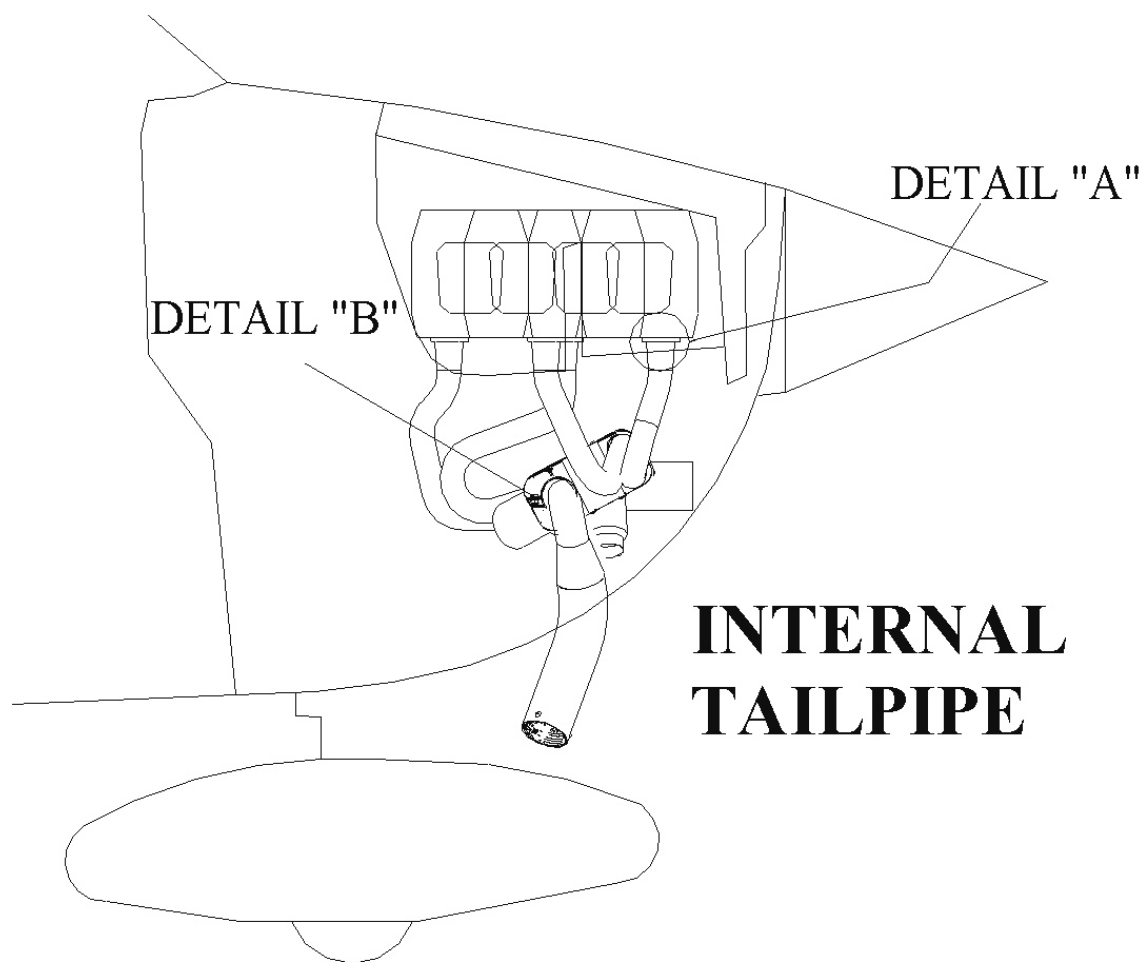
1. Remove exhaust pipes and heat exchanger assembly.
2. Remove shrouds.
3. Seal openings with expansion rubber plugs.
4. Submerge the collector assembly in water.
5. Using a manometer or pressure gauge, apply 3.0 to 3.5 PSI (approximately 7" Hg) of air pressure.
6. Let the unit sit pressurized for 10 to 30 seconds. The leak rate should be zero.
7. If a leak is found in the collector assembly, replace before further flight.
8. If no leaks are found, dry components and install on airplane.

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B



Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

INSTALLATION OVERVIEW

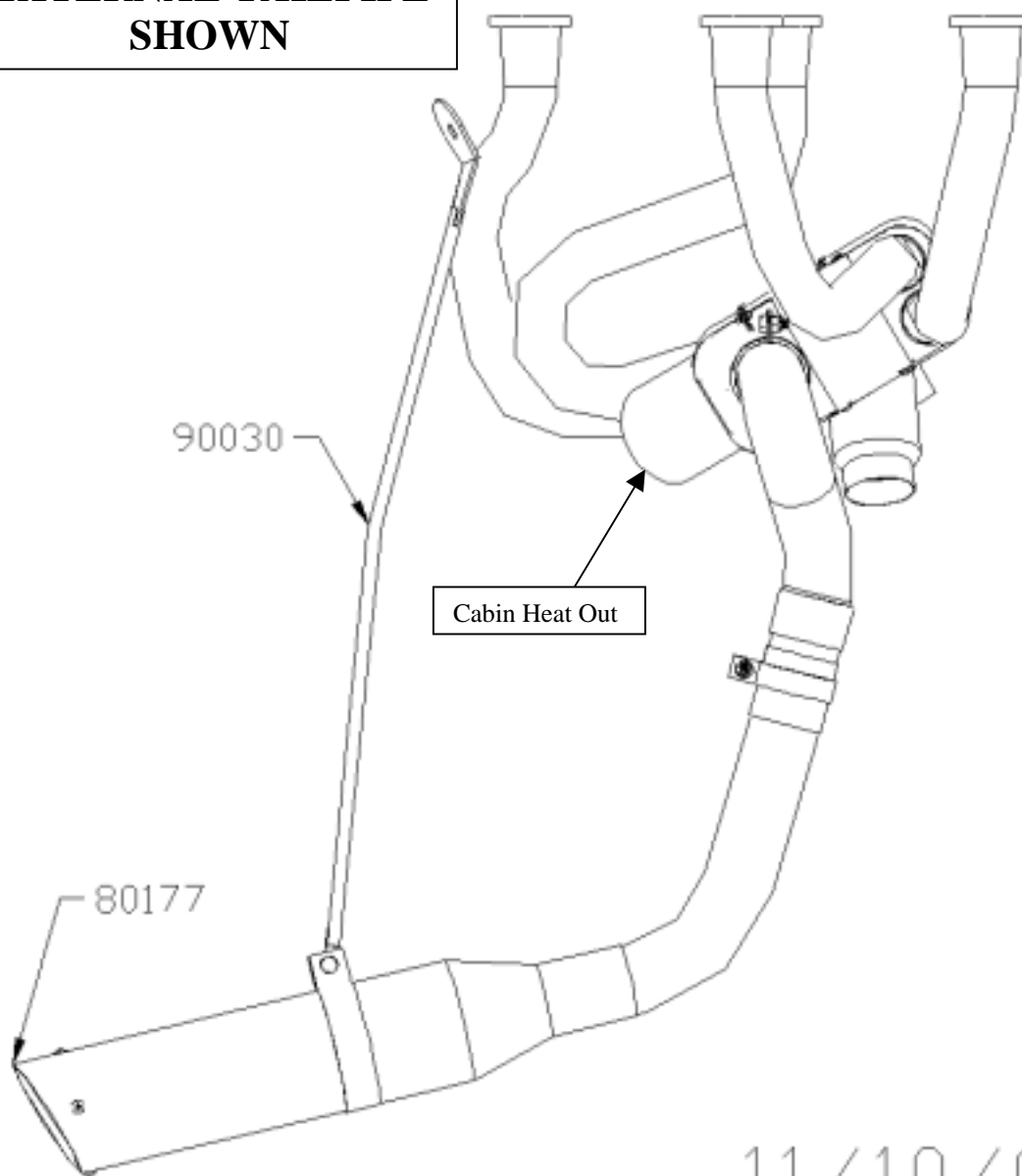


Note: Heat shroud may differ in appearance.

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

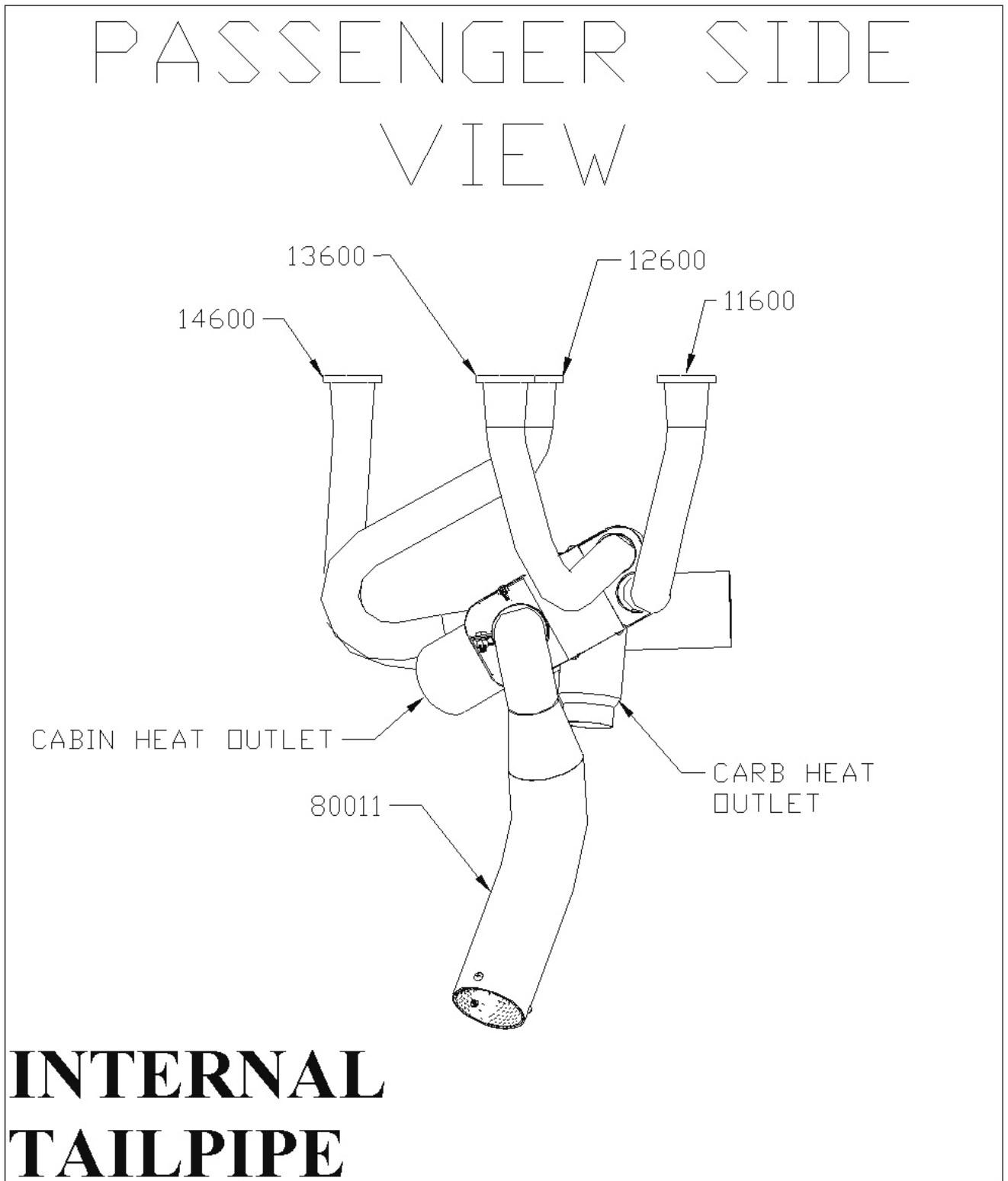
PASSENGER SIDE
VIEW C177 C177A

**EXTERNAL TAILPIPE
SHOWN**



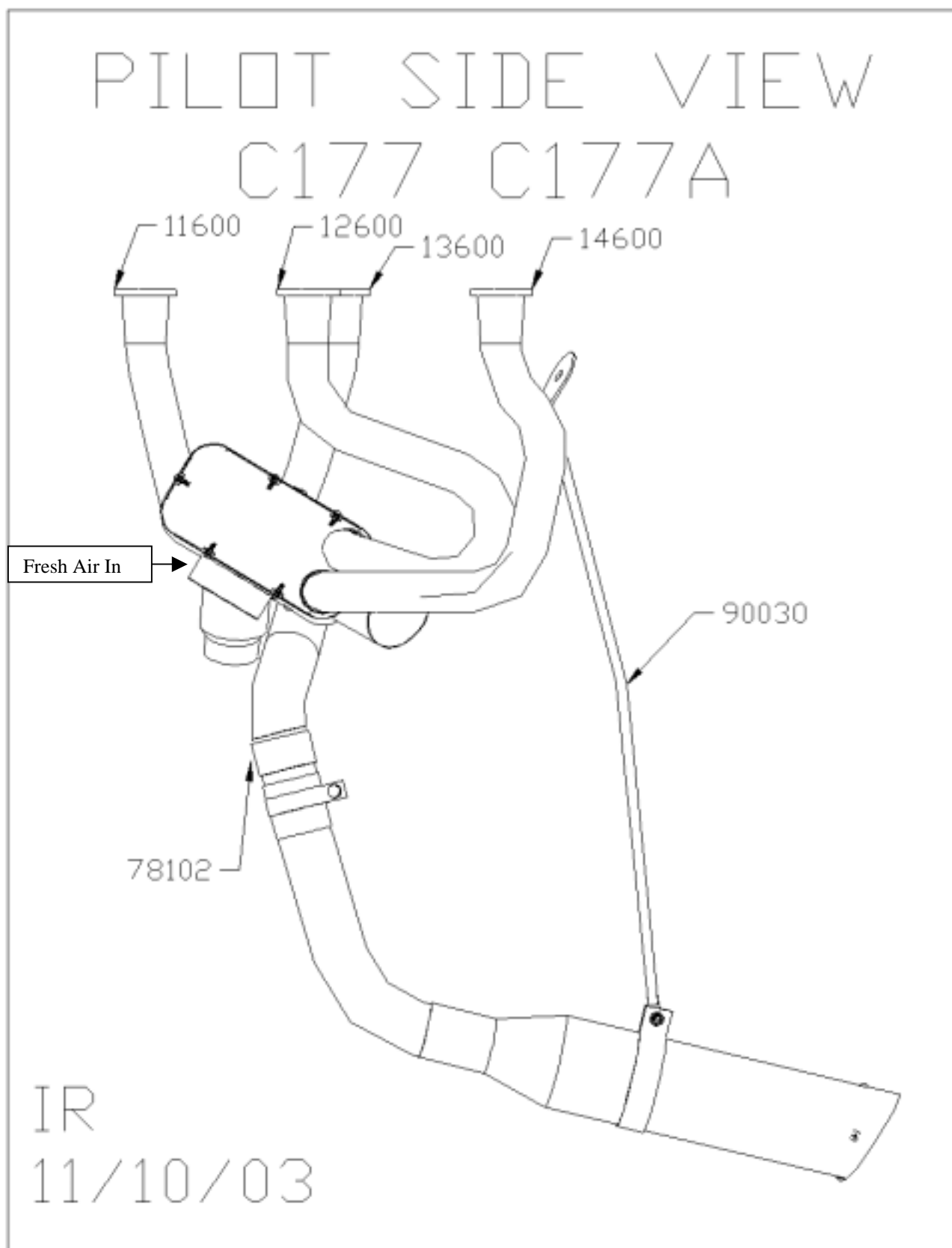
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Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

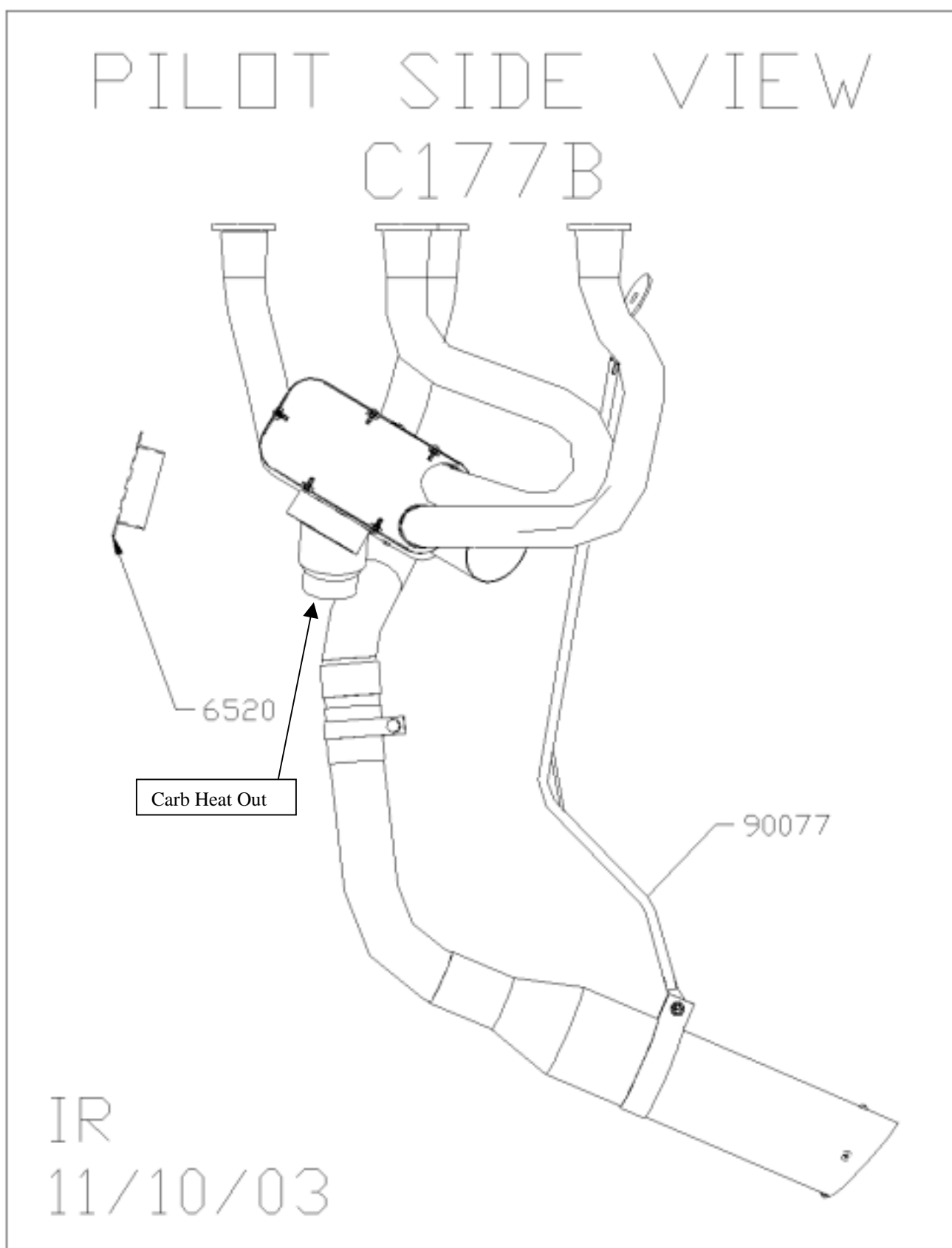


Note: Heat shroud may differ in appearance.

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

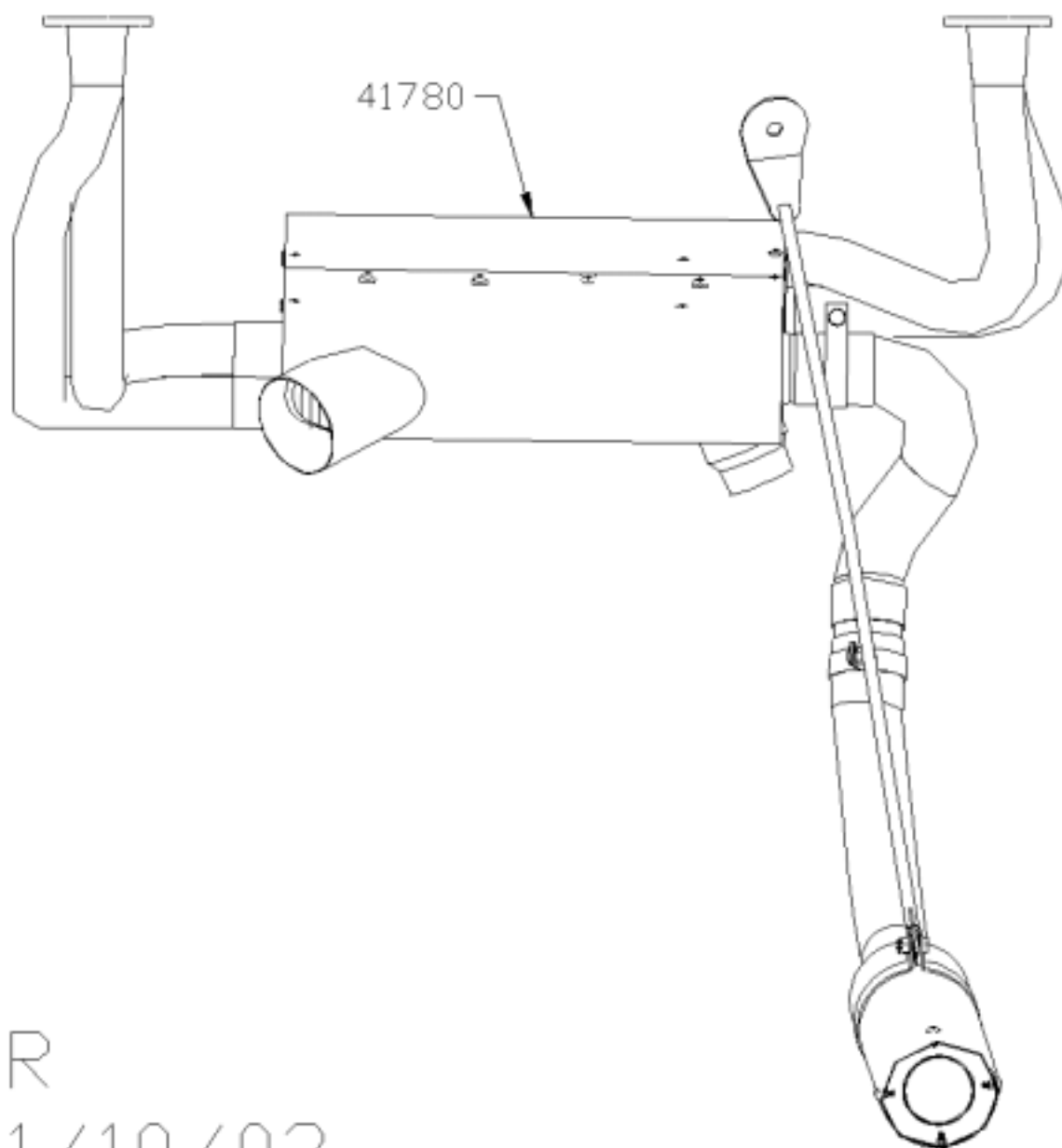


Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B



Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

REAR VIEW
C177 C177A

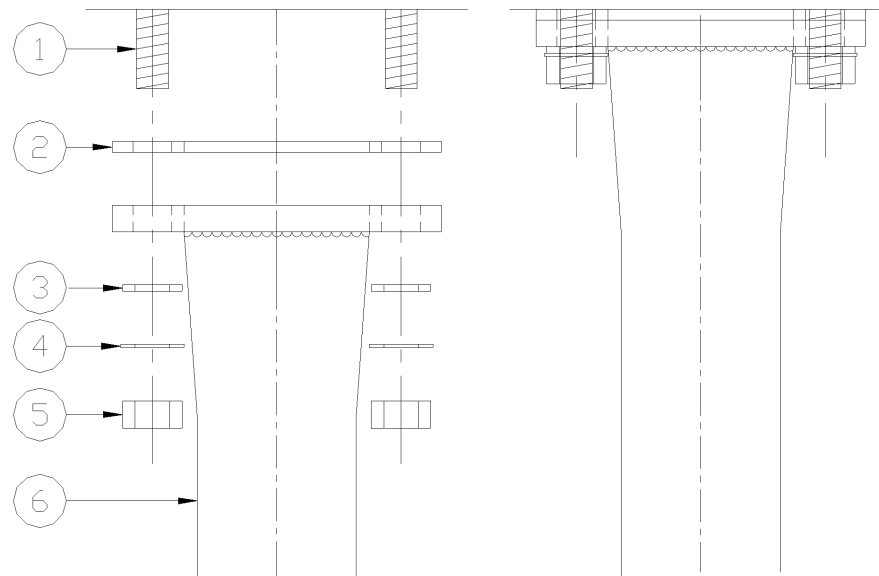


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Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

Detail "A"

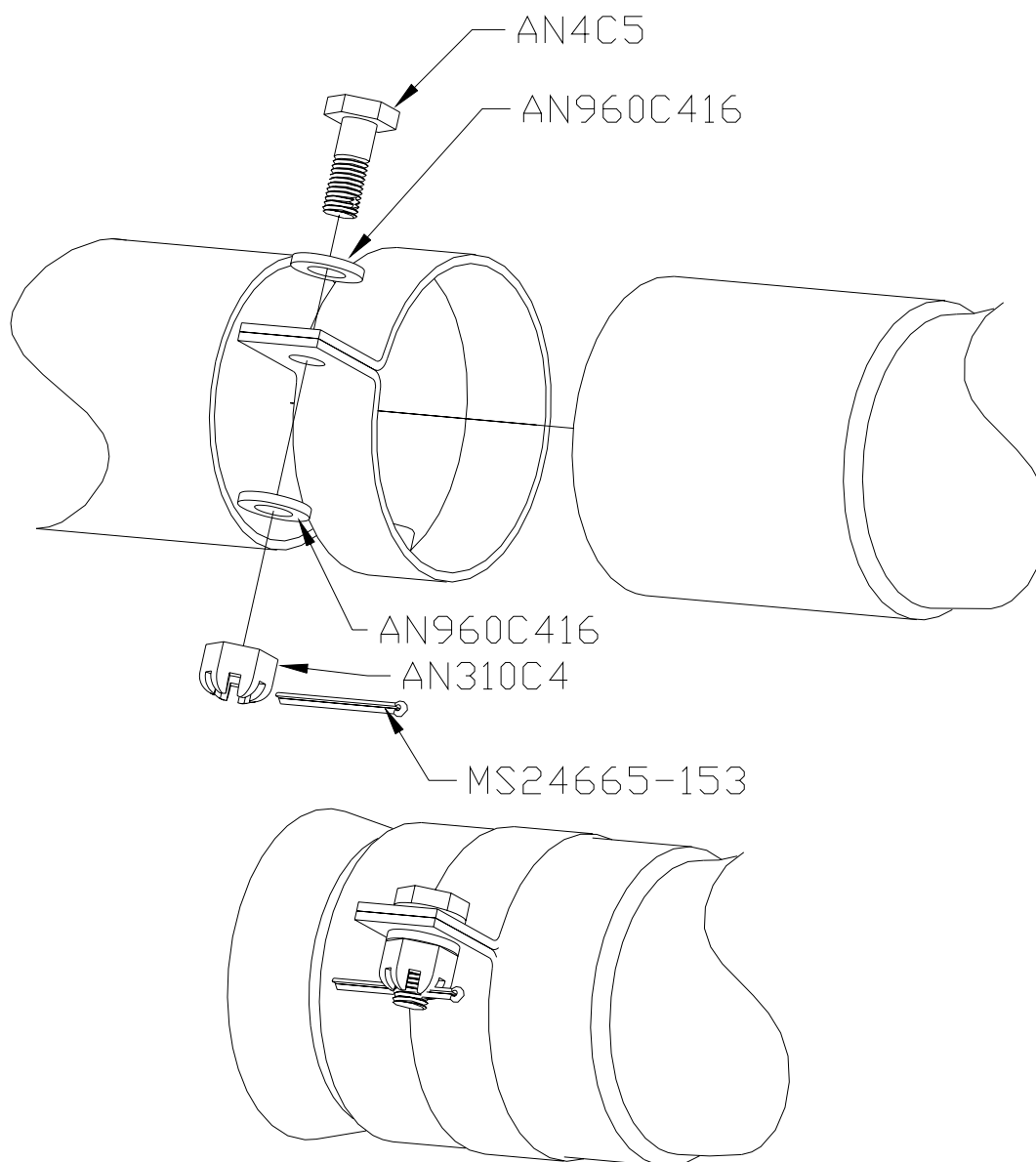
- | | | |
|---|----------------|-----------------|
| 1 | Exhaust Stud | Lycoming Engine |
| 2 | No-Blow Gasket | 77611 |
| 3 | Flat Washer | AN960-516 |
| 4 | Lock Washer | MS35333-41 |
| 5 | Nut | SL-STD-1410 |
| 6 | Header | Various |



Note: Equivalent hardware may be used.

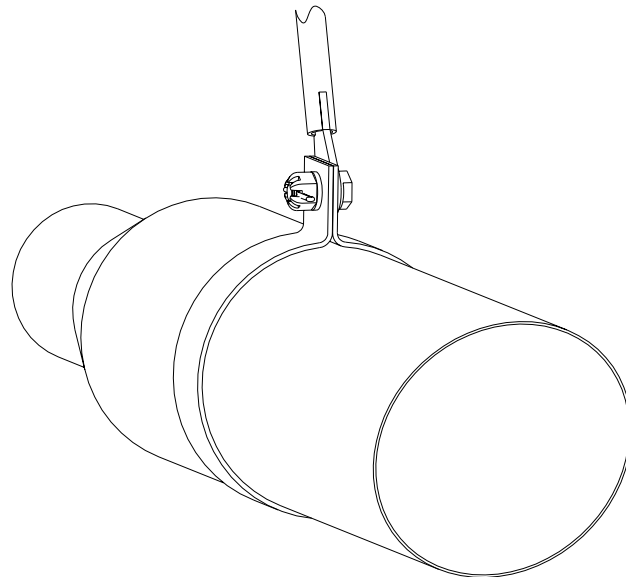
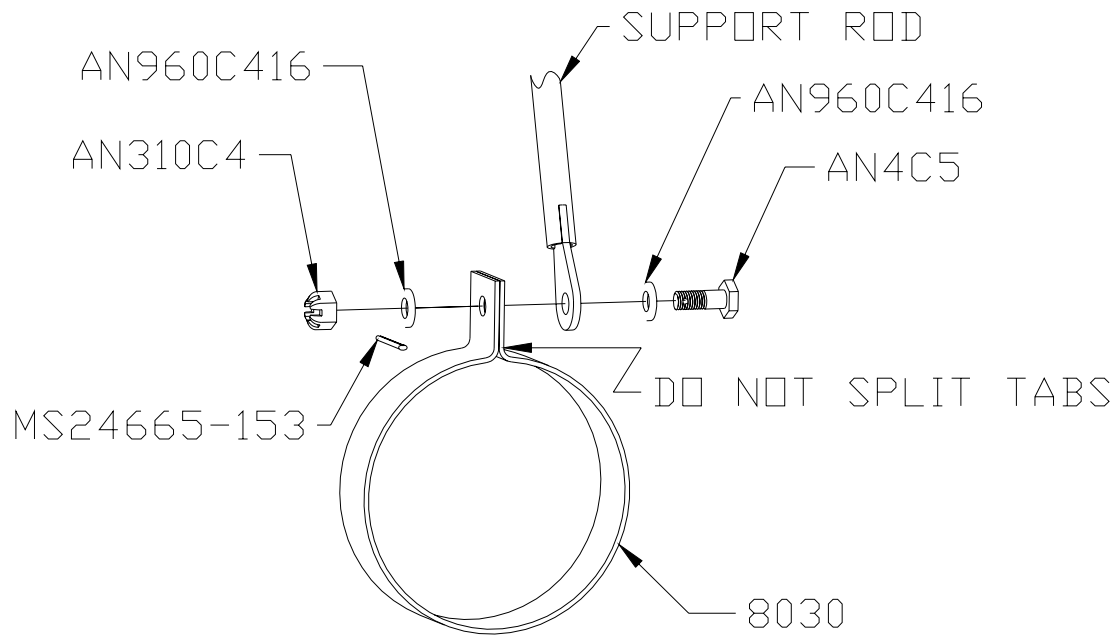
Rev A 06/05/02

DETAIL B



EQUIVALENT HARDWARE MAY BE
USED THROUGHOUT

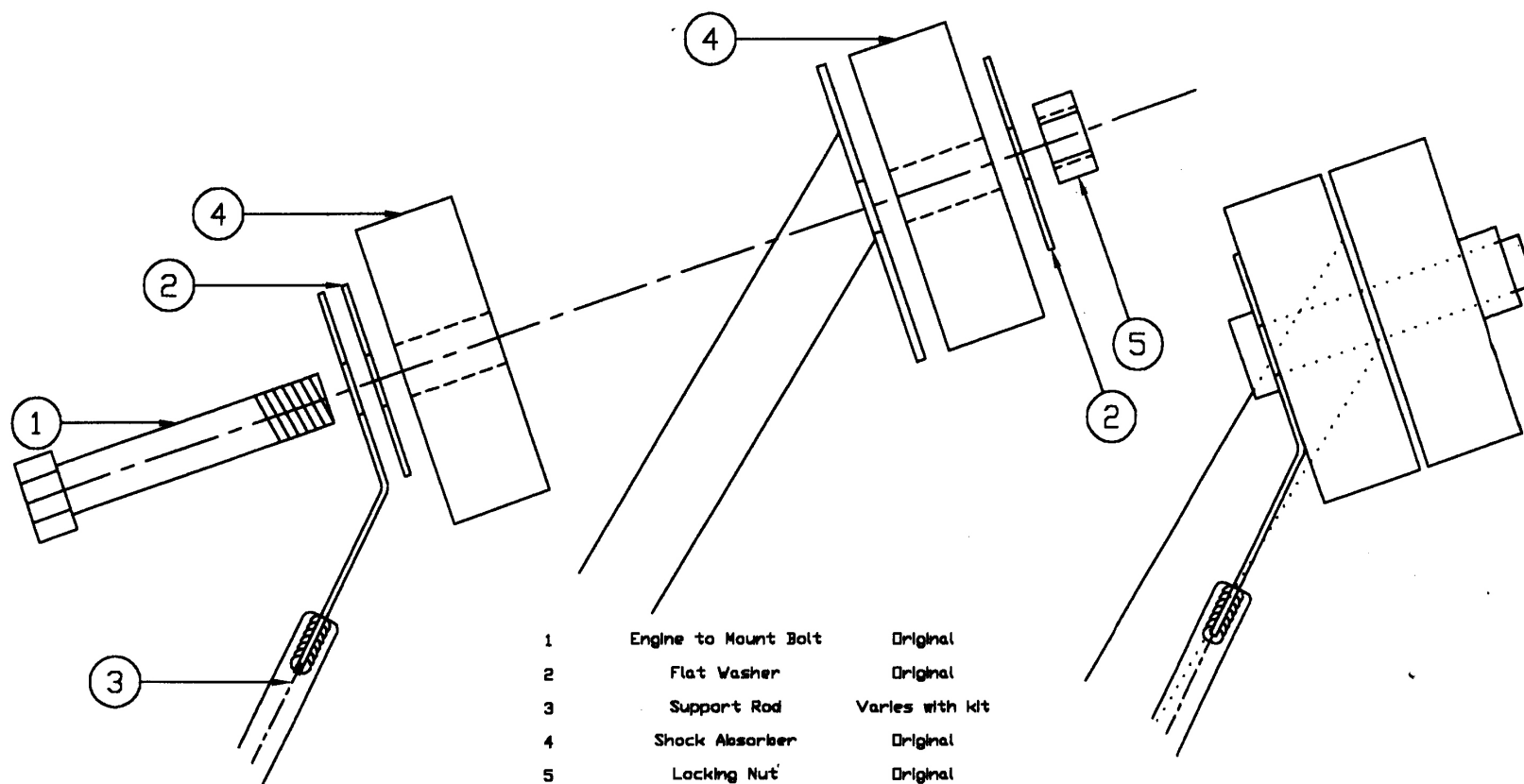
DETAIL C



EQUIVALENT HARDWARE MAY BE
USED THROUGHOUT

Power Flow System Extractor Exhaust System Installation Instructions
Cessna 177, A, B

Detail "D"



Original June 7, 2000

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

Number SA02674AT

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 therefor as specified hereon meets the airworthiness requirements of Part 23 of the Federal Aviation Regulations.

Original Product - Type Certificate Number : A13CE

Make : Cessna

Model : 177, A, B

Description of Type Design Change:

Modification of engine exhaust system for improved engine performance by installation of Power Flow Systems, Inc. Tuned Exhaust System per Master Drawing List, PFS-13740-00, Revision, IR, dated: 06/05/03 or Master Drawing List, PFS-13741-00, Revision, IR, dated: 11/26/03 and Installation Instructions Report, PFS-13750-00, Revision A, dated: 08/30/02 or Installation Instructions contained in Report PFS-13751-00, Revision, IR, dated: 11/26/03 or later FAA approved revision.

Limitations and Conditions: Airplane Flight Manual Supplement is not part of this STC. Instructions for Continued Airworthiness contained in Report, PFS-13760, Revision A, dated: 08/03/02 or PFS-13751-00, Revision IR, dated: 11/26/2003, as applicable, or later FAA approved revision is part of 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 : June 05, 2003

Date reissued : June 19, 2003

Date of issuance : June 09, 2003

Date amended : December 04, 2003



By direction of the Administrator

Melvin D. Taylor
(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.

FAA FORM 8110-2(10-68) PAGE 1 of 2 PAGES

This certificate may be transferred in accordance with FAR 21.47.