



*Installation Instructions and
Instructions for Continued Airworthiness
Kit: PFS-16201(-GEN2)*

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Instructions and Instructions for Continued Airworthiness
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B	AUG/10/2006	3-7, 10, 11	3-7, 10, 11
C	OCT/11/2007	4,8-11,13,14	4,8-11,13,14
D	MAR/11/2008	2-8,10,11,16-19	2-13,15-19
E	JUN/04/2010	1-3,6-12,15-16,19	1-3,6-12,15-16,19
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G	JAN/30/2018	ALL	ALL

Revision Notes:

Rev G: Updated instructions and BOM to include optional #1 header for GEN2 exhaust systems that have the LoPresti cowling and identified that this optional header started with exhaust s/n 275. Identified that GEN2 exhaust systems started with s/n 118 unless aircraft equipped with LoPresti cowling or electric cowl flaps. Revised all Kit Contents to add (3) AN3c12 bolts omitted in error. Identified hardware package by number for location of supplied hardware. Added text to clarify difference between quiet tailpipe and original tailpipe. Added text for installer clarity and corrected typos. Additional items to ensure suitable clearance during installation step. Sec 6.3 – identified different muffler inserts for clarity. Changed dynamic balance recommendation to 400 hours. Specified minimum temperature capability of anti-seize. Added text to Detail D.

Approval Notes:

Approved by Power Flow Systems QC and submitted to Atlanta ACO as minor revision within 6 months per QC manual.



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1.0 INTRODUCTION

- PFS is the abbreviation for Power Flow Systems, Inc.
- 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.
- 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. There is an optional pre-heat shroud that warms the air before it is routed over the collector tubes. This heated air is used to heat the aircraft cabin. A tailpipe from the collector assembly routes exhaust gases to a muffler that directs gases out of the cowling.
- There are various configurations approved by the STC and described in these instructions. The most common is the second generation tuned exhaust, called PFS-16201-GEN2 which started at exhaust s/n 118. Exhausts below s/n 118 are all first generation kits. These earlier revisions may be equipped with one of two tailpipe designs and have a cabin pre-heat option. Use the figures in paragraph 1.1 to identify your system. If you are not sure which configuration you have, please contact Power Flow Systems, Inc. before starting installation.
- The first generation kit is still available for aircraft with electric cowl flaps. Prior to exhaust s/n 275, aircraft modified with LoPresti cowlings could only install the first generation exhaust system by installing our "LoPresti header" option.
- **LoPresti cowed aircraft:** The PFS second generation exhaust may be installed on aircraft modified with a LoPresti cowling when equipped with a specific #1 header, p/n 11311, designed to accommodate the tighter clearances unique to the LoPresti cowling. This header is not supplied as standard and must be specified/ordered to replace the standard p/n 11310. Some trimming of excess material on the cowl flap and scoops may be required to obtain sufficient clearance from the exhaust to the cowling.

Kit Identification

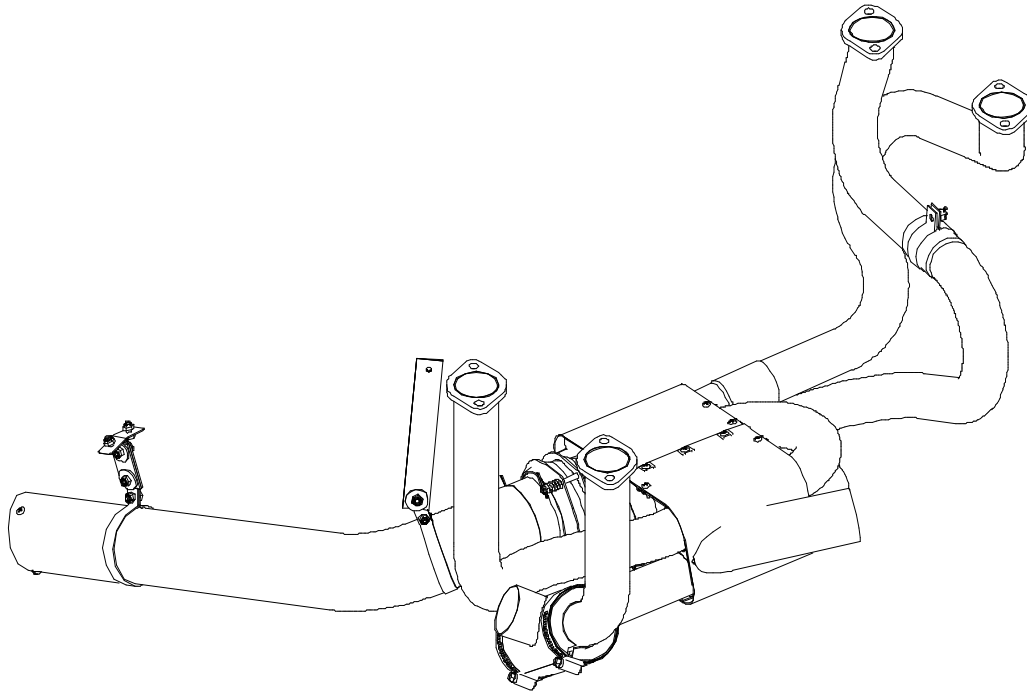


Figure 1.1 First Generation Exhaust, Original Tailpipe, Standard Headers

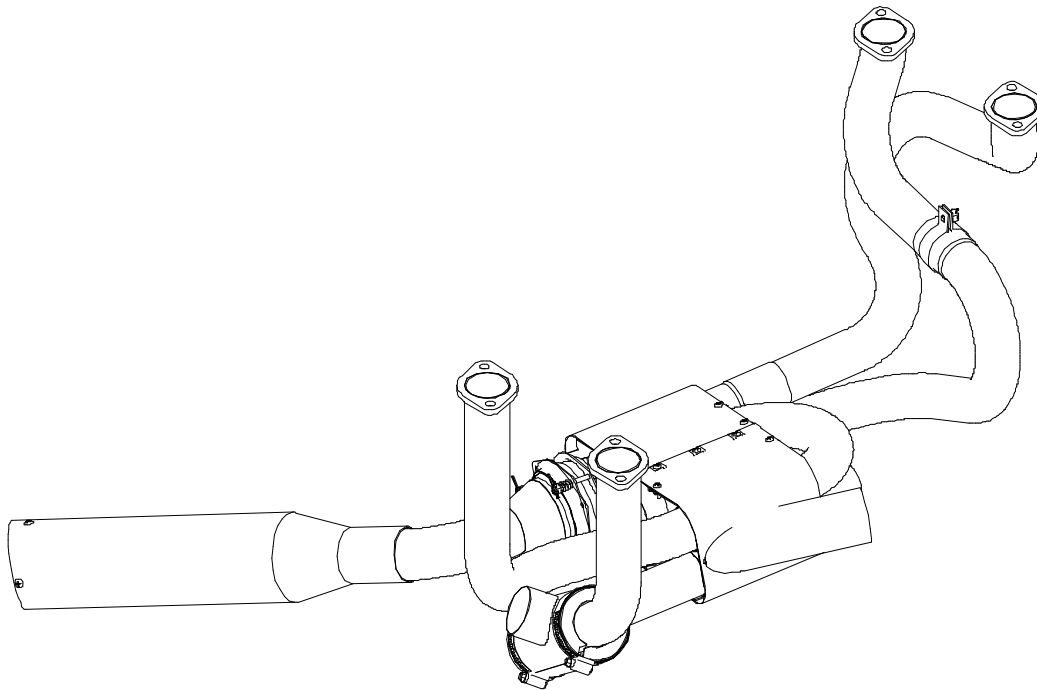


Figure 1.2 First Generation Exhaust, Quiet Tailpipe, Standard Headers

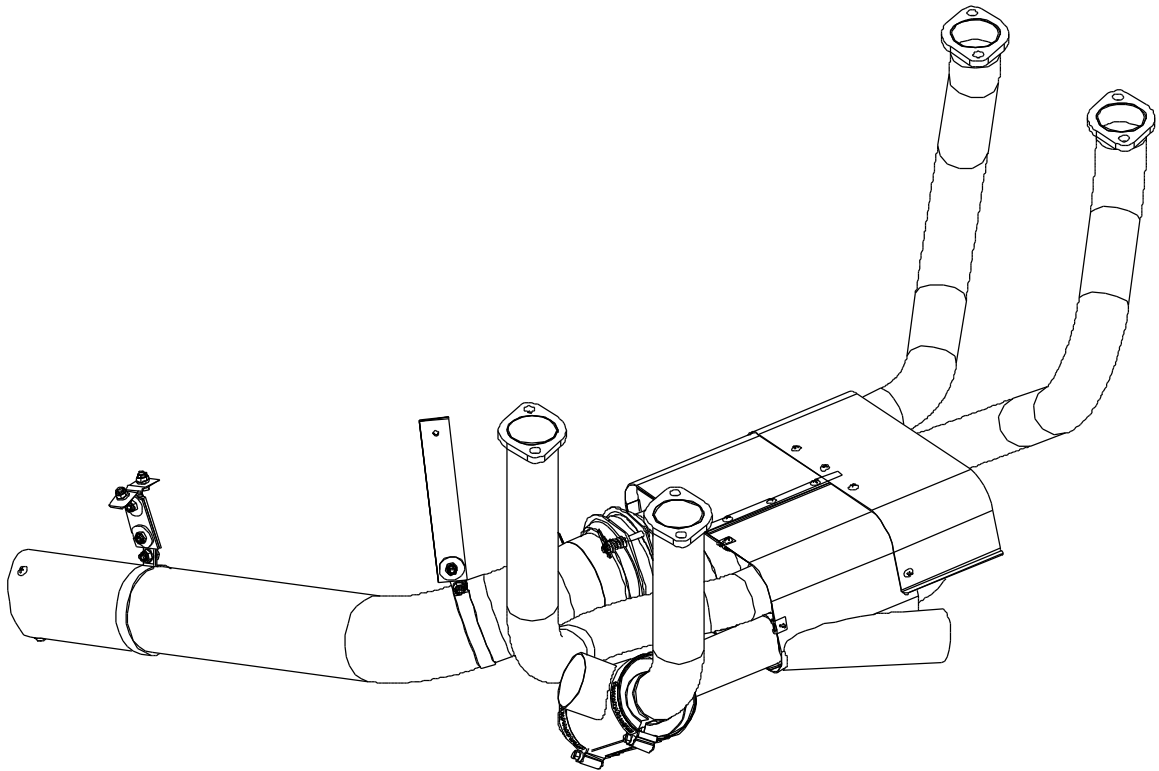


Figure 1.3 First Generation Exhaust, Original Tailpipe, Optional Headers

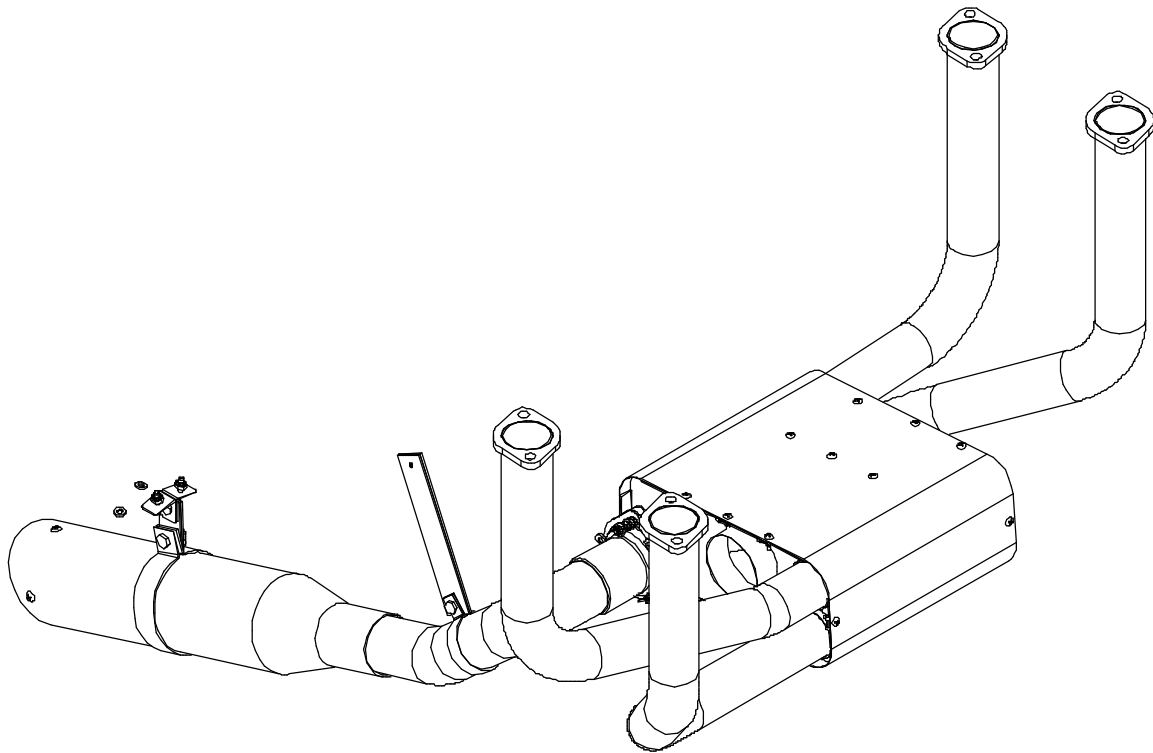


Figure 1.4 Second Generation Exhaust, PFS-16201-GEN2 (starting with s/n 118)



2.0 KIT CONTENTS

2.1 Second Generation Kit, PFS-16201-GEN2 (current) (standard for all new shipments except aircraft with electric cowl flaps)

Qty	Part Description	Part Number	Hardware Pack
1	Number 1 Header (Standard cowl)	11310 OR	
1	Optional Number 1 Header (LoPresti)	11311	
1	Number 2 Header	12310	
1	Number 3 Header	13310	
1	Number 4 Header	14310	
4	No-blow Header Gasket	77611	10310
8	Exhaust Nut	SL-STD-1410	10310
8	Lock Washer	MS35333-41	10310
8	Plain Washer	AN960-516	10310
1	Shrouded Collector Assembly	40300	
1	Tailpipe Assembly	80630(-CER)	
3	Bolt, 10-32, Cres	AN3C12	10367
3	3/16" Castle Nut	AN310C3	10367
3	Ball Joint Springs	33703	10367
6	3/16" Flat Washers	AN960C10	10367
3	Cotter Pin	MS24665-153	10367
1	3.5" Tailpipe Clamp	8030	
1	1/4" Undrilled Clamp Bolt	AN4C6A	10367
1	1/4" Large Area Washer	AN970-4	10367
1	1/4" Locknut	MS21045C4	10367
1	2.0" Tailpipe Clamp	7024	
1	3/16" Undrilled Clamp Bolt	AN3C5A	10367
1	3/16" Large Area Washer	AN970-3	10367
1	3/16" Locknut	MS21045C3	10367
4	Neoprene Straps	210	

For All M20E and M20F Aircraft with stock cowlings:

2 Attach Brackets 203

For M20E and M20F Aircraft with 2.0 Inch Cabin Heat Outlets:

1 Cabin Heat Reducer 6510

2 Hose Clamps QS200M32H

For Aircraft with Optional Pre-Heat Assembly:

1 Cabin Pre-Heat Assembly 51310

2 Hose Clamps QS200M32H

32" 2.0" SCAT Tube SCAT-8

A/R Associated Hardware

Equivalent Hardware may be used throughout.



**2.2 First Generation Kit (M20J w/ Standard Cowl, optional electric cowl flaps),
(obsolete)**

2.2.1 Original Tailpipe (tailpipe is 3.0 inch outer diameter, cone insert, obsolete)

Qty	Part Description	Part Number
1	Number 1 Header	11300
1	Number 2 Header	12300
1	Number 3 Header	13300
1	Number 4 Header	14300
4	No-blow Header Gasket	77611
8	Exhaust Nut	SL-STD-1410
8	Lock Washer	MS35333-41
8	Plain Washer	AN960-516
1	Header Clamp	7023
1	¼" Clamp Bolt	AN4C5A
2	¼" Washers	AN960C416
1	¼" Lock Nut	MS21045C4
1	Shrouded Collector Assembly	41300
1	Tailpipe Assembly	80030(-CER)
1	Ball Joint Flange	514
3	Bolt, 10-32, Cres	AN3C12
3	3/16" Castle Nut	AN310C3
3	Ball Joint Springs	33703
6	3/16" Flat Washers	AN960C10
3	Cotter PinMS24665-153	
2	Tailpipe Clamps	8032
2	3/16" Undrilled Clamp Bolts	AN3C4A
4	3/16" Flat Washers	AN960C10
2	3/16" Locknuts	MS21045C3
4	Neoprene Straps	210
1	Heat Shield, Servo Mount	2002
<u>For M20J Aircraft with Electric Cowl Flaps:</u>		
1	Motor Relocation Bracket	16201-17
1	Linkage 16201-18	
<u>For Aircraft with Optional Pre-Heat Assembly:</u>		
1	Cabin Pre-Heat Assembly	51310
2	Hose Clamps	QS200M32H
32"	2.0" SCAT Tube	SCAT-8

A/R Associated Hardware
Equivalent Hardware may be used throughout.



2.3 First Generation Kit (M20J w/ Standard Cowl, optional electric cowl flaps) Quiet Tailpipe (current)

Quiet Tailpipe (3.5 inch diameter)

<u>Qty</u>	<u>Part Description</u>	<u>Part Number</u>	<u>Hardware Pack</u>
1	Number 1 Header	11300	
1	Number 2 Header	12300	
1	Number 3 Header	13300	
1	Number 4 Header	14300	
4	No-blow Header Gasket	77611	10310
8	Exhaust Nut	SL-STD-1410	10310
8	Lock Washer	MS35333-41	10310
8	Plain Washer	AN960-516	10310
1	2.0" Tailpipe Clamp	7024	
1	3/16" Undrilled Clamp Bolt	AN3C5A	10367
1	3/16" Large Area Washer	AN970-3	10367
1	3/16" Locknut	MS21045C3	10367
4	Neoprene Straps	210	
1	Shrouded Collector Assembly	41300	
1	Tailpipe Assembly	80640 (-CER)	
3	Bolt, 10-32, Cres	AN3C12	10367
3	Balljoint Springs	33703	10367
3	3/16" Castle Nut	AN310C3	10367
6	3/16" Flat Washers	AN960C10	10367
3	Cotter Pins	MS24665-153	10367
1	3.5" Tailpipe Clamp	8030	
1	1/4" Undrilled Clamp Bolt	AN4C6A	10367
1	1/4" Large Area Washer	AN970-4	10367
1	1/4" Locknut	MS21045C4	10367
1	Header Clamp	7023	
1	1/4" Clamp Bolt	AN4C5A	10362
2	1/4" Washers	AN960C416	10362
1	1/4" Lock Nut	MS21045C4	10362
1	Heat Shield, Servo Mount	2002	

For M20J Aircraft with Electric Cowl Flaps:

1	Motor Relocation Bracket	16201-17
1	Linkage	16201-18

For Aircraft with Optional Pre-Heat Assembly:

1	Cabin Pre-Heat Assembly	51310
2	Hose Clamps	QS200M32H
32"	2.0" SCAT Tube	SCAT-8

A/R Associated Hardware
Equivalent Hardware may be used throughout.



2.4 First Generation Kit (M20E, F w/ Standard Cowl) Original tailpipe (obsolete)

2.4.1 Original Tailpipe (tailpipe is 3.0 inch outer diameter, cone insert, obsolete)

<u>Qty</u>	<u>Part Description</u>	<u>Part Number</u>
1	Number 1 Header	11300
1	Number 2 Header	12300/12320*
1	Number 3 Header	13300
1	Number 4 Header	14300/14320*
4	No-blow Header Gasket	77611
8	Exhaust Nut	SL-STD-1410
8	Lock Washer	MS35333-41
8	Plain Washer	AN960-516
1	Header Clamp	7023
1	¼" Clamp Bolt	AN4C5A
2	¼" Washers	AN960C416
1	¼" Lock Nut	MS21045C4
1	Shrouded Collector Assembly	41302
1	Tailpipe Assembly	80030 (-CER)
1	Ball Joint Flange	514
3	Bolt, 10-32, Cres	AN3C12
3	3/16" Castle Nut	AN310C3
3	Ball Joint Springs	33703
6	3/16" Flat Washers	AN960C10
3	Cotter Pin	MS24665-153
2	Tailpipe Clamps	8032
2	3/16" Undrilled Clamp Bolts	AN3C4A
4	3/16" Flat Washers	AN960C10
2	3/16" Locknuts	MS21045C3
2	Attach Brackets	203
4	Neoprene Straps	210

For Aircraft with Optional Pre-Heat Assembly:

1	Cabin Pre-Heat Assembly	51310
2	Hose Clamps	QS200M32H
32"	2.0" SCAT Tube	SCAT-8

For M20E and M20F Aircraft with Cowl Support Struts:

2	Heat Shield	2001
2	Adel Clamp size 6	MS21919WH6
2	Locknut	MS21045C3
2	Bolt	MS51958-63
4	Flat Washer	AN960C10

For M20E and M20F Aircraft with 2.0 Inch Cabin Heat Outlets:

1	Cabin Heat Reducer	6510
2	Hose Clamps	QS200M32H

A/R Associated Hardware

Equivalent Hardware may be used throughout.

*Some aircraft will receive optional 12320 and 14320 Headers where required for cowling or oil cooler clearance. These aircraft will not receive the P/N 7023 Header clamp or associated hardware.



2.5 First Generation Kit (M20E, F w/ Standard Cowl) Quiet Tailpipe (obsolete)

2.5.1 Quiet Tailpipe

Qty	Part Description	Part Number
1	Number 1 Header	11300
1	Number 2 Header	12300/12320*
1	Number 3 Header	13300
1	Number 4 Header	14300/14320*
4	No-blow Header Gasket	77611
8	Exhaust Nut	SL-STD-1410
8	Lock Washer	MS35333-41
8	Plain Washer	AN960-516
1	Header Clamp	7023
1	¼" Clamp Bolt	AN4C5A
2	¼" Washers	AN960C416
1	¼" Lock Nut	MS21045C4
1	Shrouded Collector Assembly	41302
1	Tailpipe Assembly	80640 (-CER)
3	Bolt, 10-32, Cres	AN3C12
3	Balljoint Springs	33703
6	3/16" Flat Washers	AN960C10
3	3/16" Castle Nut	AN310C3
3	Cotter Pins	MS24665-153
1	3.5" Tailpipe Clamp	8030
1	1/4" Undrilled Clamp Bolt	AN4C6A
1	1/4" Large Area Washer	AN970-4
1	1/4" Locknut	MS21045C4
1	2.0" Tailpipe Clamp	7024
1	3/16" Undrilled Clamp Bolt	AN3C5A
1	3/16" Large Area Washer	AN970-3
1	3/16" Locknut	MS21045C3
4	Neoprene Straps	210
2	Attach Brackets	203

For Aircraft with Optional Pre-Heat Assembly:

1	Cabin Pre-Heat Assembly	51310
2	Hose Clamps	QS200M32H
32"	2.0" SCAT Tube	SCAT-8

For M20E and M20F Aircraft with Cowl Support Struts:

2	Heat Shield	2001
2	Adel Clamp size 6	MS21919WH6
2	Locknut	MS21045C3
2	Bolt	MS51958-63
4	Flat Washer	AN960C10

For M20E and M20F Aircraft with 2.0 Inch Cabin Heat Outlets:

1	Cabin Heat Reducer	6510
2	Hose Clamps	QS200M32H

A/R Associated Hardware
Equivalent Hardware may be used throughout.

*Some aircraft will receive 12320 and 14320 Headers where required for cowling or oil cooler clearance. These aircraft will not receive the P/N 7023 Header clamp or associated hardware.



**2.6 First Generation Kit (M20E, F, J w/ LoPresti Cowl below exhaust s/n 275)
Original tailpipe (obsolete)**

2.6.1 Original Tailpipe

Qty	Part Description	Part Number
1	Number 1 Header	11300
1	Number 2 Header	12320
1	Number 3 Header	13300
1	Number 4 Header	14320
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	41304
1	Tailpipe Assembly	80030 (-CER)
1	Ball Joint Flange	514
3	Bolt, 10-32, Cres	AN3C12
3	3/16" Castle Nut	AN310C3
3	Ball Joint Springs	33703
6	3/16" Flat Washers	AN960C10
3	Cotter Pin	MS24665-153
2	Tailpipe Clamps	8032
2	3/16" Undrilled Clamp Bolts	AN3C4A
4	3/16" Flat Washers	AN960C10
2	3/16" Locknuts	MS21045C3
4	Neoprene Straps	210
<u>For Aircraft with Optional Pre-Heat Assembly:</u>		
1	Cabin Pre-Heat Assembly	51310
2	Hose Clamps	QS200M32H
16"	2.0" SCAT Tube	SCAT-8
A/R	Associated Hardware	

Equivalent Hardware may be used throughout.



**2.7 First Generation Kit (M20E, F, J w/ LoPresti Cowl below exhaust s/n 275)
Quiet Tailpipe (obsolete as of Jan 2018)**

2.7.1 Quiet Tailpipe

Qty	Part Description	Part Number
1	Number 1 Header	11300
1	Number 2 Header	12320
1	Number 3 Header	13300
1	Number 4 Header	14320
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	41304
1	Tailpipe Assembly	80640 (-CER)
3	Bolt, 10-32, Cres	AN3C12
3	3/16" Castle Nut	AN310C3
3	Ball Joint Springs	33703
6	3/16" Flat Washers	AN960C10
3	Cotter Pins	MS24665-153
1	3.5" Tailpipe Clamp	8030
1	1/4" Undrilled Clamp Bolt	AN4C6A
1	1/4" Large Area Washer	AN970-4
1	1/4" Locknut	MS21045C4
1	2.0" Tailpipe Clamp	7024
1	3/16" Undrilled Clamp Bolt	AN3C5A
1	3/16" Large Area Washer	AN970-3
1	3/16" Locknut	MS21045C3
4	Neoprene Straps	210

For Aircraft with Optional Pre-Heat Assembly:

1	Cabin Pre-Heat Assembly	51310
2	Hose Clamps	QS200M32H
16"	2.0" SCAT Tube	SCAT-8

A/R Associated Hardware

Equivalent Hardware may be used throughout.



3.0 PREPARATION

Verify that all contents listed in section 2 of this instruction set are included in your kit (based on the configuration you have chosen). 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 (if installed) in accordance with the latest approved revision of the aircraft service manual.
- 3.2 On some E or F model Mooneys, it may be necessary to temporarily disconnect the cowl support struts from the lower cowling (not from the firewall).
- 3.3 If installing a first generation exhaust on an M20J, install the servo mounted heat shield using the existing studs and nuts. See Detail D.

4.0 INSTALLATION OF PFS EXHAUST SYSTEM

4.1 Cowl Flap Motor Bracket Installation

This section applies only to aircraft with electric cowl flaps

- 4.1.1 - Remove the existing cowl flap motor bracket in accordance with the latest approved revision of the aircraft service manual. Save attaching hardware.
- 4.1.2 - Remove the stop switches from the bracket, noting their approximate locations. Save all attaching hardware.
- 4.1.3 - Remove the cowl flap motor from the bracket, saving the attaching hardware, and noting the orientation of the bellcrank.
- 4.1.4 - Install the PFS Bracket in the same manner as the original. Use one fastener to attach the bracket (into the threaded hole) and transfer the remaining hole locations into the bracket. Use original hardware. On some aircraft, the PFS bracket will slide between both mounting tabs on the aircraft, on others the PFS bracket tabs will lay on top of both aircraft mounting tabs.
- 4.1.5 - Install the motor into the PFS Bracket, using the original or included hardware.
- 4.1.6 - Install the stop switches into the PFS Bracket, using the original hardware. Be careful to install them in the correct locations. The PFS Bracket holes are threaded, so the original nuts are not required.
- 4.1.7 - Install the provided linkage in place of the shorter, original linkage.
- 4.1.8 - Rig the cowl flaps, adjusting the linkages as necessary to obtain the required range of motion and clearances listed in the latest approved revision of the aircraft service manual.
- 4.1.9 - Torque all fasteners in accordance with the latest approved revision of the aircraft service manual.
- 4.1.10 - Continue installation of the Power Flow Systems Tuned Exhaust. Be sure to check for interference by operating the motor after the PFS exhaust is installed. It may be necessary to slot some of the attach holes and slide the bracket closer to the firewall to obtain sufficient clearance between the exhaust and the attach bracket.

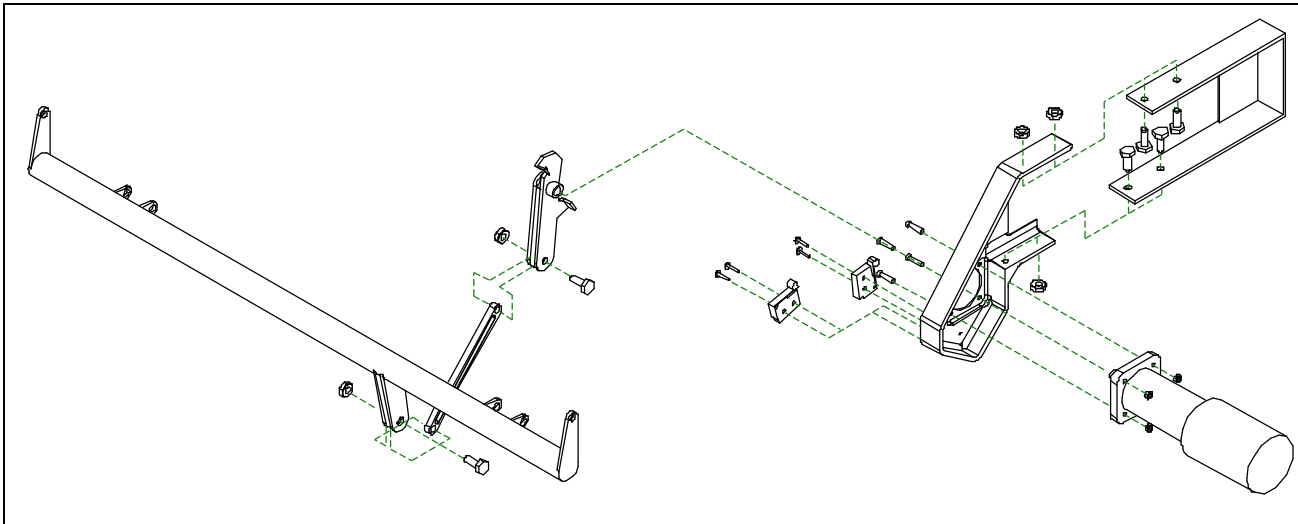


Figure 4.1 – Cowl Flap Motor Bracket Installation

4.2 Installing the Optional Pre-Heat Shroud

- 4.2.1 Determine which header tube will work best for the installation. For first generation exhaust systems with two-piece number four headers (P/N 14300), we recommend installing the shroud as shown in Detail C. For first generation exhaust systems with the optional one-piece number four header (P/N 14320), we recommend installing the shroud on the number one header (P/N 11300). For second generation exhaust systems, we recommend installing the shroud on the number two header (P/N 12310).
- 4.2.2 Install the heat shroud flanges over the header tube with the open end of the “C” shaped profile facing the ends of the tube.
- 4.2.3 Install the shroud over the tube and flanges, locating the flanges flush with the end of the shroud.
- 4.2.4 Install the band clamps over the ends of the shroud.
- 4.2.5 Orient the shroud as necessary to maximize clearances and simplify hose routing.
- 4.2.6 The band clamps should be re-tightened within the first 25 hrs of service.

4.3 Installing Collector Box Assembly and Header Pipes

Each header and collector is marked with its appropriate cylinder number – make sure that each header installed matches the correct collector location. If the headers are not numbered and/or there are no alignment marks, use the Installation Overview and the figures in section 1.1 to determine proper header orientation.

- 4.3.1 Apply generous amounts of high-temperature anti-seize (MIL-A-907E or equivalent) to the slip joints on the collector box. New exhaust systems have anti-seize applied at the factory.
- 4.3.2 Put new exhaust 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.

- 4.3.3 Loosely install the number two and four headers on their respective studs.
- 4.3.4 Install the collector box over the number two and four headers, using the alignment marks.
- 4.3.5 Install the one and three headers into the collector box and onto their respective studs.
- 4.3.6 Rotate or reposition the collector box as necessary to line up the alignment marks.
- 4.3.7 Loosely 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. See Detail "A." Ensure that there is positive clearance between the sniffle valve located on the bottom of the oil sump and the upper portion of the cabin heater shroud.**
- 4.3.8 Ensure that the throttle and mixture control have full and correct movement and are not restricted in any way.**
- 4.3.9 **Once clearances are verified**, torque the exhaust nuts to final torque **after** proper orientation and assembly position of the exhaust system is achieved. Use the torque recommended in the latest approved revision of either the Aircraft or Engine Service Manual. Remove alignment labels.
- 4.3.10 If installing EGT probes, install them into the headers in accordance with the manufacturer's recommendations (typically 2 to 4 inches from the exhaust port).
- 4.3.11 Attach all flexible tubing to the appropriate inlet/outlet tube on the collector assembly and pre-heat shroud (if installed).

4.4 Installing the Tailpipe Bracket (M20E,F w/ Standard Cowls Only)

- 4.4.1 Position the tailpipe so that it is mated to the ball joint outlet and oriented straight back, with at least ¼" of clearance to the firewall (top of the "tunnel").
- 4.4.2 Mark the bottom of the fuselage above the centerline of the tube and a point 4 to 6 inches above the tailpipe, about 3 to 6 inches from the end of the pipe.
- 4.4.3 Remove the tailpipe and the fuselage panel directly above the pipe (the tunnel shaped panel that was marked in the previous step).
- 4.4.4 Install the attach brackets at the mark made. See Detail B.
- 4.4.5 Re-install the fuselage panel and tailpipe.

4.5 Installing the Tailpipe

- 4.5.1 Position the tailpipe so that it will be in the correct position for clamping to the exhaust hangers. Using the hardware provided, assemble the ball joint. **See Installation Overview.** The compressed spring height on the ball joint should be between 0.430 and 0.475 inches, add or remove washers as necessary to obtain this height.
- 4.5.2 At this stage, the lower end of the tailpipe assembly should be able to 'wobble' ½ inch to 1 ½ inches from side to side. Caution: Over-tightening the ball joint assembly may cause cracking in the collector and damage to the ball joint assembly.



- 4.5.3 Attach the tailpipe assembly to exhaust hangers with the included clamps in the same manner as the original (**See Detail B and Installation Overview**). If you have a spring type hanger, remove the hanger and replace with two pieces of strap material (P/N 210) attached directly to the firewall with an AN3C4A bolt and AN970-3 Large Area Washer.

5.0 INSPECTION AND PAPERWORK

5.1 Check Clearances

- 5.1.1 Using a flashlight and mirror if necessary, check for clearances between all exhaust system and airframe components. 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.
- 5.1.2 It may be necessary to fabricate one or more brackets to hold the fuel lines or fuel flow transducer away from exhaust pipes or to reroute the fuel lines so that there is sufficient clearance.
- 5.1.3 Ensure that there is positive clearance beneath the engine sump sniffle valve and the upper portion of the Power Flow heater shroud. You may need to reduce the installed height of the sniffle valve if there is insufficient clearance.
- 5.1.4 Ensure that the throttle and mixture control have full and correct movement and are not restricted in any way.**
- 5.1.5 Install the engine cowling (top and bottom or left and right) IAW the latest FAA approved revision of the aircraft service manual.
- 5.1.6 **LoPresti cowl aircraft only:** Check for sufficient clearance around both the left cooling scoop and the right cooling scoop. Trim excess material as necessary to provide suitable clearance.
- 5.1.7 Close the cowl flaps and check for clearance around the tailpipe outlet. If the tailpipe contacts the cowl flap, try re-adjusting the tailpipe clamps to reposition the tailpipe. If this doesn't work, the cowl flap may need to be trimmed slightly to maintain clearance around the tailpipe. **Note: LoPresti cowl aircraft may need to trim excess material on the cowl flap above and forward of the cowl flap pivot bolt to avoid conflict with the exhaust headers. Ensure smooth and correct operation of the cowl flap in all positions.**
- 5.1.8 After installing and performing a full engine run-up, inspect the tailpipe and cowling for rubbing or chafing. The motion of the tailpipe will be greatest during engine start and shutdown. Excessive motion could be an indication of worn engine Lord mounts.

5.2 Placards

Install a placard (supplied with new kits) in clear view of the pilot that reads as follows:

"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 the aircraft is equipped with a Hartzell Model HC-C3YR-1RF/F7282 propeller, change the limitations placard located between the manifold pressure gage and the tachometer to read: **“AVOID CONTINUOUS OPERATION BELOW 22 INCHES HG BETWEEN 1950 AND 2350 RPM”** and replace the Hartzell flight manual supplement with AFMS_011810 Rev IR or later.

5.3 Records

5.3.1 Make appropriate entries in the logbook and on a FAA Form 337 (if applicable). This installation is a major *airframe* alteration. The STC is located at the back of this instruction set.

5.3.2 Weight and Balance:

- The Second Generation Power Flow Exhaust system weighs approximately 20 lbs at the same station as the stock exhaust system.
- The First Generation System with the quiet pipe weighs 21.5 lbs at the same station as the stock exhaust system. Subtract 1.0 lbs for the standard tailpipe (80030) and 1.0 lbs for the optional headers (12320/14320).
- Add 1.0 lbs for the optional pre-heat shroud (51310).
- A stock exhaust system from an M20J was weighed at 15.5 lbs. Since there are numerous types of stock exhaust systems it is recommended that the stock exhaust be weighed 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

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.

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**



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will require immediate exhaust system inspection and repair or replacement as necessary.

- 6.2.3 All slip joints must be disassembled and lubricated with a high-temperature anti-seize compound (MIL-A-907E or equivalent) 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.



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	Broken or Worn Engine Mounts	Replace or repair engine mounts.
	Tailpipe contacting firewall or cowling	Check for wear marks on the lower firewall and engine cowling, reposition tailpipe as necessary.
	Collector not centered on header pipes	Reposition collector -- ensure minimum of 1 1/2" penetration per header into central collector system
	Ball Joint too Loose	Tighten Ball Joint
	Broken Exhaust Hanger	Replace Exhaust Hanger
	Propeller not properly balanced	Have propeller dynamically balanced to at or below 0.2 ips.
Excessive noise	Muffler insert damaged or missing	Contact PFS, Inc. for new muffler insert kit, PN PFS-8016 (3.5 inch diameter tailpipe) or PFS-8011 (cone, for 3.0 inch diameter tailpipe).
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.

Dynamically balance your propeller to below 0.2 ips every 4 years or 400 hours (whichever occurs first).

- 6.4.1 Dynamically balance your propeller to below 0.2 ips after modifying, overhauling, dressing, or replacing any rotating component on the engine or propeller.
- 6.4.2 Keep slip joints lubricated with a high temperature anti-seize (MIL-A-907E or equivalent) that is rated for a minimum of 1600 degrees Fahrenheit.
- 6.4.3 Maintain even engine compressions above 70/80 psi.
- 6.4.4 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 OF PFS EXHAUST SYSTEM

- 6.5.1 Disconnect muffler clamps from the exhaust hangers. Remove clamps.
- 6.5.2 Disconnect the ball joint assembly and remove tailpipe.
- 6.5.3 Remove EGT probes if installed.
- 6.5.4 Disconnect flexible ducts from the collector assembly.
- 6.5.5 Identify each header with its cylinder number for later installation.
- 6.5.6 Mark each slip joint so that the depth and rotation of each joint can be replicated when the exhaust is reinstalled. **DO NOT USE PENCIL** or other graphite or carbon based marking device on any exhaust system component.
- 6.5.7 Remove nuts and washers attaching headers to exhaust ports.
- 6.5.8 Remove the collector assembly.

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 accordance with the latest revision of the Aircraft Service Manual and this document at either 100 hour or Annual intervals. It is recommended that the technician maintaining the exhaust system become familiar with the latest revision of FAA AC 91-59.

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 If a Hartzell HC-C3YR-1RF/F7282 propeller is installed verify the limitations placard between the manifold pressure gage and the tachometer reads: **“AVOID CONTINUOUS OPERATION BELOW 22 INCHES HG BETWEEN 1950 AND 2350 RPM”** and verify the installation of Hartzell flight manual supplement AFMS_011810 Rev IR or later.



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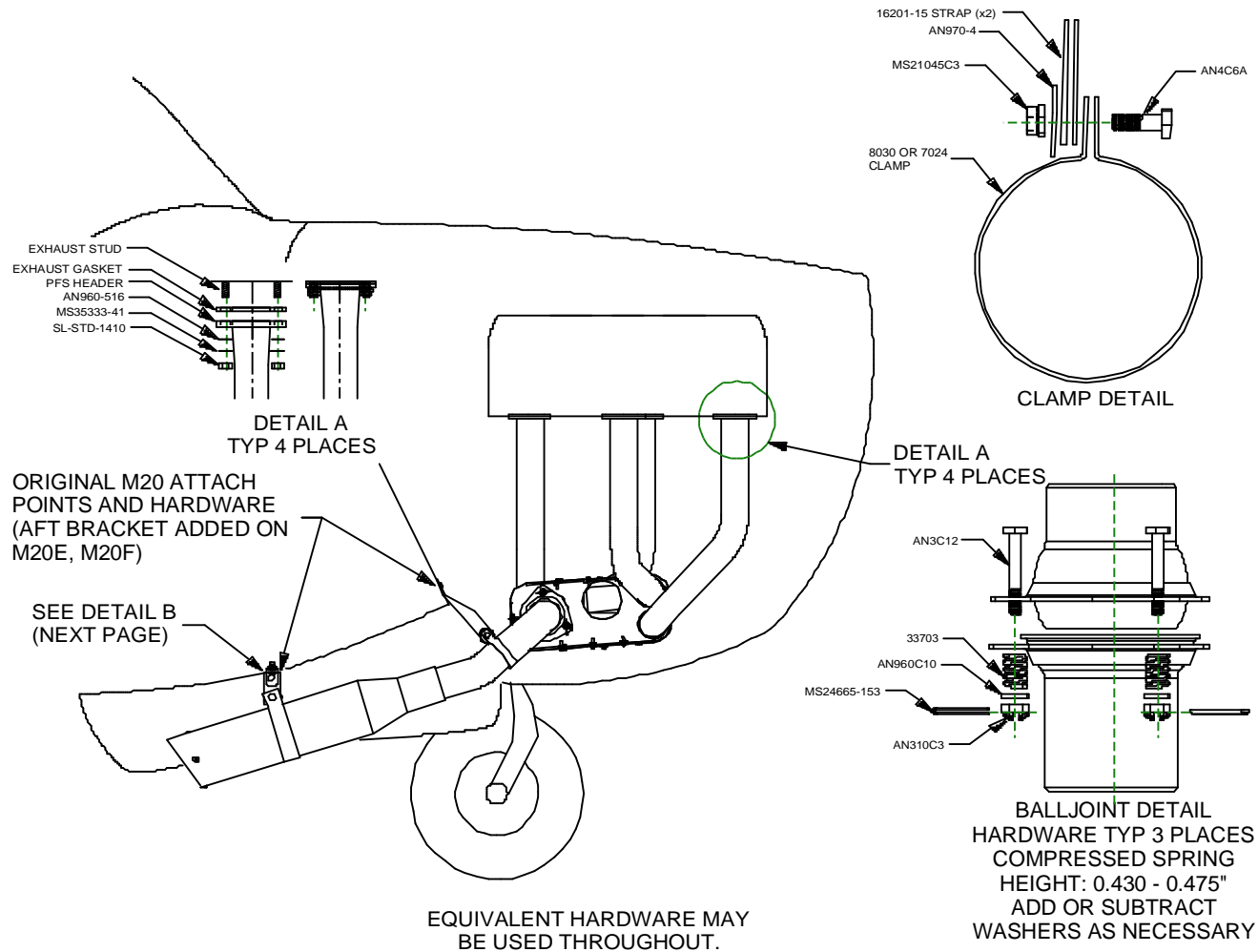
Kit: PFS-16201(-GEN2)

- 6.6.2 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.
- 6.6.3 Inspect the inside of the tailpipe body. If the interior is missing, collapsing, or deteriorated, it will require replacement. New tailpipe inserts are available from Power Flow Systems, Inc.
- 6.6.4 Inspect Strap Hangers for tearing or wear. Any worn hangers should be replaced.
- 6.6.5 Inspect for ball joint freedom of movement by disconnecting the exhaust hangers. The tailpipe should be free to move in all directions 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.
- 6.6.6 All slip joints must be disassembled and lubricated with a high-temperature anti-seize compound (MIL-A-907E or equivalent). While disassembled, inspect for wear or galling. (Only necessary at 500hr or annual intervals, whichever comes first) This should be performed more frequently if headers seize between inspections.
- 6.6.7 Be sure to remove heat shroud from collector box to inspect beneath it.

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:
- 6.6.8 Remove shroud.
- 6.6.9 Seal four of the openings (tubes) with rubber expansion plugs.
- 6.6.10 Using a manometer or pressure gauge, apply 3.0 to 3.5 PSI (approximately 7" Hg) of air pressure to the fifth opening.
- 6.6.11 Submerge the collector assembly in water.
- 6.6.12 Let the unit sit pressurized for 10 to 30 seconds. The leak rate should be zero.
- 6.6.13 If a leak is found in the collector assembly, replace before further flight.
- 6.6.14 If no leaks are found, dry components and install on airplane.

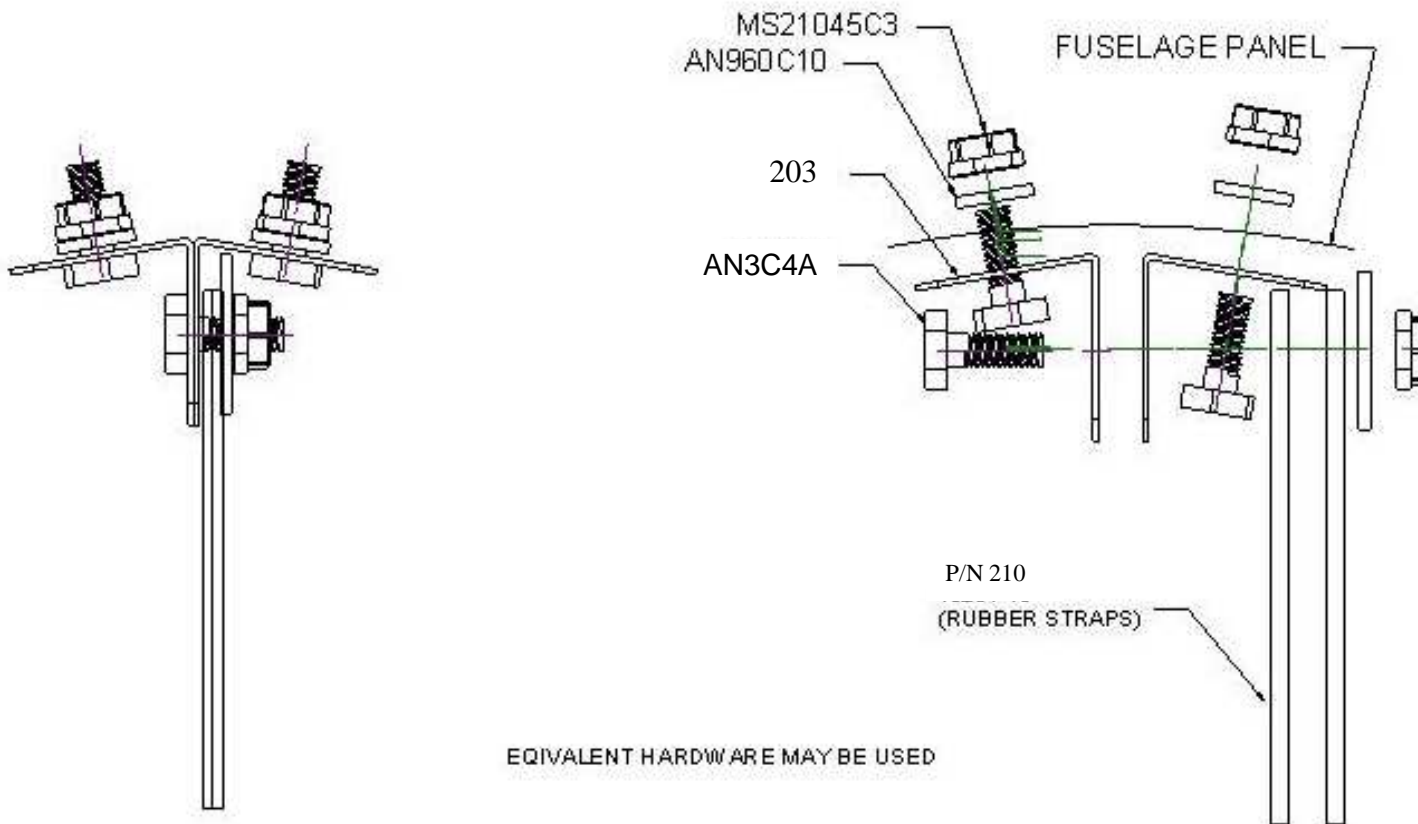
INSTALLATION OVERVIEW

INSTALLATION OVERVIEW



DETAIL B – BRACKET INSTALLATION

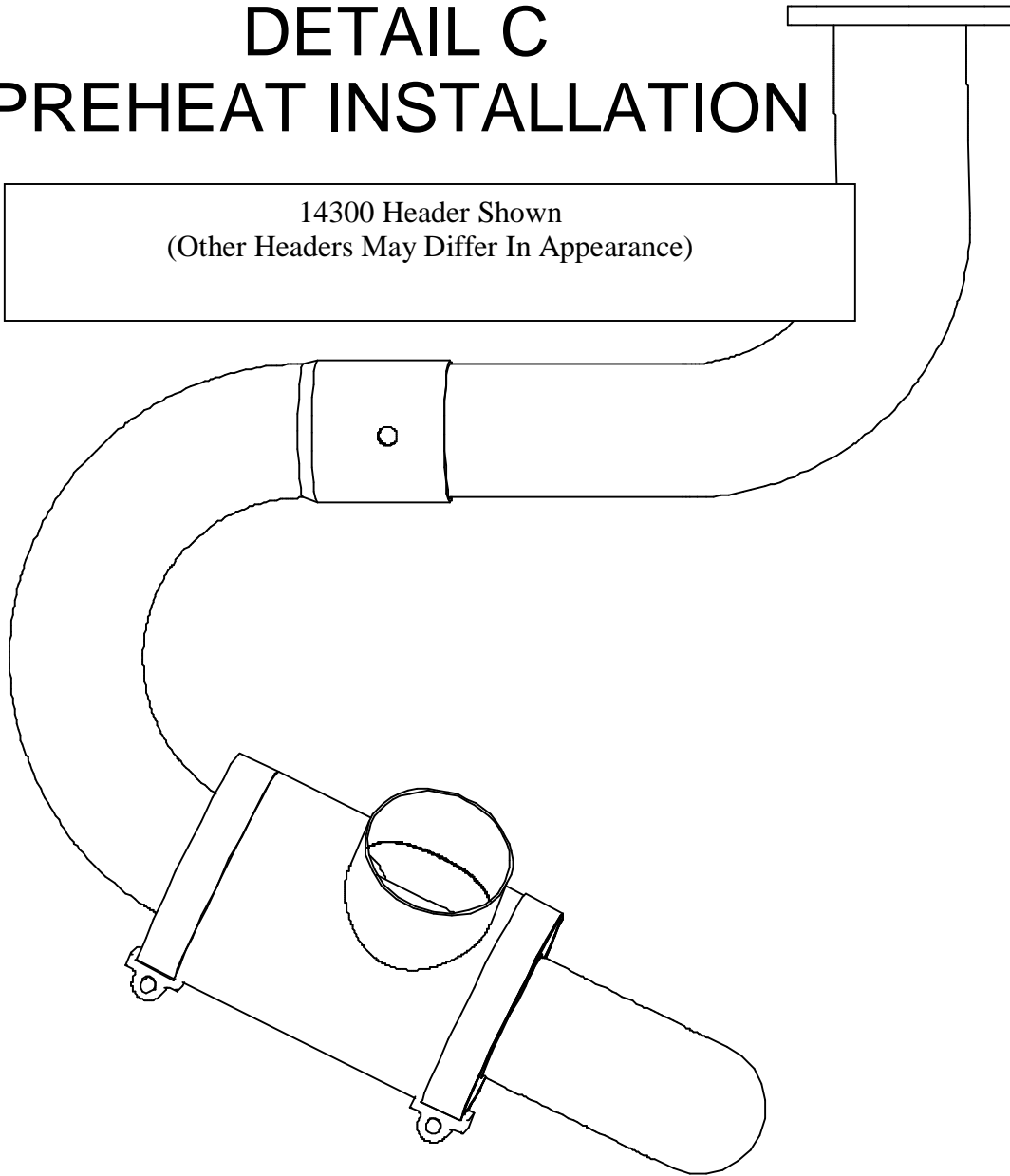
DETAIL B BRACKET INSTALLATION M20E AND M20F ONLY



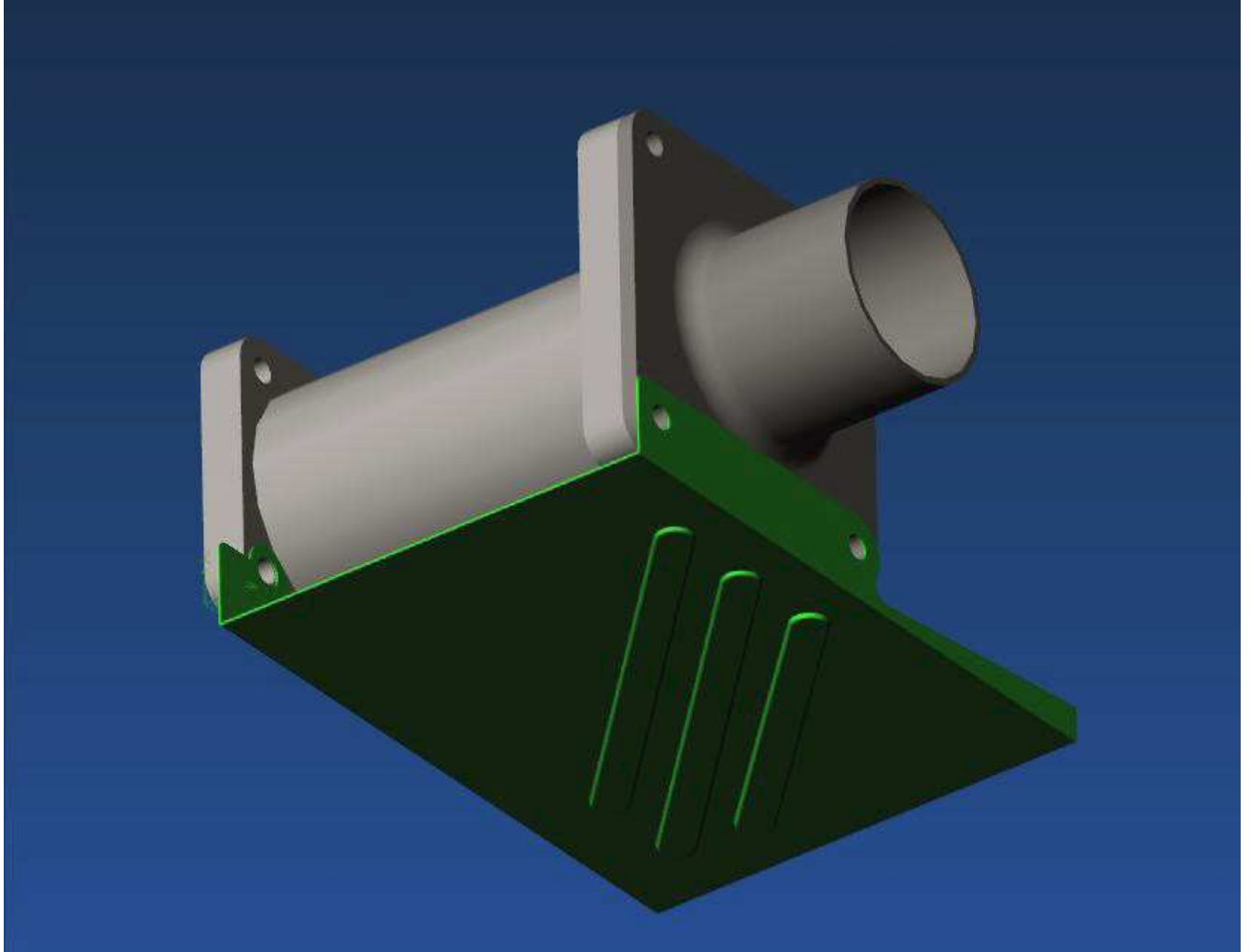
DETAIL C – PRE-HEAT INSTALLATION

DETAIL C PREHEAT INSTALLATION

14300 Header Shown
(Other Headers May Differ In Appearance)



DETAIL D – SERVO HEAT SHIELD INSTALLATION (only applicable for M20J, with first generation exhaust only)



Only applicable for M20J, with first generation exhaust only: Install heat shield to bottom of fuel servo using two forward and one aft attach bolts as shown. If equipped with a ram-air door, the ram-air actuating cable may need to be rerouted slightly for clearance. On some aircraft the cable is best routed below the shield. Torque and Safety in accordance with the latest approved revision of the applicable Mooney Service Manual.



Installation Instructions and
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PHOTOCOPY OF STC

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

Supplemental Type Certificate

Number SA02871AT

Valid only with 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
therefor as specified herein meets the airworthiness requirements of Part 23 of the Federal Aviation
Regulations.

Original Product - Type Certificate Number: 2A3

Make: Mooney

Model: M20E, F, J

Description of Type Design Change: Install Powerflow Systems, Inc., tuned exhaust system to enhance engine performance,
in accordance with the Installation Instructions contained in Report Number PFS-16150-00, Revision IR, dated January 08, 2004 or
later FAA approved revision..

Limitations and Conditions: This STC installs no Airplane Flight Manual Supplement (AFMS). Instructions for Continued
Airworthiness, contained in Report No. PFS-16150-00, Revision IR, dated January 08, 2004 or later FAA approved revision, must be
provided to the user 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 : January 15, 2004

Date reissued :

Date of issuance : May 27, 2004

Date amended :



By direction of the Administrator

Christina S. Marsh
(Signature)

for Melvin D. Taylor
Manager
Atlanta Aircraft Certification Office,

(Title)