United States of America

Department of Transportation — Federal Aviation Administration

Supplemental Type Certificate

Number SE445GL

This certificate, issued to Shadin Company, Inc.
14280 North 23rd Avenue
Plymouth, MN 55447-4910

certifies that the change in the type design for the following product with the limitations and conditions thereof as specified hereon meets the airworthiness requirements of Part 13 *of the* Civil Air *Regulations.* See Type Certificate Data Sheet E14EA for complete certification basis.

Original Product — Type Certificate Number: E14EA

Make: Lycoming

Model: TIO-540-A1A, -A2A, -A2B, -A1C, -A2C, -A1B, -C1A, -F2BD, -J2BD, -S1AD, AB1AD, LTIO-540-F2BD, and -J2BD

Description of Type Design Change:

Incorporation of a Fuel Flow Transducer in accordance with Shadin Company Report Number 4020, revised September 14, 1988, or later FAA approved revision.

Limitations and Conditions:

This approval should not be extended to other engines of these models on which other previously approved modifications are incorporated unless it is is determined by the installer that the interrelationship between this change and any other previously approved modifications will introduce no adverse effect upon the airworthiness of these engines.

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: July 31, 1980

Date reissued:

Date of issuance: September 15, 1980

Date amended: October 12, 1984, October 31, 1985
December 16, 1988

By direction of the Administrator

W. F. Horn *(Signature)*

Manager, Chicago Aircraft Certification Office
ACE-115C, Central Region
(Title)

Any alteration of this certificate is punishable by a fine of not exceeding $1,000, or imprisonment not exceeding 3 years, or both.

This certificate may be transferred in accordance with FAR 21.47.

FAA Form 8110-2 (10-68)

Shadin Co., Inc. 4020
14280 N 23 Avenue
Plymouth, MN 55447

Report: 4020
Original Date: 31 July 1980
Revision Date: 14 September 1988
Subject: Digital Fuel Flow Meter Installation

LYCOMING TIO-540-A1A, A1B, A1C
A2A, A2B, A2C
C1A
J2BD
F2BD
S1AD
AB1AD
LTIO-540-J2BD

FAA
APPROVED
DEC 13 1988
CHICAGO AIRCRAFT
CERTIFICATION OFFICE
CENTRAL REGION
ACE-130C

STOP

YOUR AIRCRAFT MAY HAVE OPTIONAL EQUIPMENT INSTALLED. THIS COULD CHANGE THE LENGTH OF FUEL LINES REQUIRED TO INSTALL THIS SYSTEM. PLEASE CHECK YOUR AIRCRAFT FOR PROPER LENGTH BEFORE CUTTING OR BUYING FUEL LINES.

FAA
APPROVED

DEC 19 1988

CHICAGO AIRCRAFT
CERTIFICATION OFFICE
CERTIFICATE
ACE-130C 27

Shadin Co., Inc.
14280 N 23 Avenue
Plymouth, MN 55447

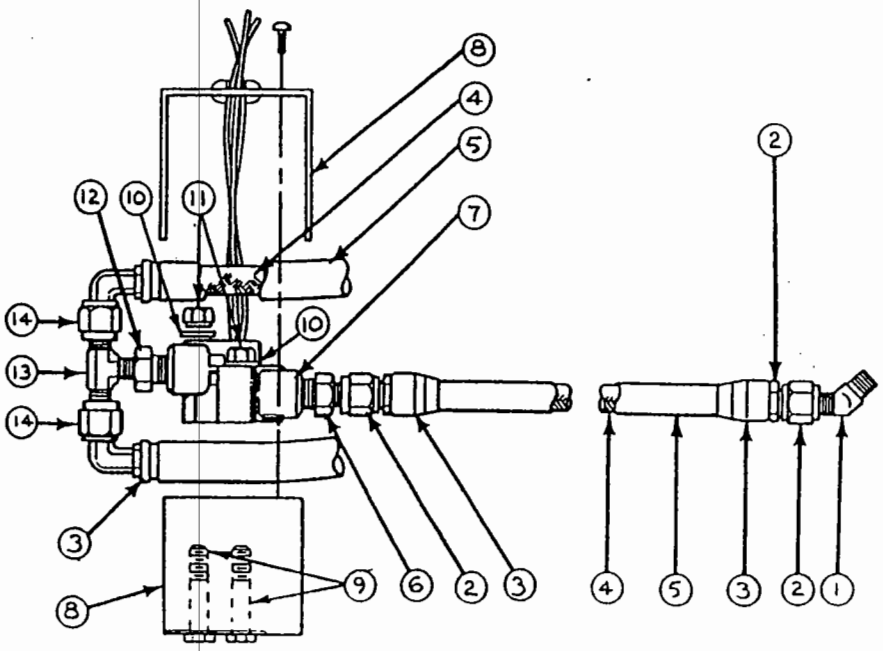
REPORT #: 4020

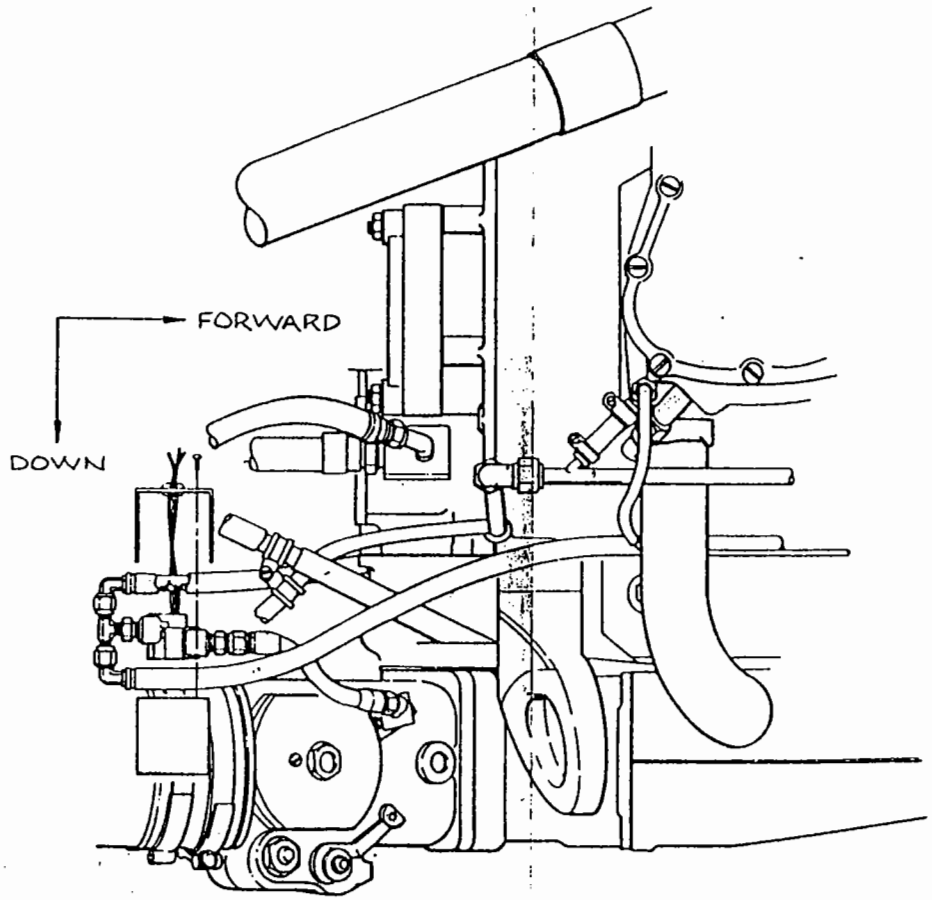
Original Date: 31 July 1980
Revision Date: 14 September 1988

PAGE CONTROL CHART

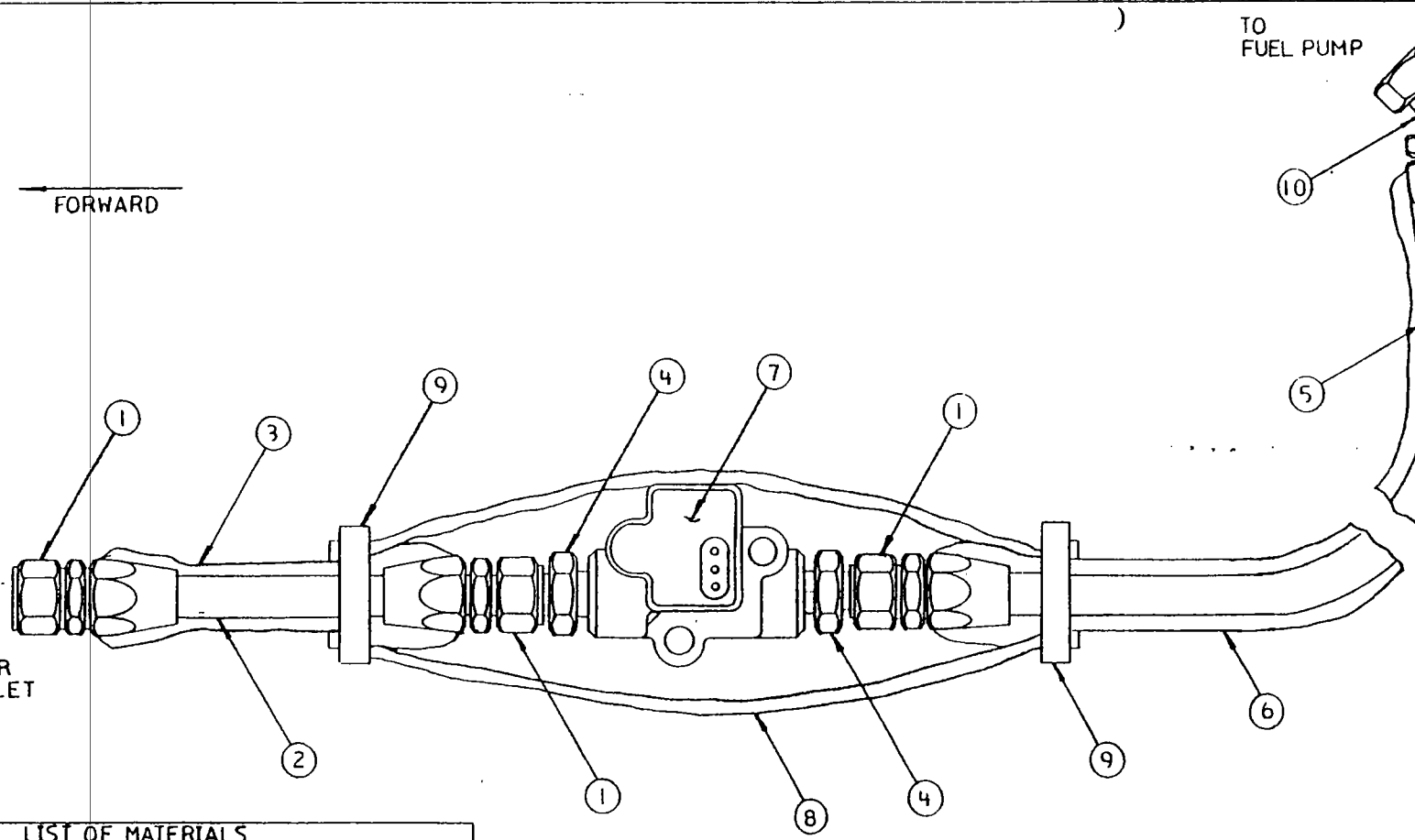
SEC. I.	DATE	REVISION
Drawing List		
4020-20 Transducer Installation	31 July 80	-
4020-21 Transducer Installation	05 July 88	B
4020-22 Transducer Installation	11 Aug. 86	-
SEC. II.		
System Description		
Page 1	30 Sep. 85	-
Page 2	30 Sep. 85	-
SEC. III.		
Installation Procedure		
Page 1	31 July 80	-
Page 2	31 July 80	-
Page 3	16 July 80	-
Page 4	05 Jul. 88	A
Page 5	11 Aug. 86	-
SEC. IV.		
Technical Specifications		
Page 1	11 Aug. 86	A

LIST OF MATERIALS			
F/N	QTY	PART NO.	DESCRIPTION
1	1	MS 51528	45° ELBOW
2	2	816-4	AEROQUIP HOSE FITTING
3	6	A-3122-14-IJ	STRATOFLEX SPEED CLAMP
4	9"	601-4	AEROQUIP HOSE
5	9"	AE102/624-8	AEROQUIP FIRE SLEEVE
6	1	MS 51500	STRAIGHT
7	1	201-B	TRANSDUCER
8	1	610504	FIRE SHIELD BOX
9	2	AN 4-12A	BOLT
10	2	AN960-416L	WASHER
11	2	MS 20365-428	NUT
12	1	1/4 x 1/8 PTR-S	BUSHING
13	1	MS 51512	TEE
14	2	8891-4	AEROQUIP HOSE FITTING





UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES TOLERANCES:	ORIGINAL DATE OF DRAWING 7-31-80 DRAFTSMAN D.E. FORD CHECKER ENGINEER SUBMITTED	SHADIN COMPANY, INC. MINNEAPOLIS MINNESOTA 55426 FUEL FLOW TRANSDUCER ADDITION LYCOMING TIO-540-A1A, A2A, A1B, A2B, A1C, A2C, J2BD, F2BD, S1AD
MATERIAL:	NEXT ASSEMBLY:	CODE IDENT NO. 4020-D20 / SIZE B / REV LTR A



FAA
APPROVED

[illegible]

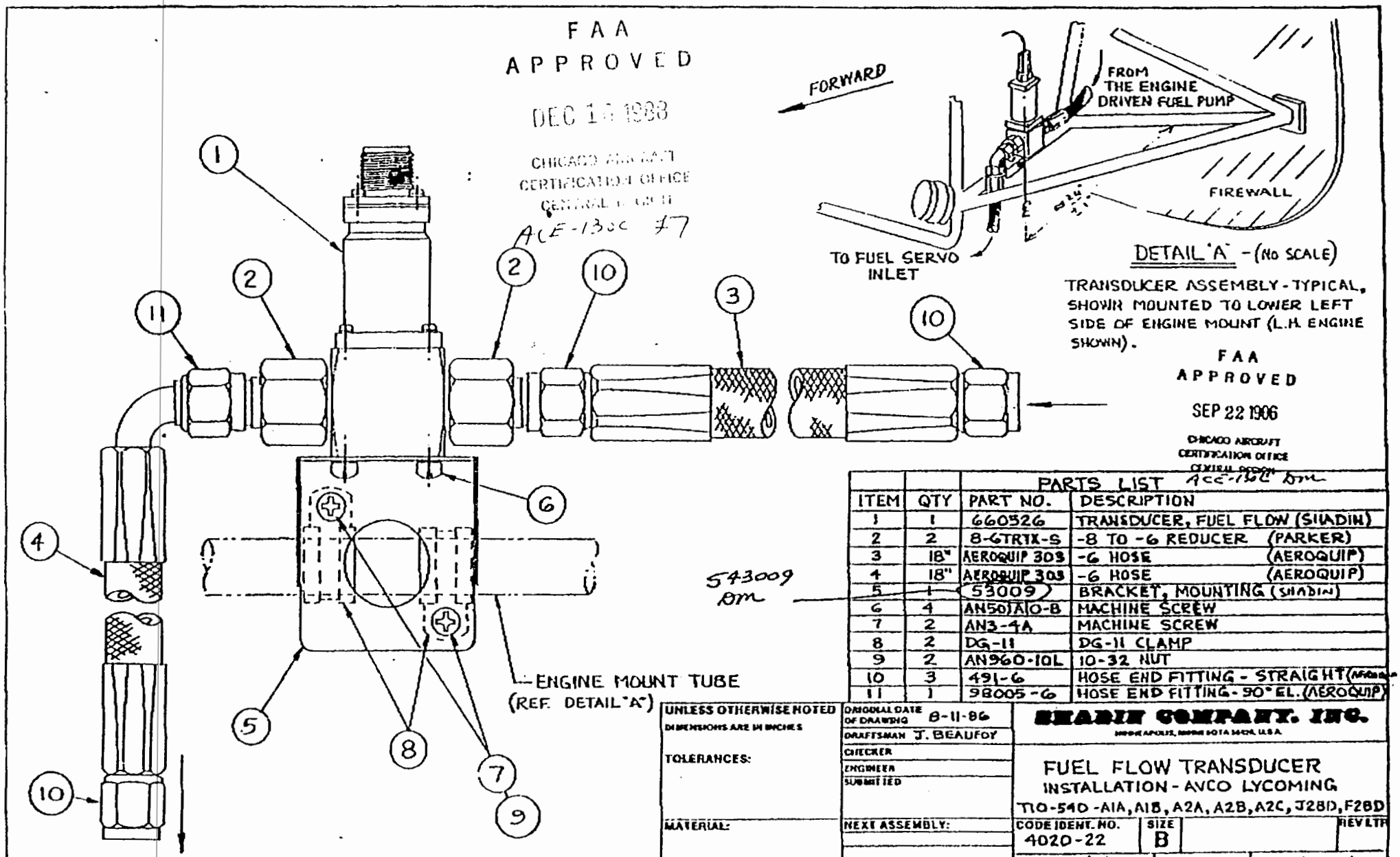
ACE 130c 27
Bv B.

LIST OF MATERIALS			
FIN	QTY	PART NO	DESCRIPTION
1	3	491-6	AEROQUIP FITTING
2	7 1/2	303-6	AEROQUIP HOSE
3	7 1/2	AE102/624-12	AEROQUIP FIRESLEEVE
4	2	AN816-6	PIPE TO FLARE FITTING
5	28"	303-6	AEROQUIP HOSE
6	28"	AE102/624-12	AEROQUIP FIRESLEEVE
7	1	2018/680501	FLOW TRANSDUCER
8	7"	AE102/624-24	AEROQUIP FIRESLEEVE
9	2	A-3122-8-1J	SPEED CLAMP
10	1	980006-6	45° AEROQUIP FITTING

7-5-88 &7

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES TOLERANCES:	ORIGINAL DATE OF DRAWING 9-30-85 DRAFTSMAN A HAMLINE CHECKER ENGINEER SUBMITTED	SHADIN COMPANY, INC. MINNEAPOLIS, MINNESOTA 55426, U.S.A. FUEL FLOW TRANSDUCER ADDITION AVCO LYCOMING TIO-540-C1A, AB1AD	
MATERIAL:	NEXT ASSEMBLY:	CODE IDENT. NO. 4020-21	SIZE B
		SCALE	WGT.
			REV LTR BA
			SHEET OF

FAA
APPROVED
DEC 14 1988
CHICAGO AIRCRAFT
CERTIFICATION OFFICE
ACE-130C #7



DETAIL "A" - (NO SCALE)

TRANSDUCER ASSEMBLY - TYPICAL, SHOWN MOUNTED TO LOWER LEFT SIDE OF ENGINE MOUNT (L.H. ENGINE SHOWN).

FAA
APPROVED
SEP 22 1906
CHICAGO AIRCRAFT
CERTIFICATION OFFICE
ACE-130C

543009 DM

PARTS LIST

ITEM	QTY	PART NO.	DESCRIPTION
1	1	660526	TRANSDUCER, FUEL FLOW (SHADIN)
2	2	8-6TRTX-S	-8 TO -6 REDUCER (PARKER)
3	18"	AEROQUIP 303	-6 HOSE (AEROQUIP)
4	18"	AEROQUIP 303	-6 HOSE (AEROQUIP)
5	1	53009	BRACKET, MOUNTING (SHADIN)
6	4	AN501A10-8	MACHINE SCREW
7	2	AN3-4A	MACHINE SCREW
8	2	DG-11	DG-11 CLAMP
9	2	AN960-10L	10-32 NUT
10	3	491-6	HOSE END FITTING - STRAIGHT (AEROQUIP)
11	1	98005-6	HOSE END FITTING - 90° EL. (AEROQUIP)

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES

TOLERANCES:

MATERIAL:

ORIGINAL DATE OF DRAWING 8-11-86

DRAFTSMAN J. BEAUFOY

CHECKER

ENGINEER

SUBMITTED

NEXT ASSEMBLY:

SHADIN COMPANY, INC.
MINNEAPOLIS, MINNESOTA 55424, U.S.A.

FUEL FLOW TRANSDUCER INSTALLATION - AVCO LYCOMING

TIO-540-A1A, A1B, A2A, A2B, A2C, J2BD, F2BD

CODE IDENT. NO. 4020-22

SIZE B

REVISIONS

SCALE 1:1 & AS NOTED

WGT. —

SHEET 1 OF 1

Report: 4020
Date: 31 July 1980
Rev.: 30 September 1985
Sec.: II.1

SYSTEM DESCRIPTION

Digiflo, the Digital Fuel Flow Meter, is designed to replace Analog Mechanical Pressure-type Fuel Flow Meters. It eliminates the hazardous fuel lines from behind the panel. It maintains a high degree of accuracy (+/- 2% or better) and provides additional functions such as time remaining, fuel used, and fuel remaining.

The system consists of a fuel flow transducer, located between the fuel control unit and fuel flow divider which generates electrical pulses corresponding to the amount of fuel passing through. The transducer is designed in such a way that if the rotor is blocked it cannot interrupt the fuel flow to the engine.

The panel mounted unit contains all circuits necessary to count the generated pulses through the microprocessor and to display the fuel flow and other functions. The fuel flow in gallons per hour is always displayed at the left window. The time remaining, gallons used, and gallons remaining are continuously computed and either displayed or stored for later display. The time remaining is displayed at the right display window. Gallons remaining and gallons used share the same right window and either can be displayed by pressing the appropriate button.

During power shut-down, the amount of fuel remaining and fuel used is stored into the memory, which is non-volatile, and requires no battery to retain the data.

Time remaining calculations are based on fuel remaining and actual fuel flow, which means that reducing the power or leaning the mixture will result in increasing the time remaining.

If the calculated time remaining at any particular power setting drops below 30 minutes, the "Time Remaining" digits in the display window will start flashing.

The test function will enable the pilot to check the software and hardware against any malfunction by running a diagnostic software program.

Report: 4020
Date: 31 July 1980
Rev.: 30 September 1985
Sec.: II.2

The accuracy of this instrument depends entirely upon the accuracy of the data entered. A periodical checking of the actual fuel onboard will eliminate the accumulation or errors due to evaporation, leaks, theft, etc.

The indicator K factor is matched with the flow transducer pulse count. If the transducer needs to be replaced, a new one with the same pulse count should be used or an error could occur.

INSTALLATION PROCEDURE

GENERAL:

A complete thorough familiarization and understanding of the system is necessary before commencing the installation. All work must conform with A.C. 43.13 1A Ch.11 Sec.2.

PROCEDURE:

1) Identify the engine's dash number and use the appropriate drawing (# 4020-D20). The transducer's dash number should match the dash number stamped on the instrument housing.

2) Shut off the DC power, fuel valves, and mixture controls.

3) Remove all top and bottom cowlings to gain access to the injector and the two distributor blocks on each side of the engine.

4) Disconnect and remove the two -4 hoses connecting the injector outlet tee and the distributor blocks.

5) Fabricate new hoses using the attached instructions and Aeroquip 601-4 hose. The length is equal to the length of the old hose plus 5" for the right bank and 8" for the left one, all measurements being from the end of the fittings. Each hose should have Aeroquip 816-4 straight fitting on one end and Aeroquip 8891-4 90° elbow fitting on the other.

6) Install all fire sleeves and secure with speed clamps.

7) Fabricate a 9" hose out of Aeroquip 601-4 hose and Aeroquip 816-4 fittings on each end as per the attached instructions. Add the fire sleeve and secure with speed clamps.

8) Install 45° elbow into the injector body as oriented by the drawing.

9) Assemble the transducer inside the fire shield box. Support with two AN4-12A bolts. Add the washers and fiber locks. Pass the wires through the grommets. Use -4 self-tapping screws to secure the cover to the fire shield box.

10) Install the straight MS 51500 fitting at the inlet (lower side) of the transducer, and the combination of the bushing and the tee at the outlet (higher side). The tee arms should be pointing up and down.

11) Connect and tighten one end of the 9" hose to the injector and the other end to the transducer inlet.

12) Install the right bank hose between the right distributor block and the top arm of the transducer outlet tee. The 8891-4 fittings should be on the transducer's side.

13) Install the left bank hose between the left distributor block and the bottom arm of the transducer outlet tee. The 8891-4 fitting should be on the transducer's side.

14) Connect the wires to the transducers using the B-14-D wrist locks with plastic sleeves to insulate and secure with tie wraps.

15) Turn the master switch and fuel selectors on, run the booster pumps, and check for leaks.

16) Start the engine and check the fuel pressure. Readjust if necessary following airframe and engine manufacturer instructions.

17) Make necessary entry into the engines logs.

ASSEMBLY INSTRUCTIONS FOR 303 HOSE AND 491 FITTINGS

Step 1 Cut hose squarely to length. Use hose cut-off machine or fine tooth hacksaw. Do not remove cover.
Step 2 Place socket in vise. Do not overtighten vise on thinwalled sockets of lightweight fittings. Screw hose into socket until it bottoms. Back-off 1/4 turn.
Step 3 Tighten nipple and nut on assembly mandrel.
Step 4 Lubricate inside of hose and nipple threads liberally. Use lubricating oil or light grease.
Step 5 Screw nipple into socket and hose using wrench on assembly tool hex. Nut must swivel freely when assembly tool is removed. Maximum allowable gap is 1/16 inch.

Clean, inspect, proof test (see below)

ASSEMBLY INSTRUCTIONS FOR 601 HOSE AND 816 FITTINGS

Step 1 Cut hose squarely to length. Use hose cut-off machine or fine tooth hacksaw. To minimize wire braid flare-out, wrap hose with masking tape and saw through tape. Remove tape before step 2.
Step 2 Insert hose in socket with a twisting, pushing motion until hose is in line with back of socket threads.
Step 3 Important-mark hose position around hose at rear of socket. Use a grease pencil, painted line or tape.
Step 4 Lubricate inside of hose and nipple threads liberally. Use SAE 30 lubricating oil. Avoid getting oil in the cutting spur of the nipple.
Step 5 Carefully insert nipple and engage nipple and socket threads while holding hose in position with other hand. Make sure that hose does not push out of socket by observing mark made in step 3.
Step 6 Complete assembly using wrench while continuing to hold in position. Maximum allowable gap is .041 inches in sizes 3,4,and 5, and .031 inches in size 6 and up.
Step 7 IMPORTANT-check for hose push-out by observing hose position mark. None should be evident.

Clean, inspect, proof test (see below)

CLEAN, INSPECT, PROOF TEST

1. CLEAN...Clean hose after cutting to length. Be sure all cutting residue is dislodged. After assembly, clean each hose assembly internally using clean, dry compressed air.
2. INSPECT...Examine hose assembly internally for cut or bulged inner tube, obstructions and cleanliness. Examine Aeroquip hose assemblies with "little gem" Fittings for hose push-out.

Shadin Co., Inc.
Report # 4020
Date : July 16,80
Rev : Original
Sec. : III.3

FAA
APPROVED

DEC 13 1988

CHICAGO AIRCRAFT
CERTIFICATION OFFICE
CENTRAL REGION
ACE-130C 27

Report: 4020
Date: 05 July 1988
Rev.: A
Sec.: III.4

==========

INSTALLATION PROCEDURE

GENERAL

A complete thorough familiarization and understanding of the system is necessary before commencing the installation. All work must conform with A. C. 43.13-1A ch. 14 sec. 2. Use this installation procedure for the TIO-540-C1A, -AB1AD.

PROCEDURE

1. Identify the engine dash number and use the drawing # 4020-21. The transducer's dash number should match the dash number stamped on the instrument housing, otherwise a considerable error could occur.
2. Shut off D.C. power, fuel values and mixture controls. Gain access to the bottom section of the engine.
3. Remove the -6 hose between engine driven fuel pump and the injector, fabricate the new hoses as shown in the drawings.
4. Install the AN 816-6 fittings into the transducer body. Connect the transducer to the hose as shown on the drawings. Monitoring the inlet and out ports. After tightening, slip the Aeroquip AE 102/624 fire sleeve over the transducer. Pass the transducer wires under the fire sleeve towards the firewall as shown on the drawings.
5. Tie the two ends of the fire sleeve using metal tie bands. Install the hose back between the engine driven pump and the injector.
6. Connect the wires to the transducers using the B-14-D wristlocks, with plastic sleeves to insulate and secure them with tie wraps.
7. Turn the master switch on, fuel selectors on, run the booster pumps and check for leaks.
8. Start the engine and check the fuel pressure. Read just if necessary following airframe and engine manufacturer instruction.
9. Make necessary entry into the engine logs.

FAA
APPROVED

SEP 22 1986

CHICAGO AIRCRAFT
CERTIFICATION OFFICE
CENTRAL REGION
ACE-130C DM

Report: 4020
Date: 11 August 1986
Rev.: --
Sec.: III.5

INSTALLATION PROCEDURE

GENERAL:

A complete thorough familiarization and understanding of the system is necessary before commencing the installation. All work must conform with A.C. 43.13 1A Ch. 11 Sec. 2. This instruction to cover the installation of the flow transducer P/N 660526.

PROCEDURE:

1) Identify the engine's dash number and use the appropriate drawing (# 4020-22). The transducer's pulse count should match the dash number stamped on the instrument housing.

2) Shut off the DC power, fuel valves, and mixture controls.

3) Remove all top and bottom cowlings to gain access to the injector and the engine driven fuel pump on the left side of the engine.

4) Disconnect and remove the -6 hose connecting the engine driven fuel pump to the injector inlet.

5) Fabricate new hoses using the attached instructions and Aeroquip 303-6 hose. All measurements being from the end of the fittings per 4020-22 drawing.

6) Install the transducer assembly on the lower left engine mount (flow arrow must point to the injector direction).

7) Install the hoses between the pump outlet and the injector inlet.

8) Connect the wires to the transducers using the airframe drawing.

9) Turn the master switch and fuel selectors on, run the booster pumps, and check for leaks.

10) Start the engine and check the fuel pressure. Readjust if necessary following airframe and engine manufacturer instructions.

11) Make necessary entry into the engines logs.

Report: 4020
Date: 11 August 1986
Rev.: A
Sec.: IV.1

TECHNICAL SPECIFICATIONS

INDICATOR SPECIFICATIONS

P/N:		9105xx or 9120xx
Maximum useable fuel:		900 Gallons
Maximum altitude:		40,000 ft.
Operating temperature:		-30 deg. C to 50 deg. C
Humidity:		up to 95% @ 32 deg. C
Flow Range:	When used with P/N 680501	.6-60 GPH/Engine
	When used with P/N 660526	1.5-70 GPH/Engine

ELECTRICAL RATING

Input voltage:	14-28 volt D.C
Input current:	400 ma

MECHANICAL RATING

Vibration:	5g
Weight:	Panel Unit: 15 oz.

TRANSDUCER SPECIFICATIONS

Fuel:	Aviation gasoline	
P/N:	680501	660526
Linear Flow Range:	0.6-60 GPH	7-70 GPH
Linearity Across Flow Range, percent of reading:	+/-2%	+/-1%
Average K Factor (pulses/gal):	84,000	42,800
Minimum Bursting Pressure:	2000 psi	16000 psi
Temperature Range:	-65'C/125'C	same
Life Expectancy:	5,000 hr.	12000 hr.
Spec:	TSO C-44a	TSO C-44a
Weight:	5 oz.	5 oz.