



Installation Report Number: 08059

Document Number: 541SMAN0001

Revision Number: D

Aircraft Serial Number: _____

STC Number: SA4342NM

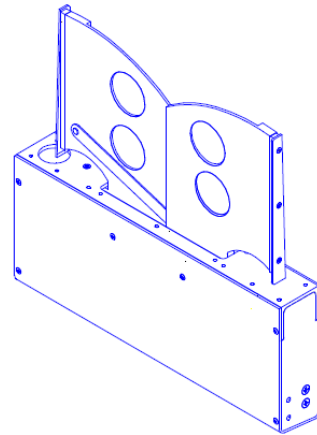
PRECISE FLIGHT, INC.
63354 POWELL BUTTE ROAD
BEND, OR 97701
800-547-2558

www.preciseflight.com

2000 SERIES Electronic SPEEDBRAKE™ - INSTALLATION MANUAL

Make: Mooney

Models: M20 Series and M22



NOTICE

The Airworthiness Limitations section (Section 4.0) is FAA Approved and Specifies maintenance required under Sections 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA Approved.

These Documents must be Kept with the Aircraft Records

NOTE: READ THESE DIRECTIONS BEFORE STARTING!

**CHECK FOR EQUIPMENT THAT MAY INTERFERE WITH INSTALLATION
BEFORE PROCEEDING!**

**ALL WORK MUST BE DONE IN CONJUNCTION WITH APPLICABLE AIRCRAFT
MAINTENANCE MANUAL!**

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REVISIONS HISTORY

Rev.	Description of Changes	Author	Date	Approved By	Approved Date
-	Original Release	STP	10/20/1999	STP	10/20/1999-
A	On page 10 Sect. G, Step 4, Incl. Statement to clarify Doubler placement. Page 11 Sect. H, Step 5, Add instructions to correct for possible existence of interference from wing skin. Page 15 Sect. K, Table & Step 1, Change PN's of old ALC's to new ALC PN	STP	4/5/2000	STP	4/5/2000
B	Sect. K, Table & Step 1, Change PN's of old ALC's to new ALC PN	MAO	3/19/2001	MAO	3/19/2001
C	Added document number, updated document format, changed PFI address, change part numbers from inventory codes to part numbers on pages 8 - 12, 15, 19, and 20. Updated overview sections, added section on use of manual. Added section 4.0 (except for ICA table). Removed drawing callout from Appendix.	MEK	7/14/2005	-	-
D	Updated part #s & reformat tables throughout. Added warranty web address to item 8 of section 1.0. Fixed various misspellings and typos throughout document, Section 2.9: updated ALC part number to 010S0303-1, added alt ALC location. Updated Section 4.0 to current PFI standards; Added Section 5.0 (References); Updated Section 6.0 (old section 5.0)	R. Norris	3/14/10		3/xx/12

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1.0 OVERVIEW

1.1 INSTALLATION OVERVIEW

1. Read through the entire manual, and become familiar with the drawings, **before** beginning any part of the installation process.
2. The installation of Precise Flight, Inc. SpeedBrakes™ consists of cutting openings in the top of each wing skin using locating templates (Drawings).
3. Installing doublers to reinforce the cutout areas, which will require removing existing rivets and installing new rivets.
4. No painting is necessary, except for the touching up of reinstalled and new rivet heads, if desired.
5. Installing the asymmetric logic control unit (ALC) and wiring the SpeedBrakes™ will require removing the interior, running wires through the fuselage from the ALC unit to the switch location, installing wiring from the ALC to the individual SpeedBrake™ Cartridges in the wing installing a circuit breaker to protect the system, and a switch to actuate the ALC and SpeedBrake™ Cartridges.
6. Functionally checking SpeedBrake™ operation.
7. Filling out necessary FAA paperwork and logbook entries to return the aircraft to service.
8. Completing warranty information at <http://preciseflight.com/support/warranty> and submitting to PFI.

Each section will include a list of tools and parts required.

1.2 HOW TO USE THIS MANUAL AND READ THE DRAWINGS

1.2.1 Notes and Warnings

Because of the uniqueness of this installation in existing aircraft, Precise Flight has added notes, cautions, and warnings to the installation manual.

NOTE

Notes are used to emphasize certain steps to prevent problems with the installation. We at Precise Flight have added these notes to prevent problems before they occur based on our experience installing these systems, or from 'your' feedback.

! CAUTION !

Cautions are used if aircraft damage can occur due to a missed step. Please remember, we only have these in key locations based on previous experience. It is the installer's responsibility to make sure the installation is done correctly, and to airworthiness standards.

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!! WARNING !!
Warnings are used to emphasize a part of the installation where if done incorrectly can pose a serious hazard to the installer or the pilot.

1.2.2 Drawing Interpretation

All drawings produced by Precise Flight Inc, are based on ASME Y14.5-1994 standards, measurements in Inches, and Third Angle Projection. Information on the drawings including notes, parts, etc. are part of the FAA approved design and in most cases do include important installation and manufacturing information.

Third Angle Projection is the method drawing views are produced as shown in Figure 1.

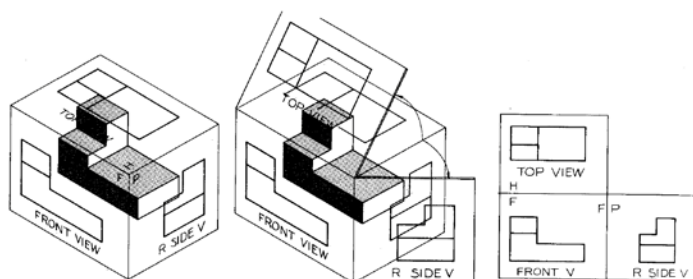


Figure 1 - Third Angle Projection Example
(Earle, James. "Engineering Design Graphics")

1.2.2.1 Parts Lists

A source of possible confusion when reading drawings is the proper interpretation of the parts list. This STC includes multiple aircraft models, and system voltages, in the same drawing package.

Figure 2 below shows a sample SpeedBrake installation, and which drawings are applicable.

2	2	PL 01750	-	PLACARD, SPEEDBRAKE	-	15
Or1	Or 1	-	541S0017-1	INTERCONNECT INSTALLATION, ALT.	-	14
1	1	-	541S0014-1	INTERCONNECT INSTALLATION, OEM	-	13
-	-	-	-	-	-	12
1	-	-	541S0003-4	CARTRIDGE INSTALLATION - RIGHT	12 VDC	11
1	-	-	541S0003-3	CARTRIDGE INSTALLATION - LEFT	12 VDC	10
-	1	-	541S0003-2	CARTRIDGE INSTALLATION - RIGHT	24 VDC	9
-	1	-	541S0003-1	CARTRIDGE INSTALLATION - LEFT	24 VDC	8
-	-	-	-	-	-	7
1	-	-	541S0002-2	COCPIT CONTROL INSTALLATION, 12 V	-	6
-	1	-	541S0002-1	COCPIT CONTROL INSTALLATION, 24 V	-	5
-	-	-	-	-	-	4
-	-	-	-	-	-	3
\	-	-	541S0001-2	SPEEDBRAKE INSTALLATION, 12V	-	2
\	\	-	541S0001-1	SPEEDBRAKE INSTALLATION, 24V	-	1
-2	-1					
QTY REQD		CODE	PART NO.	DESCRIPTION	MATERIAL/MFG.	ITEM

Figure 2 - Sample Parts List from Drawing 541S0001

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This chart shows part number 541S0001-1. Because all models listed on the STC are applicable, this installation would be used for any electrical system as described in section 2.0 of this document, or on the STC certificate. From here, the installer moves to the left until a “\” marks that applicable installation. Follow the column up to see what quantity is greater than 0. Then follow the chart back to the right to find the drawing/part number for the applicable installation. Drawings are shown in this example, but parts work on the same principle on the other installation drawings.

1.3 IMPORTANT INSTALLATION NOTES

This section lists specific installation notes of importance for this STC installation.

NOTE

It is the installer’s responsibility to verify that the installation of the SpeedBrake™ 2000 system will not interfere with any existing modification on the aircraft prior to starting the installation. Contact Precise Flight if there appears to be an installation conflict.

! CAUTION !

Verify aircraft voltage and SpeedBrake kit voltage prior to installation. Failure to use correct installation kit may damage aircraft systems, or SpeedBrake installation.

1.4 LIST OF TOOLS REQUIRED

Each section will include a list of tools required and all necessary parts for that section.

Table 1 - Tools Required

TOOLS REQUIRED		
Automatic Center Punch	Bucking Bars	Tape Measure, 12’ min
Inspection Mirror	Micro Adjust Countersink	Chip Chaser
Needle Nose Pliers	Clecos: 3/32, 1/8	Nutplate Jig #8-32
Cleco Pliers	Pencil	Rivet Squeezer
3/32 & 1/8 Countersink Die Set	Riveter: Cherry-Max	Deburr Tool
2x or 3x Rivet gun	Flush, 3/32, and 1/8 rivet sets	Die Grinder
Machinists Scale: 12” (minimum)	Drill Motor	Abrasive Cutting Wheel
Screwdrivers: Slotted and Philips	Drills: #40, #30, #12, 5/16, and 5/8” Unibit	Metal Snips: Right, left offset
Felt Marker – Ultra Fine Point	Soldering iron, electronic solder	Files: ¼” Round, 6” Flat
FAA Advisory Circular 43.13	Heat Gun	Volt Ohm meter
Hole-Finder	Wire Cutter and Strippers	Electrical contact crimper
Shim 0.050” – 0.090”		

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1.5 LIST OF SUPPLIES REQUIRED

Table 2 – Supplies Required

SUPPLIES REQUIRED		
Carbon Paper 2- 8 ½ x 11 Sheets	Masking Tape	Double Sided Tape
Solder: Rosin Core for electronics	Isopropyl Alcohol	Primer (per Mil-P-23377D)
3M Adhesive or Equivalent	Loctite 222	

1.6 LIST OF ABBREVIATIONS

This section is to provide the reader with a complete set of the abbreviations used in this document and installation.

Table 3 – List of Abbreviations

A/R	As Required
AC	Advisory Circular
FAA	Federal Aviation Administration
Lb, lbs	Pounds
PFI	Precise Flight, Inc.
VDC	Volts Direct Current
WS	Wing Station

1.7 MANUAL AND ICA REVISIONS

To ensure the maintenance of our existing aircraft fleet, possible revisions to this manual and especially section 4.0 Instructions for Continued Airworthiness may require updating over the life of the aircraft. Per the applicable Federal Aviation Regulations, an update process is required to properly maintain these instructions, in addition to the aircraft itself. Because of this, it is imperative to complete the online registration for the aircraft once the system is installed.

Revisions can be made by a service letter from Precise Flight, an Airworthiness Directive as issued by the administrator, by single page updates, or a complete replacement of all pages of the manual. It must be clearly noted as to the revision level of the pages listed in The List of Active Pages. If a single sheet(s) is replaced, replace the list of active pages with the new one provided, or update the list manually and initial and date the list.

2.0 INSTALLATION INSTRUCTIONS

Read all installation instructions prior to starting the installation, or modifying the aircraft. If necessary, please contact Precise Flight Incorporated at (541) 382-8684 and ask for SpeedBrake assistance or at www.PreciseFlight.Com, or write us at the address above, if you have any questions.

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! CAUTION !

Verify aircraft voltage and SpeedBrake kit voltage prior to installation.
Failure to use correct installation kit may damage aircraft systems or SpeedBrake system.

2.1 LOCATING WING CUTOUTS

TOOLS REQUIRED		
Automatic Center Punch	Masking Tape	Tape Measure
Felt tip marker		

PARTS REQUIRED		
Part Number	Qty	Description
541S0006-1	1	Upper Right Wing Template
541S0007-1	1	Upper Left Wing Template

1. Place template 541S0006-1 on the right aircraft wing between WS 88.75 and WS 103.5 and align template with trailing edge. Adjust template so that the row of rivets marked "CRITICAL RIVET LINE" maintain a 2D edge clearance on doubler joggle and doubler edge as shown on template. Once aligned, secure the template to the wing skin using masking tape.
2. Using the template as a guide, identify and mark the existing rivets to be removed.
3. Locate the two points labeled corner rivet location and center punch transfer these two locations to the wing skin.
4. Locate the 4 new rivet locations along Wing Station 88.75 between existing rivets and transfer these locations to the wing skin using a center punch.
5. Remove the template and set aside.
6. Repeat steps 1 thru 5 on the left wing using Template 541S0007-1.

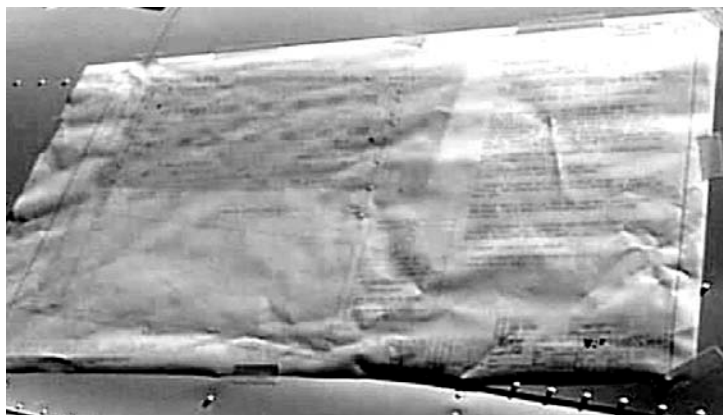


Figure 3 - Wing Template Taped to Wing

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2.2 RIVET REMOVAL

TOOLS REQUIRED		
Drill bits: #40, #30	Drill motor	

1. On the right wing upper skin, identify all rivet types and their sizes to be removed (marked in Step 2.1.2).
2. Drill out all rivets marked using the proper size drill. A rivet centering drill tool may be helpful in drilling out the rivets.
3. Using a #40 bit, drill the 2 corner rivet pilot holes marked with center punch in step 2.1.3.
4. Repeat steps 1 thru 3 on the left wing.

2.3 DOUBLER PLACEMENT

TOOLS REQUIRED		
Clecos: 1/8, 3/32	Cleco pliers	Drill bits: #30, #40
Ultra-fine felt tip marker		

PARTS REQUIRED		
Part Number	Qty	Description
541S0006-1	1	Upper Right Wing Template
541S0007-1	1	Upper Left Wing Template
541S0008-2	1	Right Upper Doubler
541S0008-1	1	Left Upper Doubler

1. On the right wing, cleco the upper doubler (P/N 541S0008-2) onto the wing skin using the 2 corner rivet location holes and 3/32" Clecos. See Template 541S0006-1.
2. Using a #40 bit, drill through the remaining pre-drilled pilot holes in the doubler through the wing skin. Use Clecos to secure the doubler as you go.
3. With an ultra-fine felt marker, trace the wing cutout onto the wing skin. This line will be used to mark the cutout in the wing skin.
4. Repeat steps 1 thru 3 on the left wing using upper doubler P/N 541S0008-1. See Template 541S0007-1.

2.4 WING CUTOUTS

TOOLS REQUIRED		
Drill motor	Drill bit: 1/4"	1/4" round file
Masking Tape	Masking paper	6" flat file
Die grinder	abrasive wheel	Metal Snips



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PARTS REQUIRED		
Part Number	Qty	Description
010S0067-1	2	Cover Plate

Various methods may be employed to make the cutouts in the wings. **Use Extreme Care!** It has been proven helpful to do the following:

1. Mask off the wing around the area to be cut to protect finish. Reference figure 4.
2. Drill a 1/4 inch hole well inside all four corners of area marked in section 2.3 step 3.
3. Using a 1/4 inch round file, file the corners close to the traced lines.
4. Using a die grinder and abrasive cutter, or snips, cut lines between the holes, staying well within the traced lines.
5. File the openings up to the traced lines using a combination of the 1/4 inch round and 6-inch flat files.
6. Cleco the doubler on top of the wing skin and finish filing the opening to the doubler.
7. Use the cover plate P/N 010S0067-1 to check the size of the opening. The cover plate should fit snugly in the opening.
8. Repeat steps 1 thru 7 on the Left wing.

NOTE

The cutouts will be the finished product. Care must be taken when finishing these openings.



Figure 4 - Wing Cutout

2.5 DOUBLER INSTALLATION (PRELIMINARY)

TOOLS REQUIRED		
Drill motor	Drill bit: #30	Clecos: 3/32, 1/8
Inspection mirror	Cleco pliers	Ultra-fine felt tip marker

PARTS REQUIRED		
Part Number	Qty	Description
541S0006-1	1	Upper Right Wing Template
541S0007-1	1	Upper Left Wing Template
541S0008-2	1	Right Upper Doubler

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541S0008-1	1	Left Upper Doubler
541S0009-1	2	Upper Doubler Support Flange

The upper doubler and support flange are temporarily positioned under the skin and on top of the rib flanges with the joggle below the stringer.

RIGHT WING

1. Reference drawing template 541S0006-1.
2. Insert the Right Upper Doubler (P/N 541S0008-2) into the wing through the cutout.
3. Position the doubler between the skin and rib flanges, and below stringer.
4. Orient the holes in the doubler with the holes in the wing skin and cleco in place. Be sure that the doubler is placed between the wing skins and ribs on both the inboard and outboard ribs.

NOTE

The joggled edge on the doubler and outboard edge of the joggle may need to be trimmed to allow cutout hole alignment. Use inspection mirror to check this interference. Ensure that 2D rivet spacing is maintained after trimming.

5. Using a felt tip marker, transfer the rivet locations for the stringer and ribs onto the doubler.
6. Remove doubler and confirm 2D edge distance from rivet holes to doubler edges.
7. Position the doubler again between the skin and rib flanges, and below stringer. Cleco doubler to wing through pilot holes with 3/32 clecos.
8. Using a #30 bit, drill through the skin into the doubler at locations where rivets were removed. Cleco with 1/8 clecos as you go.
9. Insert the upper doubler support flange (P/N 541S0009-1) under the upper doubler. You may need to slide the upper doubler support flange between the upper doubler and wing ribs to obtain the correct position.
10. Cleco the support flange in place through pre-drilled holes using 3/32 clecos.
11. Use an inspection mirror to check upper doubler support flange does not interfere with outboard overlapping wing skin. If interference exists, trim outboard wing skin using a stainless steel backing plate to avoid cutting the inboard (exposed) wing skin; make sure to maintain proper edge distance on all rivets. Alternatively, trim the upper doubler support flange being careful to maintain edge distance on all rivets.
12. Using #30 bit, drill pilot holes through upper doubler and support flange to final size.
13. Remove the upper doubler and support flange and deburr. Remove rivet tails and any chips inside the wing. Mark support flange for right wing.

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- Repeat steps 1 thru 9 on the left wing using P/Ns 541S0008-1 and 541S0009-1. Reference PFI drawing 541S0007-1. Mark support flange for left wing.

2.6 UPPER DOUBLER INSTALLATION

TOOLS REQUIRED		
Bucking bars	Cleco pliers	Clecos: 1/8
Rivet gun	Chip chaser	Drill bit: #30

PARTS REQUIRED			
Part Number	Qty	Description	PFI Number
541S0008-1	1	Left Upper Doubler	-
541S0008-2	1	Right Upper Doubler	-
MS20470AD4-5	58	Rivet, Universal Head, 1/8 x 5/16	MS 00528
MS20470AD4-3	16	Rivet, Universal Head, 1/8 x 3/16	MS 00480

RIGHT WING

Reference drawings 541S0006 & 541S0007.

- Cleco right upper doubler (P/N 541S0008-2) in place as in section 2.5 steps 2, 3, and 4.
- Rivet the upper doubler in place. Reference drawing 541S0006 for correct rivets. Do NOT rivet the holes intersecting with the support flange (P/N 541S0009-1) at this time. Leave support flange unriveted to facilitate wing access for lower support installation.
- Repeat steps 1 and 2 on the left wing using left upper doubler (P/N 541S0008-1). Reference drawing 541S0007.

2.7 SPEEDBRAKE™ CARTRIDGE INSTALLATION (TEMPORARY)

TOOLS REQUIRED		
Deburr Tool	Cleco pliers	Clecos: 3/32, 1/8
Drill Motor	Drill bits: #40, #27, 5/16"	Double sided tape
.050"-.090" Shim	Screw Driver - #2 Philips	Loctite 222 or equiv.

PARTS REQUIRED			
Part Number	Qty	Description	PFI Number
541S0003	1	Drawing, Cartridge Installation	-
541S0011	1	Drawing, Lower Support Installation	-
541S0009-1	1	Upper Doubler Support Flange	-
010S0059-71*	1	Cartridge Assembly, 12V, Right	-
010S0059-72*	1	Cartridge Assembly, 12V, Left	-
010S0059-73**	1	Cartridge Assembly, 24V, Right	-
010S0059-74**	1	Cartridge Assembly, 24V, Left	-
AN525-832R7	8	Screw, Washer Head, #8-32 x 7/16	MS 01431



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MS24693-C2	18	Screw, Flat Head Philips, SS, #4-40 x 1/4	MS 07025
541S0016-1	2	Bracket Assembly, Lower support	-
MS21061L08	8	Nutplate, One Lug, Floating, 8-32	MS 07032
MS20426AD3-3	16	Rivet, CSK Head, 3/32 x 3/16	MS 00486
010S0067-1	2	Cover Plate, Speedbrake	-
2810	2	Snap Bushing, Heyco	HD 06062

* = Parts required for 12V option.

** = Parts required for 24V option. See packing list.

RIGHT WING

1. The SpeedBrake™ Cartridges are biased forward - less space forward than aft. Orient the drain tube to the inboard side. The SpeedBrake cartridges are marked left and right - confirm you have the correct cartridge for the right wing installation. Reference drawings 541S0003 and 541S0011.
2. Cleco right side support flange (P/N 541S0009-1) to upper doubler using 1/8 clecos.
3. Attach the Cover Plate (P/N 010S0067-1) to the SpeedBrake cartridge with 9 ea. #4-40 screws (P/N MS 07025 or MS 07016) and Loctite 222.

! CAUTION !

The supplied screws are the proper length - Use of alternate screws to attach the cover plate will interfere with proper SpeedBrake operation and will compromise the component warranty.

4. Place a small amount of grease on the end of the drain tube, and position the SpeedBrake Cartridge in the wing and to mark the location on the lower wing skin where the drain tube would pass through. If the drain tube is excessively curved, temporarily place a dowel or rod into drain tube to straighten it. Ensure the cartridge is aimed straight into the cutout and the cover plate remains parallel to the top surface of the wing, and that the point where the drain tube contacts the inside of the wing is 1" away from the edge of any stringer or rib. Make a mark on the bottom inside of the wing with the grease on the end of the drain tube. Remove the cartridge from the cutout.
5. Drill a 5/16" dia. Hole at the drain tube mark. Deburr the hole and install snap bushing (P/N HD 06062) into the hole from the bottom side of the wing.
6. Attach some double-stick tape to bottom flanges of the lower support bracket (P/N 541S0016-1). Place a 0.070" $\pm$ 0.020" spacer (a tongue depressor works well) between the bracket and the cartridge. Center the bracket on the bottom of the SpeedBrake cartridge. Reference drawing 541S0003 for correct orientation. If needed, bend the support bracket slightly so the support grips the cartridge.
7. Carefully install cartridge with lower support bracket into the wing cutout. Feed the drain tube through the snap bushing. Press down to ensure that the cartridge is seated

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squarely in the opening and that the bracket adheres to the lower wing surface. The cover plate should fit flush in the opening when the cartridge is positioned correctly. Remove the cartridge from the wing, leaving the lower support bracket in place.

8. Drill two #40 holes in bottom wing skin through pre-drilled holes in forward flange of bracket. Cleco in place.
9. Drill two more #40 pilot holes in bracket through wing in the center of aft flange of bracket, with same edge distance as the pre-drilled holes in forward flange. Re-drill fore and aft holes to final size using a #27 bit.
10. Remove bracket, remove tape residue, and deburr holes in wing.
11. Using a 8-32 nutplate jig, drill rivet holes in bracket flanges, countersink, deburr and install nutplates (P/N MS 07032) to top of flanges using the supplied rivets (P/N MS 00486). Reference drawing 541S0011.
12. Attach bracket to inside bottom wing skin using four #8-32 Screws (P/N MS 01431).
13. Repeat Steps 1 thru 12 for the left wing.

2.8 EXTERIOR PANEL AND INTERIOR REMOVAL

TOOLS REQUIRED		
Screw Drivers, #1, #2 Philips		

1. Remove the front seats, pilot's side panel molding, and aft belly panel.

2.9 INSTALLATION OF THE ASYMMETRIC LOGIC CONTROL (ALC)

TOOLS REQUIRED		
AC 43.13-1(B) Chap. 11	Automatic Center Punch	Deburr Tool
Drill Motor	Drill bits: #12	Screw Driver: #2 Philips
Adhesive*	Felt tip marker	

* Mil-A-47074 or A-A-56015 Type I or II, Class 2 (Armstrong A-12, A-12T, or equiv.)

PARTS REQUIRED			
Part Number	Qty	Description	PFI Number
541S0001	1	Drawing, Speedbrake Installation	-
541S0002	1	Drawing, Cockpit Control Installation	-
541S0014	1	Drawing, Interconnect Installation	-
541S0015	1	Drawing, Aircraft Schematic Retrofit	-
541S0017	1	Drawing, Alt. Interconnect Installation	-
AS33671-4	1	Cable Tie, Nylon	HD 00427
NAS1149FN816P	4 or 5	Washer, Flat, #8	MS 00452
MS21044N08	4 or 5	Nut, Self-Locking, #8-32	MS 00485
AN525-832R7	4 or 5	Screw, Washer Head, #8-32 x 7/16	MS 01431
010S0303-1	1	ALC Assembly	-
MS21919WDG8	1	Clamp, Cushioned (Adel)	MS 07014

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MS21266-1N	1	Edging, Grommet	HD 06064
7566K62	1	Holder, Cable Tie, Self-Adhesive	HD 06066

CABIN – Under AFT Seats and Floorboard (STD Location)

CABIN – Attached to Avionics Shelf in AFT Fuselage (ALT Location)

1. Reference drawing 541S0014 (STD location) or 541S0017 (ALT location).
2. Place ALC (P/N 010S0303-1) in desired mounting location. Mark hole locations with fine tipped marker, then dimple with automatic center punch.
3. Drill 4 holes using a #12 bit, and deburr.
4. Install the ALC as shown using the four #8-32 screws, #8 washers, #8-32 nuts, and one Adel clamp (STD location). (P/N's MS 01431, MS 00452, MS 00485, and MS 07014)
5. Drill 1 hole using a #12 drill, and deburr for Adel clamp (ALT location only).
6. Be sure to route all three cable assemblies through the Adel clamp.
7. Install the grommet edging (P/N HD 06064) with adhesive to avoid chafing of the cable assemblies (STD location only).
8. Install cable tie holder with the self-adhesive backing to the aluminum panel as shown. Tie the 3 cable assemblies to the holder (STD location). (P/N HD 06066, HD 00427)
9. Check ALC unit and cable assembly installation does not interfere with any other aircraft systems.

2.10 WIRING SPEEDBRAKE™ CARTRIDGES TO THE ALC

TOOLS REQUIRED		
AC 43.13-1(B) Chap. 11	Inch Scale	Soldering Iron
Rosin Core Solder	Volt-Ohm Meter	Screw Driver: #2 Philips
Wire Cutter	Wire Stripper	Terminal Crimper

PARTS REQUIRED			
Part Number	Qty	Description	PFI Number
541S0015	1	Drawing, Aircraft Schematic Retrofit	-
205838-1	2	Connector Housing, Plug, CPC, #11-8	EL 01726
1-206062-6	4	Connector Backshell, CPC #11	EL 01727
M81969/1-02	1	Tool, Contact Insert/Extract	EL 01773
9421	360	Cable, 8 conductor, 22 AWG	SP 02029
66569-3	16	Contact, Socket, Solder, 20-24 AWG	EL 01728
66570-3	16	Contact, Pin, Solder, 20-24 AWG	EL 01725
205841-2	2	Connector Housing, Receptacle, CPC #11-8	EL 01729

RIGHT WING LOWER

1. Remove under wing inspection panels from the SpeedBrake™ bay to the wing root.

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2. Carefully measure the distance from the right SpeedBrake™ cutout in the wing to the ALC mount in the cabin. Allow for routing through the wing with sufficient slack at both ends. Route the cable (P/N SP 02029) through the wing using the “J” stiffener holes in the ribs where possible. After routing cable, cut to length. Save the remainder.
3. On the ALC end of the cable, strip the jacket back exposing wires 5/8”.
4. Remove ¼” of insulation from all wires.
5. Solder a contact pin (P/N EL 01725) to the end of each wire.
6. Insert the wire ends through the connector backshell and clamp (P/N EL 01727).
7. Refer to drawing 541S0015 for wire color to pin mapping. Insert pins into their respective holes in the connector receptacle housing (P/N EL 01729).
8. Attach the backshell (P/N EL 01727) to the housing (P/N EL 01729). Tighten the strain relief to the cable jacket. Check for pin continuity with a Volt-Ohm meter.
9. Connect the ALC plug and assembled receptacle together. Secure the cable using AC 43.13-1(B), Chapter 11 as guidance.
10. Repeat Steps 3 to 8 on the SpeedBrake™ end of the Wiring Harness using sockets and plug housing instead of pins. (P/N's EL 01728, EL 01726 and EL 01727).
11. Repeat Steps 1 to 10 for the Left SpeedBrake™ Cartridge.

2.11 WIRING THE ALC TO INSTRUMENT PANEL

TOOLS REQUIRED		
AC 43.13-1(B) Chap. 11	Inch Scale	Soldering Iron
Rosin Core Solder	Volt-Ohm Meter	Screw Driver: #2 Philips
Wire Cutter	Wire Stripper	Terminal Crimper

PARTS REQUIRED			
Part Number	Qty	Description	PFI Number
541S0015	1	Drawing, Aircraft Schematic Retrofit	-
205838-1	1	Connector Housing, Plug, CPC, #11-8	EL 01726
1-206062-6	1	Connector Backshell, CPC #11	EL 01727
M81969/1-02	1	Tool, Contact Insert/Extract	EL 01773
9421	A/R	Cable, 8 conductor, 22 AWG	SP 02029
66569-3	8	Contact, Socket, Solder, 20-24 AWG	EL 01728

1. Route the remaining cable (P/N SP 02029) from the ALC mounting location in the cabin, through the floorboards, pilot's side panel, to the instrument panel, leaving sufficient slack at both ends. Secure cable according to AC 43.13-1(B), Chapter 11. Cut the cable to length and save the scrap.
2. On the ALC end of the cable strip the jacket back exposing wires 5/8”.

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- Remove ¼" of insulation from all wires.
- Solder a socket contact (P/N EL 01728) to the end of each wire.
- Insert the wire ends through the connector backshell and clamp (P/N EL 01727).
- Refer to Drawing 541S0015 for wire color to pin mapping, and insert the sockets into their respective holes in the connector plug housing (P/N EL 01726).
- Attach the backshell (P/N EL 01727) to the housing (P/N EL 01726). Tighten the strain relief to the jacket. Check for pin continuity with a Volt-Ohm meter.

2.12 CIRCUIT BREAKER AND SWITCH INSTALLATION

TOOLS REQUIRED		
Needle Nose Pliers	Drill Motor	Soldering Iron
Rosin Core Solder	Volt-Ohm Meter	Drills: 7/16, 5/8 Uni-Bit
Wire Cutter	Wire Stripper	Terminal Crimper

PARTS REQUIRED			
Part Number	Qty	Description	PFI Number
541S0002	1	Drawing, Cockpit Control Installation	-
541S0015	1	Drawing, Aircraft Schematic Retrofit	-
7277-2-3	1	Circuit Breaker, 3A	EL 01270
*See Below	1	Annunciator, Amber (Optional)	EL 02404
2194A3-12V	1	Annunciator Light, 12V Amber (Std)	EL 02185
2194A3-28V	Or 1	Annunciator Light, 28V Amber (Std)	EL 02186
PB-12331ZQ	1	Switch, Push On/Off, Yoke Mount	EL 01265
31-261.0252	Or 1	Switch, On/Off, w/Annunciator, Panel Mount	EL 01184
31-903.6	1	Lens, Blue, for EAO Switch	EL 01185
010S0202-1	1	Switch Placard, EAO	-
GE336	1	Bulb, 12V, for EAO Switch	EL 01187
GE334	Or 1	Bulb, 24V, for EAO Switch	EL 00961

* Eaton P/N 58210A0B0C3F4L5N1(A)P11,13SPEED,BRAKE

Reference Drawings 541S0002 & 541S0015

- At the instrument panel, install and wire the circuit breaker (P/N EL 01270). Reference drawing 541S0015 for proper wiring.
- Insert the proper light bulbs into the switch or annunciator, depending on option ordered. (P/Ns depend on kit option ordered; see packing list for part numbers.)
- Install the switch and annunciator within full view and easy access of the pilot. Use drawings 541S0002, 541S0015, and AC 43.13-1(B) Chapter 11 for reference.
- Control switch may be yoke mounted using EL 01265 with panel mount annunciator EL 02404, EL 02185 or EL 02186; or panel mounted using EL 01184 (with integral annunciator).

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NOTE: For switch and annunciator locations other than that shown, obtain separate FAA engineering approval.

2.13 SPEEDBRAKE™ CARTRIDGE INSTALLATION (PERMANENT)

TOOLS REQUIRED		
Screw Driver: Philips #2		

PARTS REQUIRED			
Part Number	Qty	Description	PFI Number
541S0003	1	Drawing, Cartridge Installation	-
MS24694-C5	28	Screw, #8-32 x ½, FHP, Struct, SS	MS 07041
010S0059-71*	1	Speedbrake Cartridge, 12V (Right)	-
010S0059-72*	1	Speedbrake Cartridge, 12V (Left)	-
010S0059-73*	Or 1	Speedbrake Cartridge, 24V (Right)	-
010S0059-74*	Or 1	Speedbrake Cartridge, 24V (Left)	-

* See Packing List

RIGHT WING

1. Attach the wiring harness to the cartridge. Drop cartridge into wing opening ensuring that the drain tube is fed through the grommet and the cartridge is seated firmly on the lower support. Check that cartridge is flush with top skin.
2. Attach the Speedbrake cartridge with cover plate to the upper support flange, using 14 ea. #8-32 screws (P/N MS 07041).
3. Trim drain tube 1/4 inch from wing skin at an angle away from the direction of airflow.
4. Repeat Steps 1 through 3 for the left wing.

2.14 PLACARDS

PARTS REQUIRED			
Part Number	Qty	Description	PFI Number
541S0001	1	Speedbrake Installation	-
541S0002	1	Cockpit Control Installation	-
-	1	Placard, Panel, Speedbrake Equipped	PL 00456
010S0200-1	2	Placard, Speedbrake	-
-	2	Placard, Wing, Speedbrake	PL 01750

1. Clean surfaces with isopropyl alcohol; Install instrument panel placard (P/N PL 00456) in full view of the pilot.

**SPEEDBRAKE EQUIPPED: FOR OPERATING INSTRUCTIONS & LIMITATIONS
SEE SUPPLEMENT IN OWNERS MANUAL OR OPERATING HANDBOOK.**

2. Install placards (P/N 010S0200-1) at SpeedBrake™ circuit breaker and next to SpeedBrake™ switch.

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3. Install placard (P/N PL 01750) on wing skin aft of SpeedBrake™ cartridges.

Electrically Actuated - DO NOT MANUALLY OPERATE

2.15 DOCUMENTATION

Before performing flight tests it is recommended you complete the calculations for weight and balance and revise the equipment list showing installation of Precise Flight SpeedBrakes™ (9-lbs. at 133.0" arm). Complete FAA form 337, section 8 "Description of work accomplished".

8. Description of Work Accomplished

(If more space is required, attach additional sheets. Identify with aircraft nationality and registration mark and date work completed.)

- A. The following components were installed:
PRECISE FLIGHT 2000 Series Electric SpeedBrake™ STC # SA4342NM.
Installation Kit Number _____.
- B. Installed the SpeedBrake system in accordance with Precise Flight Installation manual document 541SMAN0001 (report #08059) Rev D, and guidance in FAA Advisory Circulars 43.13-1(B), Chapter 11, and 43.13-2(B), Chapter 1 & 2.
- C. An electrical load analysis was performed and the revised continuous load of the alternator (*generator or other supply*) does not exceed 80% of capacity or approved in accordance with the procedures in FAA Advisory Circular 43.13-1(B), Chapter 11.
- D. A complete operational test was performed according to SPEEDBRAKE Installation Manual 541SMAN0001 dated _____. The equipment performed satisfactorily and did not adversely affect existing components or systems in the aircraft (EMI/RFI), as required by FAR 23.1301, FAR 23.1431.
- E. The aircraft equipment list was revised to reflect these changes; weight and balance data was revised and placed in the aircraft records. A Precise Flight Inc. SPEEDBRAKE Aircraft Flight Manual Supplement dated _____ was placed in the aircraft.

Figure 5 - Suggested FAA Form 337 Description of Work Statement

Add the FAA approved Flight Manual Supplement to the aircraft Flight manual.
Keep all Precise Flight 2000 Series SpeedBrakes™ papers with aircraft records.
Completing warranty information at <http://preciseflight.com/support/warranty> and submit to PFI.

3.0 TROUBLE SHOOTING GUIDE

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3.1 SPEEDBRAKE CARTRIDGE FAILS TO OPERATE CORRECTLY

- Check circuit breaker.
- Check connector plugs for security.
- Check all connector plugs for correct wiring (See Drawing 541S0015 for electrical schematic); ensure contacts are fully seated within connector housing and that contacts are properly crimped.
- Check that system voltage is adequate (no less than 11V or 22V DC.) The ALC is designed to disengage the SpeedBrake blades should either cartridge fail to fully deploy within a few seconds. Low voltage or corroded contacts may cause the ALC to time out, to retract the blades or behave erratically.
- The cartridge wire harness connectors, J2 and J3, may be reversed at the ALC to isolate a problem to a specific cartridge or the ALC. (This would cause the right cartridge to indicate as the left, and left as right, if separate annunciation is used.)
- A SpeedBrake cartridge may be removed from the wing and plugged directly into the ALC at connector P2 or P3 to isolate a harness problem.
- If SpeedBrake doors open, check that doors stop approximately $\frac{1}{4}$ " before becoming fully vertical. There should be no gap between the SpeedBrake doors. If doors open beyond this position, call Precise Flight, Inc.

3.2 WARNINGS

!! WARNING !!

Do not operate the SpeedBrakes™ by hand while electrical power is applied. Damage to cartridges and personal injuries may result!

!! WARNING !!

Do not use spray lubricants on SpeedBrakes™. Damage to cartridges and SpeedBrake clutch or motor may result!

3.3 FOR ADDITIONAL TECHNICAL ASSISTANCE

Please call Precise Flight, Inc. 800-547-2558

Additional information and products are available on the web, at

<http://www.preciseflight.com> or email us at preciseflight@preciseflight.com

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4.0 INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

4.1 INTRODUCTION

The content of this section provides the instructions for continued airworthiness for the SpeedBrake® 2000 Series System Installation. Because a majority of the installation does not affect the standard airworthiness of the aircraft, only the key items that are different are noted in this section. All structure and general maintenance must be performed in accordance with existing approved maintenance practices, or the aircraft maintenance manual.

4.2 SYSTEM DESCRIPTION

The Series 2000 SpeedBrake® Option consists of wing mounted electric SpeedBrake® Cartridges. Each SpeedBrake Cartridge is interconnected electronically by a central Automatic Logic Control unit and the yoke or instrument panel mounted SpeedBrake actuator switch. The SpeedBrake® Cartridges receive electrical power from the aircraft electrical buss through a disconnect type circuit breaker.

The Precise Flight SpeedBrake® 2000 System is installed to provide expedited descents at low cruise power, glide path control on final approach, airspeed reduction and an aid to the prevention of excessive engine cooling in descent. The SpeedBrakes can be extended at aircraft speeds up to V_{ne} .

The SpeedBrake Annunciator is located near the airspeed indicator. The SpeedBrake switch is activated **ON** to fully deploy and **OFF** to retract the SpeedBrakes. The annunciation indicates deployment when both SpeedBrake® units are deployed. A failure of a single cartridge drive unit will prevent the Annunciator light from illuminating.



Figure 6 – SpeedBrake Annunciator

The Annunciator will light after the SpeedBrake® Switch is toggled ON and both brakes are in the up position. If the Annunciator fails to light and both brakes do not extend after the switch is depressed, it indicates a failure of one SpeedBrake® cartridges, and the SpeedBrake® switch should be depressed OFF. The system can be checked again for proper operation, but after the second attempt, the SpeedBrake® switch should be left **OFF**. When the SpeedBrake® Switch is depressed **OFF**, the Annunciator will extinguish when both brakes are fully stowed in the wing. In the unlikely event that the SpeedBrakes®

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do not retract when the switch is depressed OFF, the circuit breaker can be pulled to remove power from the system. Springs will retract the blades with power removed.

4.3 SPECIAL TOOLS REQUIRED

Refer to Table 1 and Table 2 of this document for a list of special tools and materials required for installation and maintenance of the SpeedBrake® 2000 system.

4.4 MAINTENANCE INSTRUCTIONS

Maintain aircraft structure, and wiring in accordance with aircraft maintenance manual, and FAA AC 43.13.

4.5 TROUBLE SHOOTING GUIDE

Refer to Section 3 of this document for trouble shooting guide.

4.6 AIRWORTHINESS LIMITATIONS

The Airworthiness Limitations section (Section 4.0) is FAA Approved and specifies maintenance required under Sections 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

Note – The operation of the SpeedBrake® System does not impact the airworthiness limitations and is not required for normal flight.

4.7 SCHEDULED MAINTENANCE INTERVALS AND INSPECTIONS FOR CONTINUED AIRWORTHINESS

This section includes the inspection intervals, and requirements for maintenance of the SpeedBrake® 2000 system when installed in the aircraft. The breakdown of required inspections is listed in Table 4.



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Table 4 - Scheduled Maintenance Intervals and Inspections

MOONEY SPEEDBRAKE 2000™	EACH 5000 HOURS				
	EACH 1000 HOURS				
	ANNUALLY				
	EACH 100 HOURS				
	EACH 50 HOURS				
1. Check Cap Strip attachment screws for security, if loose, remove screws and apply Loctite 262, re-torque to 8 in-lbs. Check SpeedBrake cover plate attachment screws for security, if loose, remove screws and apply Loctite 222, re-torque to 8 in-lbs.	•				
2. Check drain tubes for debris	•				
3. a.) Remove inspection plates b.) Disconnect electrical plugs c.) Remove SpeedBrakes™ from aircraft d.) Clean and Inspect unit for damage, corrosion, looseness & proper operation e.) Lubricate worm and worm gear with AeroShell 22. DO NOT USE SPRAY LUBRICANTS! f.) Reinstall SpeedBrakes™ in aircraft g.) Connect electrical plugs h.) Install inspection plate i.) Check for proper placards			•		
4. a.) Remove inspection plates b.) Disconnect electrical plugs c.) Remove SpeedBrakes™ from aircraft d.) Return SpeedBrakes™ to Precise Flight Inc. for Clutch Lubrication and Spring Replacement e.) Reinstall SpeedBrakes™ in aircraft f.) Connect electrical plugs g.) Install inspection plate h.) Perform operational check per Section 2				•	
5. a.) Remove inspection plates b.) Disconnect electrical plugs c.) Remove SpeedBrakes™ from aircraft d.) Return SpeedBrakes™ to Precise Flight Inc. for Drive Assembly Replacement e.) Reinstall SpeedBrakes™ in aircraft f.) Connect electrical plugs g.) Install inspection plate h.) Perform operational check per Section 2					•

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5.0 REFERENCES

1. FAA AC43.13-1, Acceptable Methods, Techniques, and Practices – Aircraft Inspection and Repair, Revision B Chg 1, September 2001 (or later FAA approved revision).
2. FAA AC43.13-2, Acceptable Methods, Techniques, and Practices – Aircraft Alterations, Revision B, March 2008 (or later FAA approved revision).
3. Federal Aviation Regulations Part 43 (FAR 43) Effective 8 August 2006 Including Amendments 43-0 through 43-44, Maintenance, Preventive Maintenance, Rebuilding, and Alteration, Department of Transportation, Federal Aviation Administration

6.0 ELECTRICAL LOADS ANALYSIS:

MODEL _____
S/N _____
DATE _____

The following provides additional information to revise the existing aircraft Electrical Load Analysis.

The following is a list of SpeedBrake components that place a continuous load on the aircraft circuitry. It is recommended that under no condition shall the total continuous electrical load be more than 80% of total alternator capacity. Revise existing electrical load analysis, or create a new list

OPTIONAL EQUIPMENT	NO. OF UNITS	AMPERES PER UNIT
SpeedBrake Clutch - 24 VDC	2	0.12
SpeedBrake Clutch - 12 VDC	2	0.24
SpeedBrake Annunciator Lights	1	0.08

The following is a list of SpeedBrake components that place an intermittent load on the aircraft circuitry. Do not include these items when computing the total electrical load.

INTERMITTENT LOAD EQUIPMENT	NO. OF UNITS	AMPERES PER UNIT
SpeedBrake Drive -24V	2	1.0
SpeedBrake Drive -12V	2	2.0

	NO.		AMPERAGE
EXISTING AIRCRAFT CONTINUOUS LOAD			
REVISED AIRCRAFT CONTINUOUS LOAD			

NOTE: Please ensure that the revised Electrical Load is in accordance with the procedures in FAA Advisory Circular 43.13-1(B), Chapter 11.