SOCATA TB-20

Converting to a Two Magneto Engine

Overview

I wish to thank Jon Miller, owner of Trinidad N5543T. He was the first to do a conversion! He is the trail blazer. Jon's help was very valuable.

As far as I know my conversion is the second conversion of a TB-20.

The following document is one owner's experience in converting from the Lycoming IO-540-C4D5D (Dual Mag) to the Lycoming IO-540-C4D5 (2 Mag) engine in a TB-20 Trinidad. Errors may be present in this document. It is only intended to give a general story of how the engine switch was done. Check appropriate SOCATA documents, Lycoming documents, FAA documents for all detailed information. This conversion described was done on a US Registered (FAA) aircraft. Other countries may have different rules and requirements.

The information provided is to be used at your own risk.

William W. Bennett

Engine Replacement and Converting from the Dual Magneto to Two Separate Magnetos in 161 days

SOCATA Trinidad TB-20

William W. Bennett

Figure 1: TB-20 Trinidad

I own a TB-20 Trinidad serial number 445. In 2021, I had owned the plane about 13 years and flown the plane for over 700 hours. Before I owned it, it had a factory Remanufactured Engine installed in 1994.

It was a "Chevron Engine" as I was told, when contaminated fuel was sold by Chevron at a few airports it damaged quite of few planes back in 1994. Chevron (or their insurance company) paid to have Factory Reman engines installed in the damaged planes.

When I bought the plane, N67RL had 917 hours on the engine in 2008. The 14 prior years prior to my purchase had various amounts of activity and some time with little or no hours of operation.

In 2021, the engine ran well with only some minor issues with the engine that started in the previous 18 months. First an Engine Fuel Pump was leaking and starting to fail. The fuel pump was replaced and worked fine.

Next the exhaust valve issue required the cylinder to be pulled and sent off for repair. The A&P reused the old rings, and from then on, oil consumption jumped.

The engine at this point has 1,500 hours and 27 years since overhaul (in this case factory remanufacture).

For many reasons I decided it was time to switch A&P's. At Annual inspection the new A&P fixed all the exterior oil leaks to see how this would change oil consumption.

After about a month of flying, oil consumption continued high. The JPI showed that #1 cylinder most likely the one with the leak. The new A&P felt pulling the #1 Cylinder and replacing rings was appropriate action to resolve the high oil consumption issue.

This is where things turned bad, upon removing the #1 cylinder, he found what he believed to be a high amount of corrosion on the connecting rods and some corrosion on the crank shaft.

Sadly, as he suggested looking deeper the tappets and other components had significant corrosion.

Note this is only one year after the previous A&P removed the #1 cylinder, and when asked he said only that "there is some corrosion in the engine but not more than I would have expected". He is also the one that did NOT re-hone the cylinder and reused the existing rings which I have been told is poor practice.

Problem Found, Now What to do?

The options were, a top overhaul but with tappets in bad shape an estimated 100 hours or 2 years I would be back for a total overhaul. A second A&P was brought in just to get additional insight. He concurred we could make it work for a while but it's days, due to corrosion, were numbered.

Lycoming technology upgrades. As I looked at the differences, I was quite interested in seeing how much the Lycoming factory has changed. Starting around 2005 they started eliminating many of the manual lathes going to CNC (computerized numerical control) machines. By around 2010 it sounds like all (or almost all) manual machines had been replaced and they were bringing some outsourced work back inhouse. Lycoming quality has always been pretty good for a long time, of course there are notable exceptions. But the introduction of more CNC machinery appears to have improved consistency in tolerances of parts produced.

I decided to look at both Major Overhaul Shops and Factory Overhaul and Factory Reman engines. In the end, I selected Factory Reman Engine from Lycoming. Built to new specification of parts, it only requires a running engine when taken out of service. For an overhaul, only parts designed to be replaced are built into the price, if the drive shaft, cam shaft, case, etc. fail inspection to overhaul limits (not new limits) then additional cost is incurred. With my situation of corrosion, it is possible many parts could fail. Also, in the back of my mind was to move to two magnetos but only if it made sense.

First part decided, Lycoming Factory Remanufactured engine was best for me. I felt I would have high confidence in the engine and the price was not going to change. Also, resale value will probably be the highest of all options. The next part is to decide if I want the same Lycoming IO-540-C4D5D or to switch to a different model engine.

Lycoming TBO (Time Between Overhaul)

The TBO for engines operated in the US under FAA Part 91 **do not require** you adhere to TBO recommendations by the manufacturer. But the information of the documented TBO is part of understanding how long the engine is designed to operate by the manufacturer.

While many owners speak of the hours of operation, few seem to discuss the calendar time period. Probably because this is the hardest number to deal with. Of course, frequency of usage, environment (especially damp environments) plays a huge factor on the useful life of the engine.

CALENDAR TIME PERIOD TBO

All engine models are to be overhauled within twelve (12) calendar years of the date they first entered service or of last overhaul. This calendar year time period TBO is to mitigate engine deterioration that occurs with age, including corrosion of metallic components and degradation of non-metallic components such as gaskets, seals, flexible hoses and fuel pump diaphragms.

⚠ **CAUTION** CALENDAR YEAR TBO IS BASED ON ACCELERATED TESTING AND OVERALL FLEET SERVICE DATA. LOCAL CLIMATE CONDITIONS, STORAGE CONDITIONS, FREQUENT EXTENDED PERIODS OF INACTIVITY, PRESERVATION TECHNIQUES USED DURING INACTIVE PERIODS, AND FREQUENCY OF OIL CHANGES CAN AFFECT CORROSION OF METALS AND DEGRADATION OF NON-METALS.

Figure 2: Lycoming Service Instruction No. 1009BE dated April 2020.

It seems it is common for many owners to want to jump to “how many hours are listed between overhaul”. It is only part of the picture for TBO.

Table 1
Fixed Wing Aircraft
Operating Hour Time Between Overhaul Periods

Engine Models/Series	See Note	Hours
IO-540-AG1A5	--------	1800
IO-540-C	1,10,11,15,16	2000
IO-540-D	1,10,15	2000

Figure 3: Lycoming Service Instruction No. 1009BE dated April 2020.

NOTES

1. Only engines built with 1/2 in. (12.7 mm) dia. exhaust valve stems. Engines of this series with 7/16 in. (11.1 mm) dia. exhaust valves must not exceed 1200 hours between overhauls regardless of the type of operation. New and rebuilt engines built with 1/2 in. (12.7 mm) dia. exhaust valve stems are identified, respectively, by serial numbers and date in the latest revision of Service Instruction No. 1136.

10. Some engines in the field have been altered to incorporate an inverted oil system in order to perform aerobatic maneuvers. Whenever this modification is done to an engine, the TBO of the engine must be determined in the same manner listed for AEIO engines of the same model series. See Note 6.

11. If an engine is being used in "frequent" type service, by accumulating 40 hours or more per month, and has been so operated consistently since being placed in service, add 200 hours to TBO time. (Engines affected by AD 2012-19-01 and not in compliance with AD-2012-19-01 are not eligible for this TBO extension.)

15. A 200-hour extension to the listed TBO can be applied to Lycoming Factory New, Lycoming Factory Rebuilt, and Lycoming Factory Overhauled engine models. Engine repairs or field overhauls that are performed by any entity other than the Lycoming Factory in Williamsport PA must meet all of the following requirements to be eligible for this 200-hour TBO extension:
    a. Be performed using ONLY Lycoming genuine parts or FAA-PMA parts approved by Lycoming
    b. Be performed using ONLY Lycoming approved procedures
    c. Block 12 of FAA form 8130-3 or international equivalent must indicate the repair or overhaul was performed using ONLY Lycoming approved procedures and Lycoming genuine parts or FAA-PMA parts approved by Lycoming

    A repair or overhaul performed using any FAA approved local shop procedures or using FAA-PMA parts not approved by Lycoming is not eligible for this 200-hour TBO. (Engines affected by AD 2012-19-01 and not in compliance with AD-2012-19-01 are not eligible for this TBO extension.)

16. When NOTE 15 is referenced with NOTE 11 for engine models in Tables 1 and 2, and the conditions of both NOTES are met, the sum of the extended TBO hours in both NOTES 11 and 15 can be added to the required TBO, thus extending the TBO a total of 400 hours. (Engines affected by AD 2012-19-01 and not in compliance with AD-2012-19-01 are not eligible for this TBO extension.)

Figure 4: Lycoming Service Instruction No. 1009BE dated April 2020.

Most engines seem to exceed the calendar time period of the TBO quite well. But by how long? One year, ten years, 50 years? But how about the hours portion? This too varies with some going 200% or 300% of number of hours. I suspect the engineers at Lycoming know very well why they put both calendar time and engine hours in their TBO. The operating conditions vary a lot. Frequency of use, conditions of use and storage can be huge.

Remanufactured Engine

Is Remanufactured Engine a real term? Well yes and no. As far as the FAA is concerned it is not. Yet they do define it in FAA Advisory Circular "Reciprocating Engine Overhaul Terminology and Standards" CI 43-11. It states in the Advisory Circular the following:

> ***e. Remanufacture.***
>
> *(1) The general term remanufacture has no specific meaning in the regulations. A new engine is a product that is manufactured from raw materials. These raw materials are made into parts and accessories that conform to specifications for issuance of an engine's TC. The term "remanufactured" infers that it would be necessary to return the part to its basic raw material and manufacture it again. "Remanufactured" as used by most engine manufacturers and overhaul facilities, means that an engine has been overhauled to meet the standards required to grant the engine zero time in accordance with § 91.421.*
>
> *(2) Not all engine overhaul facilities which advertise "Remanufactured Engines" overhaul engines to new dimensions. Some of these facilities do overhaul to new dimensions, but may not be authorized to zero time the engine records. As outlined in § 91.421, only the manufacturer or an agency approved by the manufacturer can grant zero time to an engine.*

CamGuard

In the last 10 year I regularly used CamGuard, not sure it helped or not. I do not know if it was used by prior owners. Clearly the corrosion does not go away because it is used. But it may have slowed down the corrosion, I am not sure. I do plan on using CamGuard with my new engine.

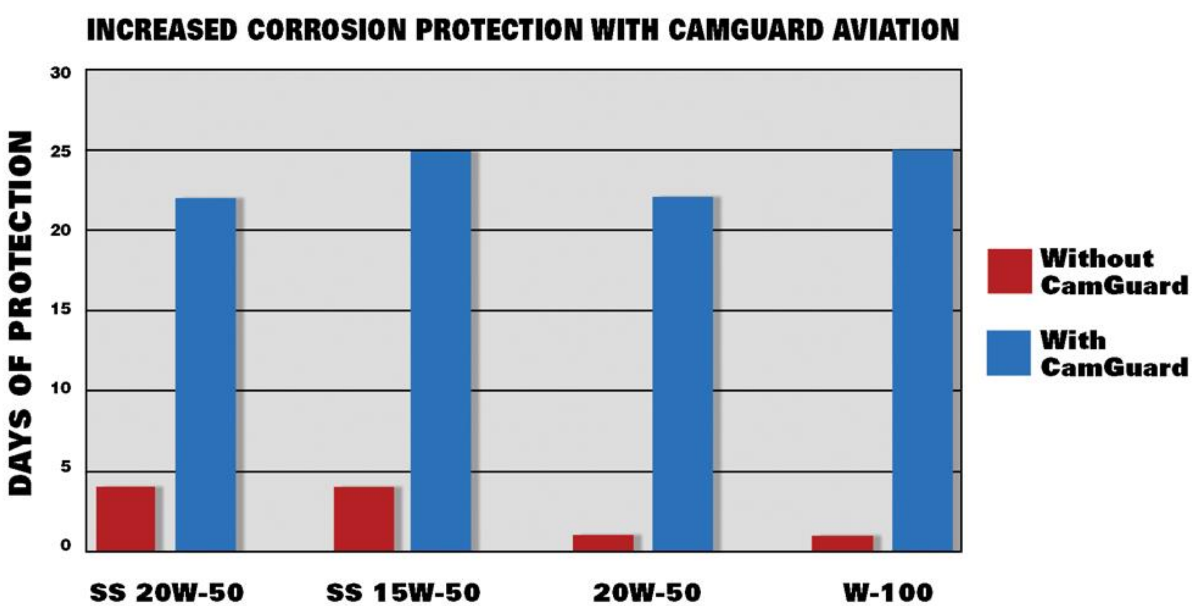

Figure 5: Claim by CamGuard as seen on their website aslcamguard.com/aviation/

Oil Analysis

Some owners have engine oil sent of regularly for analysis. My A&P never felt it was worth that much but we did several samples over the years. In general, most of the numbers always stayed very consistent from test to test. Usually all were within the normal range specified by the oil analysis company.

Ben Visser had an April 15, 2021 article in ***General Aviation News*** titled “The six myths of oil analysis”. It is an interesting read for those interested in what oil analysis “can do” and what it “can’t do”.

Corrosion: The enemy of GA engines

In the “Mike Busch on Engines” book, page 229 he states ***“For the rest of us – and that includes the great majority of owner-flown airplanes (including mine) – corrosion is the number one reason that engines fail to make TBO.”***

Mike Busch is an interesting person who knows quite a lot about engines, however his reasoning on some things don’t always make sense to me. He quite frequently likes to contradict the manufacture of GA products with his own ideas.   Even his statement assumes hours, not time period. He has some good ideas and some not so good. Either way, his book is a worthwhile read.   When it comes to corrosion on engines, I think he is correct.

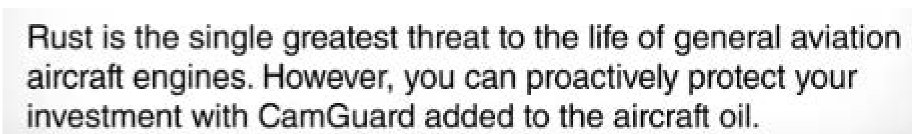

Figure 6: CamGuard Video reference

Many personal use GA airplanes average less than 100 hours of use per year. At 100 hours per year multiplied by 12 years (TBO time period) that is only 1,200 hours of use. Far less than the 2,000 hours (TBO hours).

In a flight school it is much different story. Many of those planes fly several hundred hours per year and are much more likely to hit TBO hours prior to TBO time period.

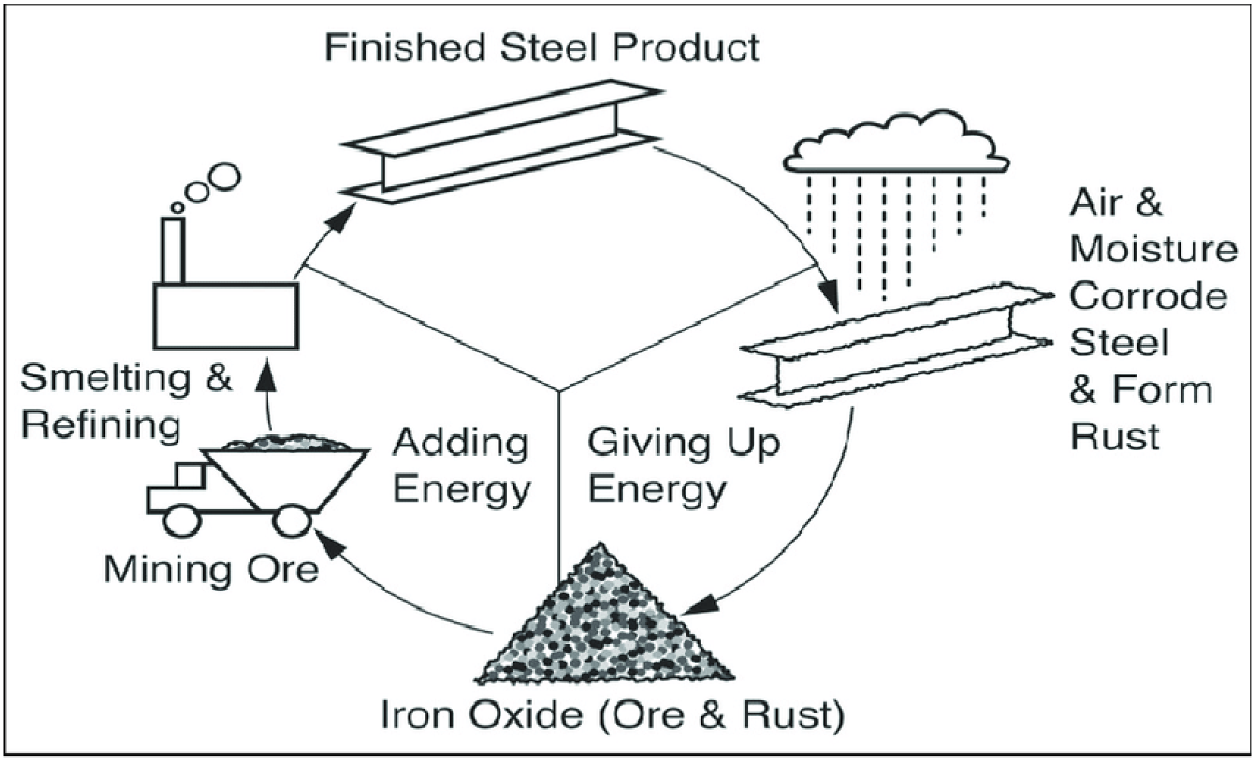

Figure 7: The life of steel (and other metals) It all starts and ends as iron oxide.

Factors Affecting Corrosion in Aircraft

Many factors affect the type, speed, cause, and seriousness of metal corrosion. Some of these factors that influence metal corrosion and the rate of corrosion are:

- Type of metal
- Availability of oxygen
- Presence of moisture
- Presence of a dissimilar, less corrodible metals (there is a mixture of metals within engine)
- Anodic and cathodic surface areas (in galvanic corrosion)
- Temperature (high temperature, low temperature and temperature variation)
- Heat treatment and grain direction
- Presence of electrolytes (hard water, salt water, battery fluids, acids in oil, etc.)
- Mechanical stress on the corroding metal
- Time of exposure to a corrosive environment
- Presence of biological organisms

Figure 8: North America corrosion severity chart. From www.aircraftsystemstech.com/2019/02/factors-affecting-corrosion-in-aircraft.html

Some people believe their engine has no corrosion; they are likely wrong. Lycoming Service Letter No. L180B states "*Our experience has shown that in regions of high humidity, active corrosion can be found on cylinder walls of new engines inoperative for periods as brief as two days.*" The question is probably best said "How much corrosion do you have?"

Clearly steel does rust when not protected and in contact with oxygen and moisture. Corrosion starts small, not visible to the human eye and grows over time. Clearly some corrosion is not a problem, but when it grows to certain levels it can make the metal loose strength become abrasive and rub other surfaces causing damage.

Lycoming Engine Data

For the SOCATA Trinidad TB-20, transition the standard Lycoming IO-540-C4D5D dual magneto engine to a two separate magnetos Lycoming IO-540-C4D5 engine.

The SOCATA Trinidad TB-20 is only certified for one engine based on the US Type Certificate A51EU. That is the Lycoming IO-540-C4D5D engine. Any engine change would require one of the following.

(1) STC (Supplemental Type Certificate),

(2) a FAA Form 337 FAA FSDO Field Approval or

(3) a DER completes FAA Form 8110-3 in leu of a FAA FSDO Field Approval.

All three options require use of FAA Form 337, but only option (2) requires an FAA FSDO Field Approval portion of the form. Currently, in 2021, there are no STCs for different engines available. That leaves option 2 and option 3.

Lycoming Model Number Explained

The IO-540-C4D5D engine can be broken into 3 major parts. The prefix, displacement and the suffix. For the TB-20 engine, IO (Prefix) 540 (Displacement) C4D5D (Suffix)

Portion of Engine Number	Description of Engine	Value	Comments
I	Fuel Injected	I = Fuel Injected	if carbureted then blank
O	Cylinders	O = Horizontally opposed cylinders Cylinder Cubic inches displaced	
540	Displacement	Cylinder Cubic inches displaced	
C	Power Section (Series)	C = 250 HP	Could be 1 or 2 characters, in this case only 1 character
4	Nose Section	4 = type 4	2nd character, could be 3rd character in some cases
D	Accessory Section	D = type D	3rd character, could be 4th character in some cases
5	Counterweight application	5 = one fifth and one sixth weight counterweights	4th character, could be 5th character in some cases
D	Dual Magneto	D = Dual Magento	if used as 4th or 5th suffix value. Blank If 2 magnetos used.

The TCDS (Type Certificate Data Sheet) is an FAA required document produced by SOCATA. It references the valid type engines for the airframe. Shown below is an excerpt from the TCDS.

TYPE CERTIFICATE DATA SHEET A51EU

This data sheet which is part of Type Certificate No. A51EU prescribes conditions and limitations under which the product for which the Type Certificate was issued meets the airworthiness requirements of the Federal Aviation Regulations.

Type Certificate Holder.	SOCATA 65921 - TARBES Cedex 9 France
Type Certificate Holder Record	S O C A T A - Groupe AEROSPATIALE transferred to SOCATA on February 16, 2011

I. Model TB 20, 4 PCLM (Normal Category), approved January 27, 1984.

Engine.	LYCOMING IO-540-C4D5D
Fuel.	100 minimum octane aviation gasoline
Engine Limits.	For all operations, 2575 r.p.m. (250 H.P.)

Figure 9: The US Type Certificate Data Sheet showing engines available to TB-20.

For the differences from C4D5D to C4D5 it changes the dual magneto to two separate magnetos. The actual accessory case is the NOT same even though the 3rd character are both D's. This seems to be an anomaly in the naming of the engine. *(It is closer to a -C4B5 as shown later)*

IO-540-C* SERIES

FAA Type Certificate	1E4
Rated horsepower	250
Rated speed RPM	2575
Bore, inches	5.125
Stroke, inches	4.375
Displacement, cubic inches	541.5
Compression ratio	8.5:1
Firing order	1-4-5-2-3-6
Spark occurs, degrees BTC	25
Valve rocker clearance (hydraulic tappets collapsed)	.028-.080
Prop. drive ratio	1:1
Prop. driven rotation	Clockwise

* - IO-540-C4D5D model engine has an alternate rating of 235 horsepower at 2400 RPM. When operated at alternate rating, all performance data pertinent to the IO-540-W series is applicable.

*Figure 10:The IO-540-C series from **LYCOMING OPERATOR'S MANUAL O-540, IO-540 SERIES** manual.*

Lycoming description of Accessory Housing: *The accessory housing is made from an aluminum casting and is fastened to the rear of the crankcase and the top rear of the sump. It forms a housing for the oil pump and the various accessory drives.*

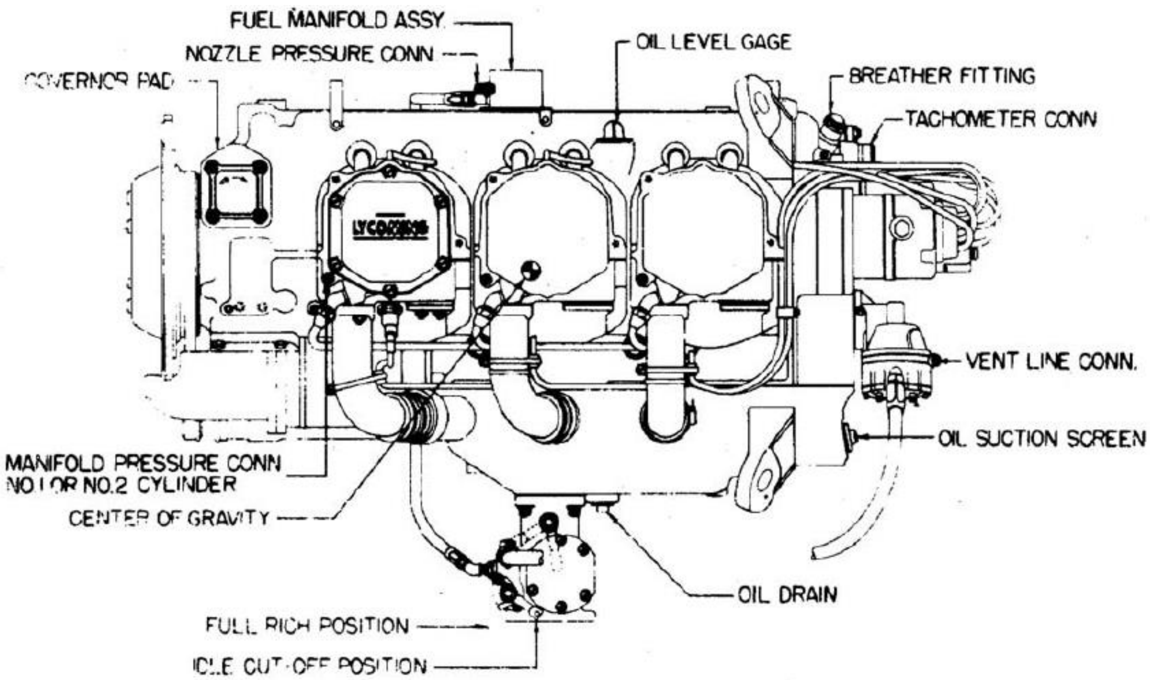

Figure 11: Left Side View – IO-540-C, -D, -J, -N from ***LYCOMING OPERATOR'S MANUAL O-540, IO-540 SERIES*** *Manual.*

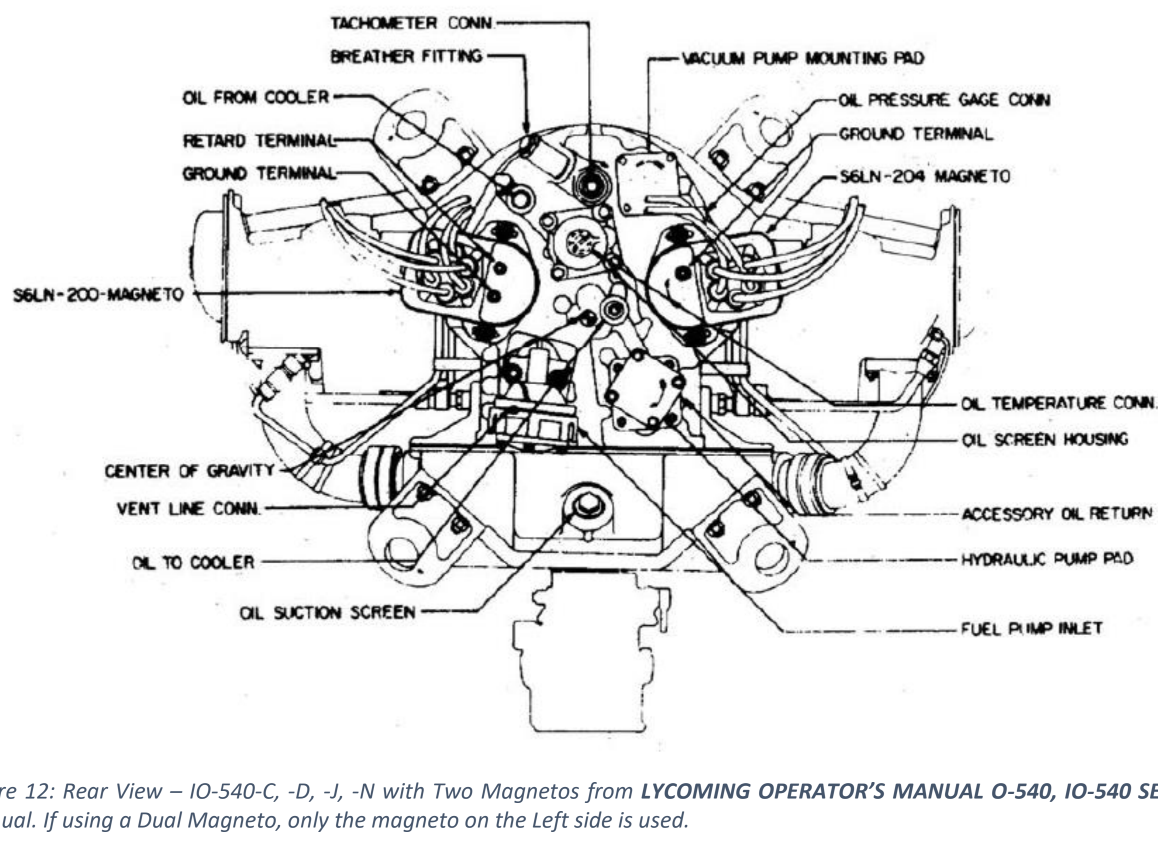

Figure 12: Rear View – IO-540-C, -D, -J, -N with Two Magnetos from ***LYCOMING OPERATOR'S MANUAL O-540, IO-540 SERIES*** *Manual. If using a Dual Magneto, only the magneto on the Left side is used.*

Why Change Engine Models

First is safety and reliability. The Lycoming IO-540-C4D5D has a single shaft that drives both magnetos. While the reliability of the dual mag is good even though it is not two independent magneto systems. A single point of failure is introduced at both the drive shaft the magneto seal and magneto housing. *Note: I don't think the safety item is a huge difference; clearly, I flew the plane with a D-3000 Series dual magneto for many years. I do think it <u>slightly reduces the risk</u> of failure.*

Second, the single dual magneto has had in the past concerns in 2010 with part suppliers. This was resolved for the time but this could become a problem again as dual magnetos make up a small percentage of the fleet for General Aviation planes in service. Now, two choices of vendors of replacement magnetos is available going forward.

Third, it allows for better future use of electronic ignition in place of one magneto. See Electroair Electronic Ignition System.

Lastly, it removes the need for 500-hour recurring inspection required under AD 2005-12-06 for D-3000 Series magnetos.

Information about Electronic Ignition is changing quickly. The below information was current as of EAA AirVenture 2021.

Electronic Ignition - Electroair

Electroair Electronic Ignition System STC SA03286CH. Oddly enough, this STC refers to the TB-20 but it requires a two-magneto engine (not the dual magneto engine) as is standard on the TB-20. The footnotes for the STC may explain it to be those aircraft altered to different engines as specified. This may be possible via this STC or additional DER work may be required to install.

EIS-61000-5M Ignition System	Aviation Ltd. [1,2]	260-T3A	A73EU	Regulations (CFR) Part 23	EIS-61000	FAA approved revision	April 04, 2016
EIS-61000-5C or EIS-61000-5M Ignition System	Socata[1,2]	TB 20	A51EU	14 Code of Federal Regulations (CFR) Part 23	EIS-61000	Rev. 09, Dated 08/10/2015 or later FAA approved revision	April 04, 2016
EIS-61000-5C or EIS-61000-5M	Socata[1,2]	Rallye 235E,	7A14	14 Code of Federal Regulations (CFR)	EIS-61000	Rev. 09, Dated 08/10/2015 or later	April 04, 2016

Figure E1: Electroair STC SA03286CH shows TB-20 in list, there are footnotes for Socata listed.

[1] Electronic Ignition System Installation is eligible for these airplane models that have converted to Continental E-165, E-185, E-225, O-300, GO-300, IO-360, L/TSIO-360, O-470, IO-470, TSIO-470, IO-520, L/TSIO-520, IO-550 and TSIO-550 model series engines by FAA Approved means as applicable. Electronic Ignition System Installation is eligible for these airplane models that have converted to Lycoming O-540, IO-540, AEIO-540, L/TIO-540, TIO-541, TIGO-541, IO-580, and AEIO-580 model series engines by FAA Approved means as applicable.

[2] These airplane models are eligible but not required to use Electroair Spark Plugs part numbers EARHB32E, EARHB32S, EAREM37HE, or EARHM38SE. These Electroair Spark Plugs can ONLY be used with Electroair's electronic ignition system. Engine model eligibility of the EAREM37HE is the same as the Unison UREM37BY spark plug. Engine model eligibility of the EARHM38SE is the same as the Unison URHM38S spark plug. Engine model eligibility of the EARHB32E is the same as the Unison URHB32E spark plug. Engine model eligibility of the EARHB32S is the same as the Unison URHB32S spark plug. If conventional spark plugs will be used, adjust the gap of the spark plugs in accordance with Electroair EIS-61000 Installation Manual IM EIS-61000.

Figure 13:Electroair STC SA03286CH footnotes.

ElectroAir require special spark plug wires as well. The electronic units can be installed on either the firewall or attached to the engine mount structure.

ElectroAir claims it will have the dual magneto replacement out by the middle of 2021. This may be a new STC or an enhancement to the current STC SA03286CH. This would place one electronic unit where the dual D-3000 magneto was previously located at the back of engine on accessory housing. The second unit requires the propeller to be removed and reinstalled and placed at the front of the engine behind the alternator. Cost for the six-cylinder EIS-62000DM is listed at $6,595.

Even when the STC is approved for IO-540 engines, there will be the need for a secondary electrical supply. The STC will not include that second electrical supply. A battery option may be TCW Technologies back-up battery from $575 to $1,100 plus $220 install kit. There is currently no STC for Trinidad's for that secondary electrical supply (extra battery or extra alternator) though it is hopefully one will become available. Other option to get the additional power supply is to use FAA Field Approval or engage a DER for the second electrical power source.

The unit may also require their special "IGNITION SWITCH PANEL" another $269, this removes the key unit and takes more space than the existing unit. For the Trinidads there is also concerns around the elimination of the "p-lead" to make G500 TXi, JPI 900 and some other units from functioning correctly.

At this time the Electroair Electronic Ignition system has great potential for the future, but is not quite ready for install into Trinidads as of the end of AirVenture 2021. Above does <u>not</u> include the install cost.

Electronic Ignition - SureFly

<u>SureFly Electronic Ignition</u> may have a *D-3000 dual magneto replacement* soon. As of mid 2021 they do not.

Currently they have two STCs. The first STC is SE04349CH and only includes two magneto engines. The AML list by engine type (not airframe). The IO-540-C4D5 engine is listed on the STC for one of two magnetos to be replaced. The second STC SA04378CH list the various airframes it can be applied to. Unlike the Electroair, the TB-20 is not listed for the current airframe STC.

FAA APPROVED MODEL LIST (AML) NO. SE04349CH
SureFly Partners, Ltd.
INSTALLATION OF SUREFLY IGNITION MODEL SIM4N, SIM4P, SIM6C or SIM6L

Issue Date: October 31,

		O-540-A1A, -A1A5, -A1B5					
		-H2A5, -J5A5					
27	LYCOMING ENGINES	**IO-540**--A1A5, - B1A5, -B1B5, -B1C5, -C1B5, -C1C5, -C2C, -C4B5, -C4D5, -C4C5, -D4A5, -D4B5, -D4C5, -E1A5, -E1B5, -E1C5, -G1A5, -G1B5, -G1C5, -G1D5, -G1E5, -G1F5 -J4A5, -K1A5, -K1A5D, -K1B5, -K1C5, -K1D5, -K1E5, -K1F5, -K1G5, -K1H5, -K1J5, -K1K5, -K2A5, -L1A5, -L1C5, -M1A5, -M1C5, -N1A5, -P1A5, -R1A5, -S1A5, -T4B5, -V4A5, -W1A5, -AA1A5, -AA1B5, -AB1A5, -AC1A5, -AE1A5 -AF1A5, -AG1A5	1E4	SEE NOTE 1, CAR 13 and Amendments listed in TCDS No. 1E4	SIM6L Installation Instructions, SF1004	REV B*, 07/26/2018	October 31, 2018
				SEE NOTE 1			

Figure S1: SureFly Engine STC SE04349CH shows engines models only, not airframes.

FAA APPROVED MODEL LIST (AML) NO. SA04378CH
SureFly Partners, Ltd.
INSTALLATION OF ENGINE MODIFIED WITH A SUREFLY IGNITION MODULE SIM4N, SIM4P, SIM6C or SIM6L

Issue Date: February 15, 2019

ITEM	AIRCRAFT MAKE (TCDS Holder) [common name or previous make]	AIRCRAFT MODEL	ORIGINAL TYPE CERTIFICATE NUMBER	CERT BASIS FOR AMENDMENT	INSTALLATION INSTRUCTIONS TITLE, NUMBER	REV, DATE	AML AMENDED DATE
				SEE NOTE 1			
		250		No. 1A13			
99	**SOCATA Morane Saulnier Rallye** (SOCATA) [SOCATA - Groupe Aerospatiale]	Rallye 100S, Rallye 150ST, Rallye 150T, Rallye 235E, Rallye 235C, MS 880B, MS 885, MS 894A, MS 893A, MS 892A-150, MS 892E-150, MS 893E	7A14	SEE NOTE 1, CAR 3 and Amendments listed in TCDS No. 7A14	SF2001 Installation Instructions	REV IR*, 10/19/2018 Note 4	-
				SEE NOTE 1	SF2001	REV IR*	

Figure S2: SureFly Airframe STC SA04378CH shows airframes, note SOCATA but not TB series.

At this time the SureFly Electronic Ignition system is not available for install into Trinidads.

When to Switch

Switching the engine models only seems practical when a complete engine overhaul or replacement is necessary. While it could be done at any time, cost would dictate that only during a major overhaul would it be practical for most people.

Factory only conversion or can any shop can do it? Can a Lycoming IO-540-C4D5D be converted to an IO-540-C4D5 in the field via overhaul? Possibly, but the data plate seems to be a Lycoming factory item.

Lycoming Manuals

Lycoming Manual List -C4D5 for TB-20: Lycoming documents that both engines are listed for the TB-20 Trinidad. *(I do not know why this is documented this way as the aircraft Type Certificate does <u>not</u> list it this way.)*

	Piper Aircraft. Aztec C (PA-23-250), Aztec F. **Wassmer.** (WA4-21).
IO-540-C4D5	**S.O.C.A.T.A.** (TB-20).
IO-540-C4D5D	**S.O.C.A.T.A.** Trinidad (TB-20).
IO-540-D4A5	**Piper Aircraft.** Comanche (PA-24-260). **Siai-Marchetti.** (SF-260)

Figure 14: From LYCOMING CERTIFICATED AIRCRAFT ENGINES manual page 43 dated May 2020 (SSP-110-2) shows TB-20 in list for both engines.

One high level explanation of the differences between the engines as shown by Lycoming. *(A better explanation is shown later)*

IO-540-C4D5	250	2575	100/100LL	8.50:1	Same as –C4D5D except has two Magnetos	-48
IO-540-C4D5D	250	2575	100/100LL	8.50:1	Same as –C4B but with D6LN-3000 impulse coupling dual Magneto	-48

Figure 15: From LYCOMING CERTIFICATED AIRCRAFT ENGINES manual page 23 dated May 2020 (SSP-110-2) shows differences of the both engines.

Engine Differences IO-540-C4D5D and IO-540-C4D5: Based on the naming convention then the IO-540-C4D5D and the IO-540-C4D5 should have the same accessory case. *(Well, the naming standard is not quite right. Who knows why?)* If you look in the Lycoming parts manuals the IO-540-C4D5 is actually much more like the IO-540-C4<u>B</u>5 engine. Thus, a different accessory case. For the -C4D5D the case is part number 21D21069-4 (formerly part number LW-10908), and for -C4D5 (-C4<u>B</u>5) the case is part number 21D21539-02 (formerly part number 76152).

In simple observation the -C4D5D vs the -C4D5 case, the -C4D5D "sort of" put the oil filter where the 2nd magneto goes on the -C4D5 case.

Figure 16: The accessory case is for -C4D5 or -C4B5 engine.

Figure 17: The accessory cases are not just two dimensional, they are three and can be seen better here. This case is for -C4D5 or -C4B5 engine.

SUPPLEMENT No.	ENGINE MODEL	PUBLICATION No.	PUBLICATION DATE
SSP-192	IO-540 Series	PC-615	October, 1979

Insert in front of catalog for useage of subject matter.

Revised January, 1992

Page 4-3

Figure 20: Slick Magnetos, Harnesses, Drives And Spark Plugs

List page added for IO-540-C4D5

Page 4-4

Figure 20: Slick Magneto, Harnesses, Drives And Spark Plugs

Illustration page added for IO-540-C4D5

NOTE

For all other IO-540-C4D5 parts, refer to IO-540-C4B5 in this catalog.

Figure 18:From LYCOMING AIRCRAFT ENGINES PARTS CATALOG IO-540 Wide Cylinder Flange Models manual PC-615 (SSP-192) revision page dated January 1992.

Engine Differences IO-540-C4D5 and IO-540-C4B5

The engine to be installed is the -C4D5. As mentioned above the -C4B5 is closer to what we are switching to except what is described in Figure 13. The difference between these two engines is the magneto selected.

The -C4B5 uses Bendix Magnetos. Left Magneto LW-163050-9 (Bendix S6LN-204) and the right Magneto LW-163010-10 (Bendix S6LN-200).

The -C4D5 uses Slick Magnetos. Both magnetos 66JC35SDNN (Slick 6251 is superseded by Slick 6351). Slick 6351 is a magneto with an impulse coupling. Or choose Left Magneto Slick 6351 (impulse coupling) and right magneto Slick 6350 (no impulse coupling). Reference Service Instruction No. 1443R (April 2020) for additional options of magnetos.

Bendix and Slick are both fine products and work slightly different. Some people think one is better than the other but seldom agree which of the two is better.

The good news is the -C4D5 is certified to operate with either Bendix or Slick magnetos. This is a significant improvement in the number of choices over the original -C4D5D Bendix D-3000 Dual Magneto. Reference

CONTINENTAL IGNITION SYSTEMS, SERVICE SUPPORT MANUAL, Publication X44001 Revision 4, 2015 for a list of Bendix magneto to engine selection.

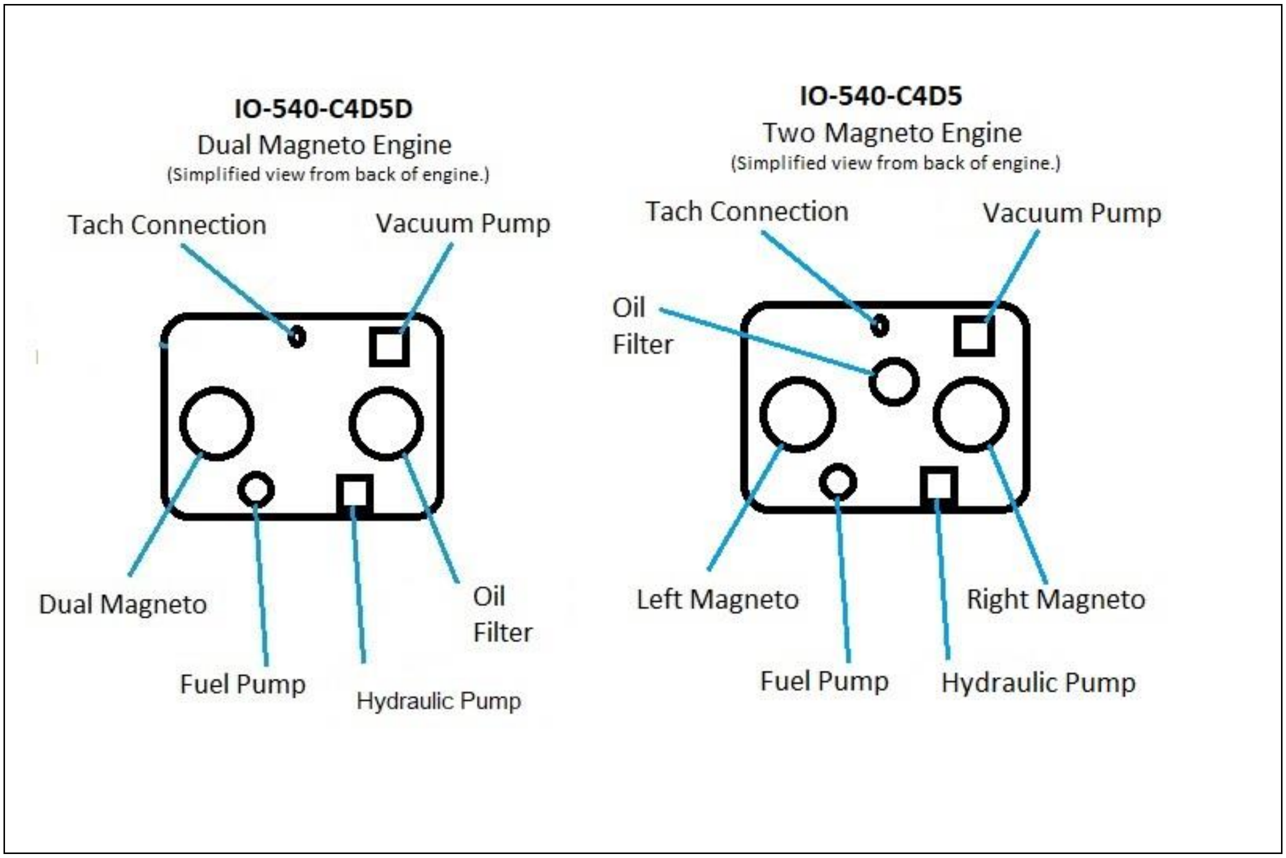

Figure 19: Simplified Accessory Cases looking from firewall forward.

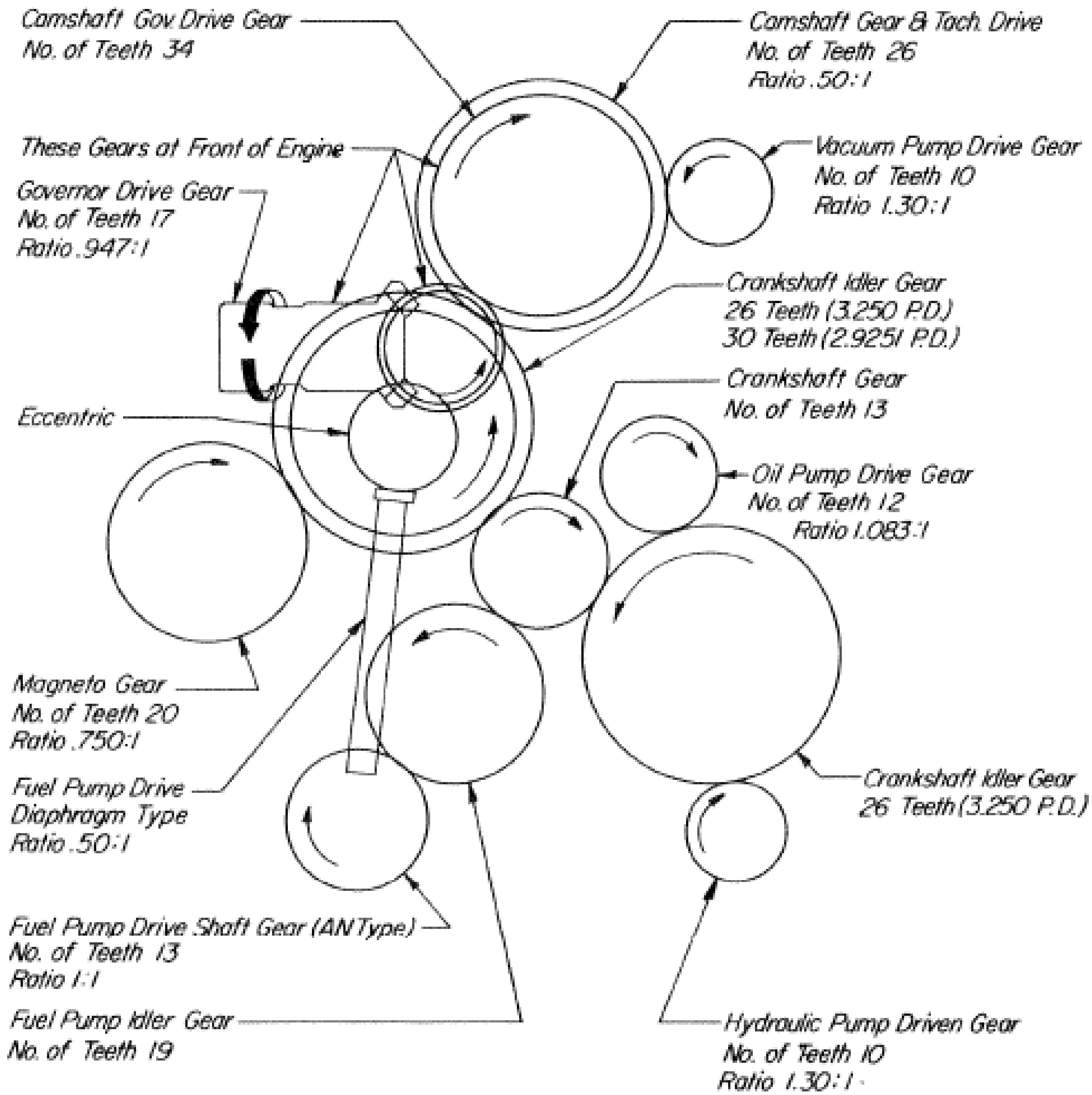

Figure 20:A Six Cylinder Gear Train Diagram (Dual Magnetos) From Lycoming Overhaul Manual Direct Drive Aircraft Engines 60294-7.

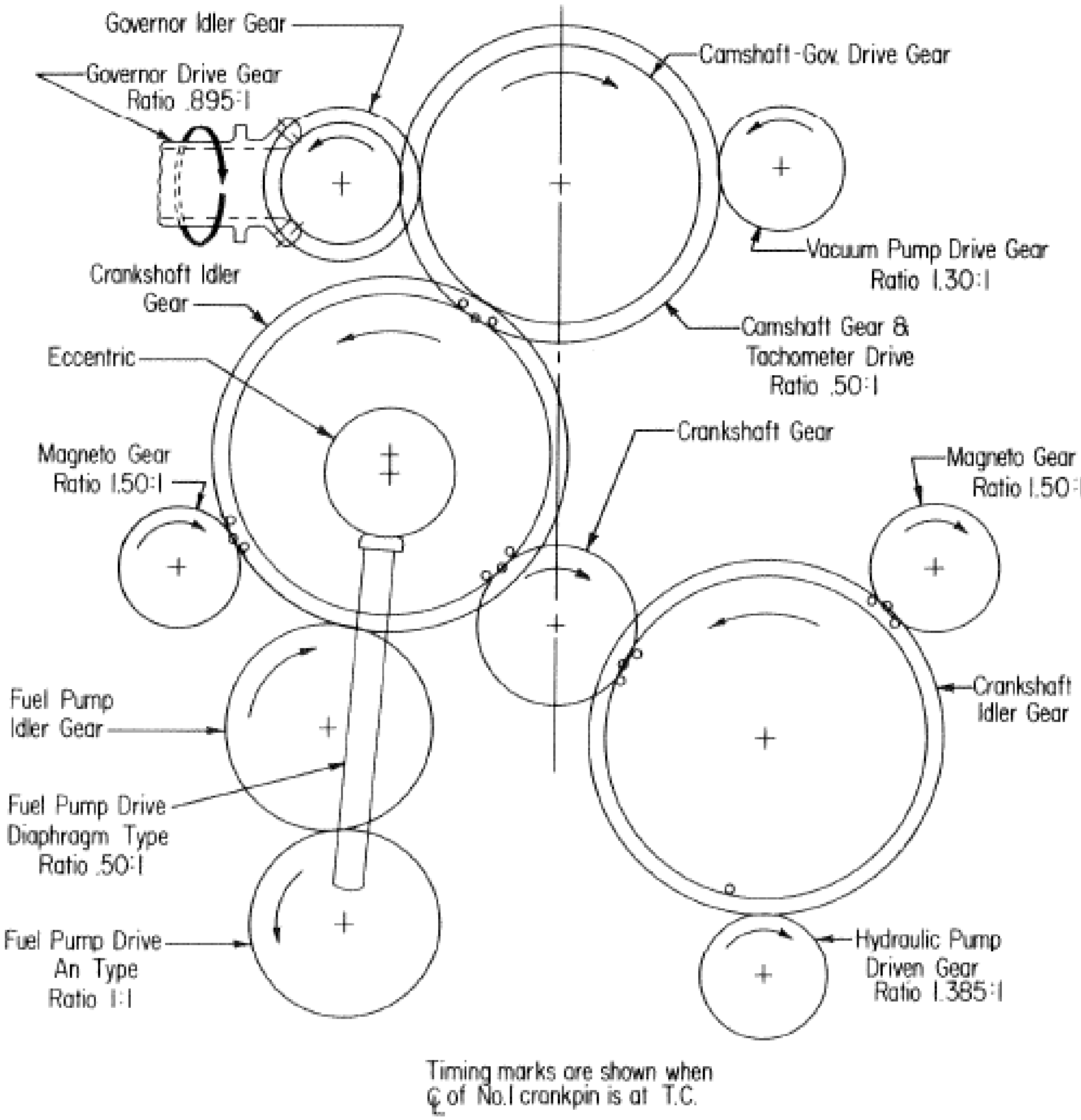

Figure 21:A Six Cylinder Gear Train Diagram (Two Separate Magnetos) From Lycoming Overhaul Manual Direct Drive Aircraft Engines 60294-7.

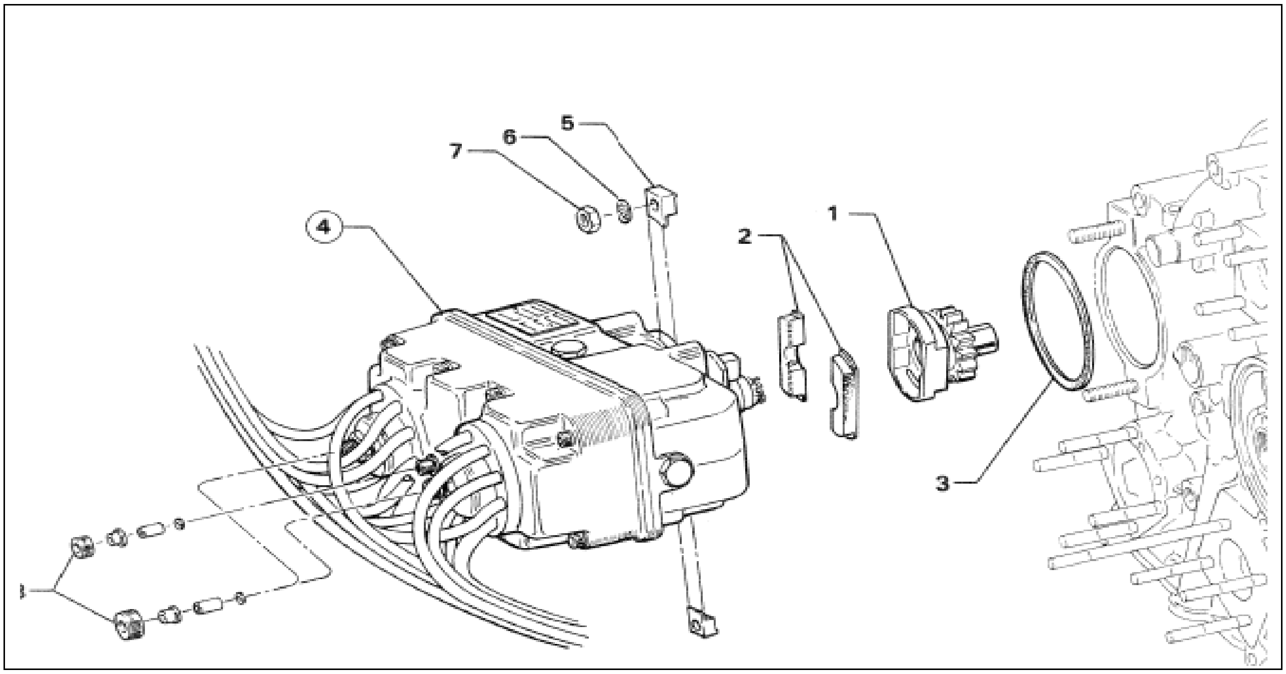

*Figure 22: The Dual D-3000 Series Magneto (LW-685126-105, D6LN-3031) used on the TB-20 Trinidad IO-540-C4D5D from the **AVCO Lycoming IO-540-C4D5D Parts Catalog** Manual.*

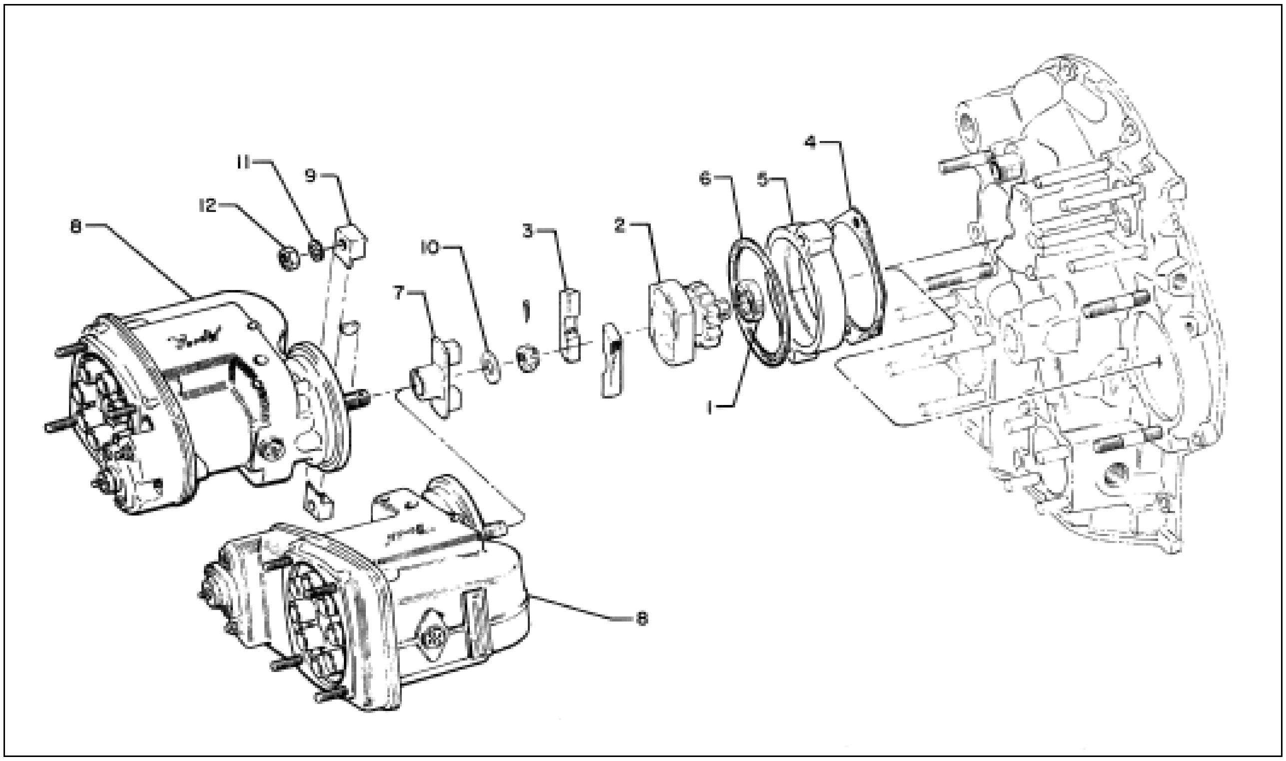

*Figure 23: Two Magnetos (74830 and 75124) used on the IO-540-C4D5 from the **Lycoming Aircraft Engines Parts Catalog , IO-540 Wide Cylinder Flange Models** Manual PC-615 January 1992.*

Engine Mount Arrangement

The following explanation is from Acorn Welding (www.acornwelding.com) they describe the 3 common types of engine mounts used on small aircraft.

> ***Conical Engine Mounts***
>
> *Conical mounts are the simplest as they offer easy installation and maintenance or repairs space. There are four points where the engine is connected with the mount making the grip more sturdy. However, conical mounts are less effective when it comes to high powered engine vibrations. These types of engine mounts were normally used in the traditional aircraft or perhaps less heavy airplanes. Conical mounts are mostly used in passenger aircrafts as they best suit their maintenance and repairs process.*
>
> ***Dynafocal Engine Mounts***
>
> *Dynafocal mounts are way stronger than the average conical mounts, as they are highly capable of suppressing the engine vibrations and maintain the flow of the force created by torque. These mounts are designed based on gravity points that in the aircraft which can vary from one plane to another. The structure itself is built in a ring shape, increasing the strength of the structure but limiting the access for installation and repairs. This is the reason that these engine mounts are considered to be more costly, especially for commercial aircraft.*
>
> ***Bed Mounts***
>
> *The last one of the three kinds of mounts is the bed mount. Mostly used with diesel and Rotax engines, these offer their own set of features. The shape of the bed mount is the diverging effect of both conical and dynafocal mounts. The aircraft engine is installed above the mount as the name suggests, offering an even higher structural strength and engine connectivity. Bed mounts are installed under a crankcase which also becomes a differentiating factor of the three mounts. A bed mount also has four fastening points that stabilize the engine more securely.*

The IO-540-C4D5D uses the Dynafocal Mount arrangement. Lycoming describes the Engine Mounts as:

> *Dynafocal Mounts set at a specified angle to the crankshaft with Type 1 (30°) and Type 2 (18°) being different angles for four cylinder engines and Type 1 (31°) and Type 2 (20°) for six cylinder engines.*
>
> *A Dynafocal aircraft engine mount is a trademarked damped engine suspension developed by the Lord Corporation in 1939. The company called it a "gamma product," which they defined as one based on new technology, patentable and having a price advantage on the market due to lack of competition.*

Dynafocal Engine Mounts may be best described as engine mounts (metal structure) are much more capable of distributing torque and vibration from the engine. The design and attachment locations are decided based on the center of gravity of the applied engine.

To confuse things a bit the metal structure is the Engine Mount. The “compression type couplings” (rubber diffusers, Elastomeric, Vibration Isolation, etc.) are also commonly called “engine mounts”.

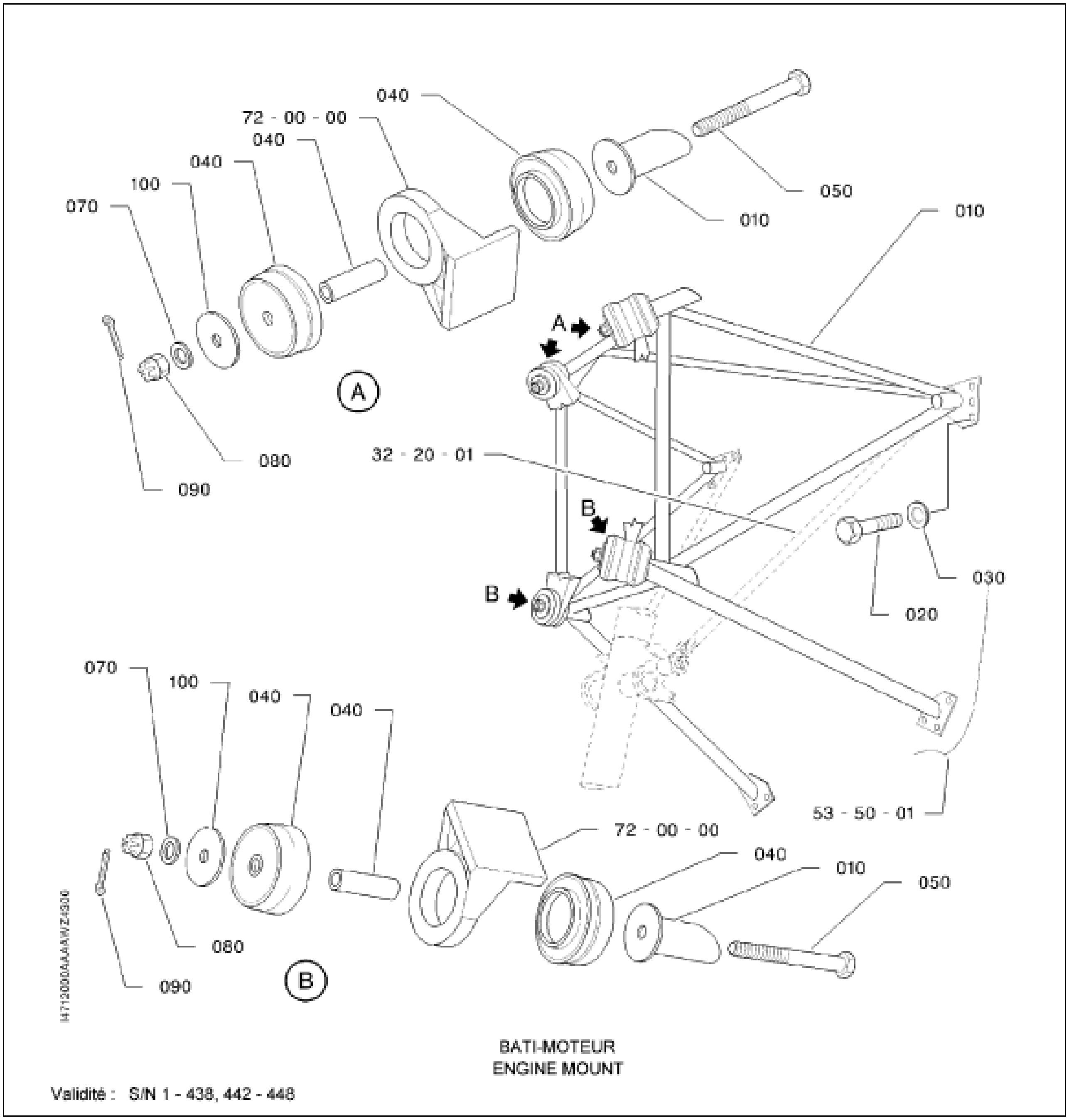

Figure 24: SOCATA TB-20 Illustrated Parts Catalog Chapter 71 Powerplant.

Flat Tappets vs Roller Tappets

Not sure how big a deal roller tappets really are, sounds like some people think they are a very big deal and others, not so much. Lycoming introduced Roller Tappets in 2005. New engines and rebuilt Lycoming engines now have roller tappets as seen in this diagram below. Engine serial numbers will end with an "E" if Roller Tappets are installed.

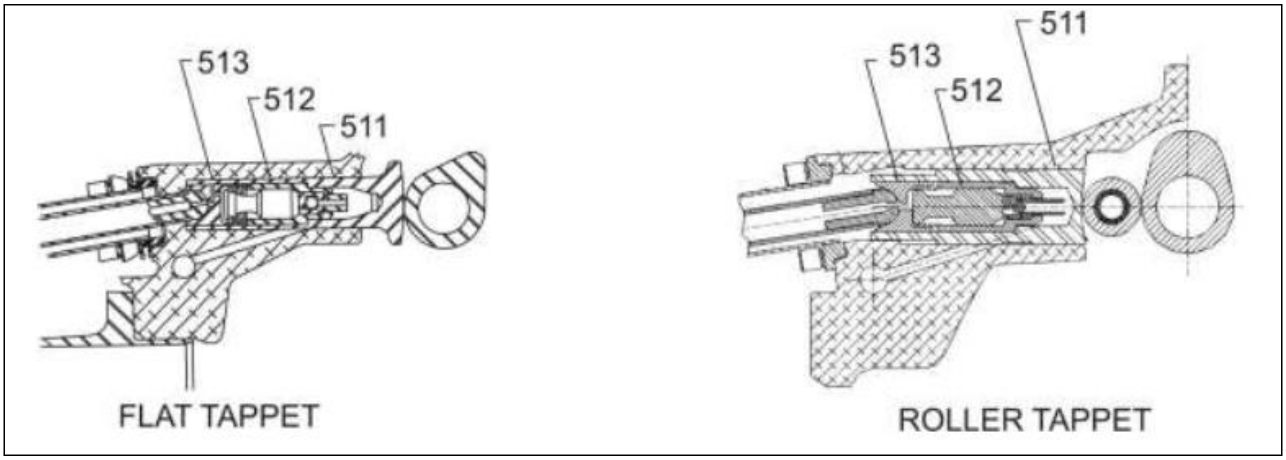

Figure 25:Lycoming Manual SSP-1776-5 page 1-5.

The need for a DER to Switch Engine Models

Since I was ordering a new engine, I contacted Jon Miller, owner of Trinidad N5543T. A lot of credit should go to Jon, as far as I know, he was the first to take a Trinidad from -C4D5D to -C4D5. He had done the switch in 2015. Also, of note he added a "stand-by alternator" at the same time. The same DER did this as well.

Jon told me that Triad Aviation in North Carolina did the work. They had worked with a DER (Designated Engineering Representative for the FAA) named Bobby Minnis.

The Trinidad uses a Starter Gear Ring LW-16471(single pully), the engine quoted came with a Starter Gear Ring 31M19861 (two pully). I could order it with LW-16471 for $3,500 more. OK, but part LW-16471 only cost $650 new? In the end the decision to order "as is" and switch to LW-16471 ourselves. Easily done it seems.

My A&P had a good relationship with Air Power in Texas as the engine ordering agent. There are only a few Lycoming Dealers to work with. After working with Air Power, they said Lycoming required a DER completed FAA 8110-3 document in place to order the unit. Interestingly enough, there are several different "order variations" of both -C4D5D and the -C4D5 engines. We selected Lycoming Part #8274 as it has two 6351 magnetos.

I contact Bobby Minnis, DER and he is knowledgeable and willing to produce the same FAA required documentation for a set $1,200 fee.

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

STATEMENT OF COMPLIANCE WITH AIRWORTHINESS STANDARDS

1. DATE: **26 February 2021**

AIRCRAFT OR AIRCRAFT COMPONENT IDENTIFICATION

2. MAKE	3. MODEL NO.	4. TYPE (Airplane, Engine, Propeller, etc.)	5. NAME OF APPLICANT
Socata	TB-20 Trinidad	Airplane	William W. Bennett 2820 Roundrock McKinney, TX 75[illegible]

LIST OF DATA

6. IDENTIFICATION	7. TITLE
FAA Form 337 Dated: 26 Feb. 2021 (Engineering data only)	1. Removal of Textron Lycoming IO-540-C4D5D engine, [illegible]mber RL-22449-48A equipped with single magneto drive. 2. Installation of Textron Lycoming IO-540-C4D5 engine, Serial Number (to be assigned by Lycoming) equipped with dual magneto drives. 3. Aircraft: Make - Socata Model – TB-20 Trinidad N67RL S/N 445 Reference: a. No Acoustical change, engine [illegible] RPM, exhaust system & propeller are unchanged. b. Continued Airworthiness [illegible] is unchanged. c. POH – Unchanged. Notes: a. This approval is for the engineering data only. It indicates the data listed above demonstrate compliance only with the regulation specified by paragraph and subparagraph listed below as "Applicable Requirements." b. This form constitutes FAA approval of all the engineering data necessary for substantiation of compliance to necessary requirements for FAA Form 337 data [illegible]ed in Item 8. ------------------------------ END ------------------------------

8. PURPOSE OF DATA

1. Make findings of compliance to applicable FAR's as specified in Item 9.
2. In support of D[illegible]al for Socata Model – TB-20 Trinidad N67RL S/N 445

9. APPLICABLE REQUIREMENTS (List specific sections)

14 CFR FAR 23.901(a) [illegible] Amdt 23-51, 23.903(a) Amdt 23-62, 23. 23, 23.1301(a)(b)(c) Amdt 23-62,

10. CERTIFICATION - Under authority vested by direction of the Administrator and in accordance with conditions and limitations of appointment under Part 183 [illegible] Aviation Regulations, data listed above and on attached sheets numbered () have been examined in accordance with established [illegible] and found to comply with applicable requirements of the Federal Aviation Regulations.

I [illegible] ☐ Recommend approval of these data
☒ Approve these data

11. SIGNATURE(S) OF [redacted]	12. DESIGNATION [redacted]	13. CLASSIFICATION(S)
Bobby W Minn[redacted]	DERT-[redacted]	Propulsion Powerplant & Engines

FAA Form 8110-3 (03/10) SUPERSEDES PREVIOUS EDITION

SAMPLE DOCUMENT ONLY

Figure 26: Sample FAA Form 8110-3, a FAA Form 337 is also required

Ordering a Lycoming Engine

Well, it is not exactly like an Amazon order. The Air Power salesman is quite helpful as it does require some paper work and funds transfer. The Order goes in as LYCOMING IO-540-C4D5 PART #8724, Price was $44,700 plus freight and tax. They indicated it is a 12-14 weeks (or about 100 days) before it could be delivered.

Interestingly enough, the quote I received from Air Power for the -C4D5D was $46,722 or $2,022 MORE than the -C4D5. So even with the extra $1,200 paid to the DER, the -C4D5 is less by a small amount. Sales tax and freight not included.

At the time of the order, Air Power required a $10,000 deposit. They like funds to be wired rather than checks.

Lycoming Manufacturing Scheduled

After the order is scheduled by Lycoming (my case about 4 weeks), Airpower will follow-up with you noting the "estimated" ship date and when they require full payment. Payment is required a couple weeks prior to ship date. Again, money transfer by wire is preferred.

A second part is an ACH authorization to cover the old core of the engine to be returned. Old core value for the IO-540-C4D5D is $21,600. They will only draft the funds from your account if you fail to return the core to Lycoming.

Good news is the scheduled ship date is only eleven and a half weeks from when I placed the order. As opposed to the original estimate of 12-14 weeks.

Just when you are getting close…

With about two weeks to the planned shipping, I got the bad news from Airpower. The ship date had been delayed by Lycoming an addition 2 and half weeks. Of course, this requires the A&P to change his scheduling as well but hopefully it will all work out.

I asked Air Power why Lycoming did not have a system to give updated delivery? He said they did, only the data on dates was almost always wrong and would change without notice or reason. He could call and sometimes get some additional information. He agreed this is a frustration for both him and the end customer.

Another delay with about two weeks prior to the new planned shipping date. The ship date had been delayed by Lycoming an addition 9 days this time. Of course, this requires the A&P to change his scheduling. I suspect much of the delay is a result of the COVID-19 virus which has slowed many things. Sad to say that Lycoming does not give you a reason for the delay.

Now the third completion date is here. I contacted Air Power again on the new engine completion date, they checked the Lycoming computer system and it showed ready to ship. Air Power representative is to send shipping data to me when he gets it today or Monday. I am hopeful it will only take a few days.

Engine Shipping

The engine was shipped on a Friday FedEx Freight Priority, it traveled from Pennsylvania to Dallas area in just six days. About what I thought it might be. It was originally scheduled to arrive on Tuesday. But did not arrive until Wednesday. At 580 pounds shipping weight in a wooden and cardboard crate that will be used to send my old engine back in. Lycoming has a tip indicator in the crate along with instructions on how to inspect for shipping damage.

Figure 27: Engine delivered in box. Pallet with carboard (reenforced with lumber) for the top.

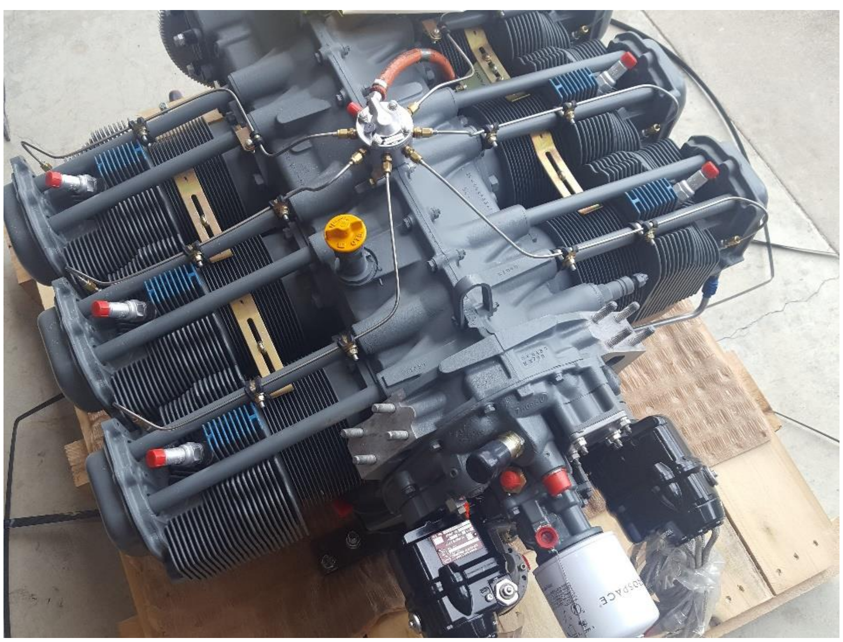

Figure 28: New engine with box top removed.

Engine Arrival and Prep for Install

After the engine arrives, we are back to the schedule of the A&P. The A&P removes the accessories from the old engine, then the engine is removed from the airframe. Clean and inspect everything firewall forward. Special attention is paid to the engine mount, baffling and connecting cables for excessive wear or damage.

Figure 29: Engine removed for airframe.

Figure 30: Engine removed for airframe.

Other Firewall Forward Parts

All the “other parts”, some of these come with the engine and some do not. Deciding what to Repair or Overhaul, buy new or keep as is. Some of my accessories had an overhaul or IRAN recently and thus we decided not to do additional work on those components. For my plane this is how it worked out.

Item	**Included or Extra**	**Comment**
Ignition Harness	Included	Comes with engine from Lycoming factory
Spark Plugs	Included	Comes with engine from Lycoming factory
Engine Driven Fuel Pump	Included	Comes with engine from Lycoming factory
Oil Pump	Included	Comes with engine from Lycoming factory
Magnetos	Included	Comes with engine from Lycoming factory
Fuel Injector Throttle Body	Included	Comes with engine from Lycoming factory
Fuel Injectors	Included	Comes with engine from Lycoming factory
Roller Tappets	Included	Comes with engine from Lycoming factory
Starter Ring Gear	Included *	Switch to the correct TB-20 part
Alternator	Extra	Reuse, Recent OH/IRAN performed
Alternator Belt	Extra	New
Propeller	Extra	Reuse, Recent OH/IRAN performed
Propeller Governor	Extra	Reuse, condition good
Vacuum Pump	Extra	Reuse, Recent OH/IRAN performed
Engine Rubber Mounts	Extra	New
Engine Mount (Steel tube)	Extra	Clean and check for damage
Engine Mount Bracket	Extra	Clean, repair and paint as needed
Exhaust System	Extra	Reuse, Recent OH/IRAN performed
Hoses (oil)	Extra	Hose length changes due to engine accessory case
Hoses (fuel)	Extra	Reuse
Hoses (air)	Extra	New (blows air on engine driven fuel pump)
Hose Fittings	Extra	Replace 2 hose fittings as slightly different
Starter	Extra	New, SkyTec 149NL
Baffling	Extra	Clean and repair as needed
Oil quick drain valve	Extra	New

Notes:

** The Trinidad uses a Starter Gear Ring LW-16471(single pully), the engine quoted came with a Starter Gear Ring 31M19861 (two pully). I could order it with LW-16471 for $3,500 more. OK, but part LW-16471 only cost $650 new? In the end the decision to order “as is” and switch to LW-16471 ourselves.*

Engine Install

The engine once prepped was then lifted from the crate and attached to the airframe. Once this is complete, the install of accessories, exhaust, sensors, etc. can be done.

Figure 31: New engine moved into position.

Figure 32: Engine attachment begins.

Figure 33: Engine attached to airframe and hoist removed. Ready for the accessories and other parts to be attached. Three people were performed the install of the engine. Anthony Arispe (left) owner of Airspeed and Altitude with two of his employees Connor (right) and Mikey (not shown).

There was a minor adjustment to the baffling for the new engine as the spark plug wires now have different paths and difference distances to travel to two separate magnetos. The accessory housing also required slightly different length oil hoses as the openings on the case are in different locations than before.

Engine Oil

Lycoming and Phillips don't exactly agree here on oil selection. In the Lycoming document "Service Instruction No. 1014N", the type of oil for both break-in and continue use is explained. They suggest "non-dispersant mineral oil during the first 50 hours of operation".

Oil selection was Phillips Type M 20W-50 (Mineral Oil, ashless, non-dispersant), for the break-in period.

Oil selection was Phillips X/C oil, for continued use. Phillips X/C boast in their advertisements that they are approved for new engine break-in. The explanation is that Lycoming recommends Mineral Oil for break-in. Phillips X/C 20W50 explains that it is Mineral Oil unlike some of their competitors.

Phillips X/C while mineral oil, it is also has a dispersant. My A&P along with numerous sources have said they had excellent success with using Phillips X/C 20W50 from day one. See AviationPros.com article by Steven Strollo for more information. **Even though possible to use Philips X/C from day 1, we chose the more standard approach of Phillips Type M (Mineral Oil) and then transition to Phillips XC 20W50.**

PHILLIPS 66

X/C® Aviation Oil

Ashless Dispersant, Multi-Grade Engine Oil for Aircraft Piston Engines

Phillips 66® X/C Aviation Oil is an ashless dispersant, multi-grade engine oil specially formulated for year-round use in aircraft piston engines. It provides distinct performance benefits compared with single-grade engine oils, including easier starting and faster oil circulation at low temperatures, reduced warm-up time, and reduced oil consumption in most engines. It maintains its film strength under high loads and at high temperatures to protect against wear and piston scuffing. The ashless dispersant formulation helps minimize the formation of engine sludge, varnish, piston deposits and combustion chamber deposits, resulting in a much cleaner engine compared with the use of straight (non-dispersant) mineral oils.

Features/Benefits

- Ashless dispersant helps minimize engine sludge and varnish deposits for a cleaner engine
- Easier starting and faster oil circulation at low temperatures compared with single-grade oils
- Reduced warm-up time and cooler operating temperatures compared with single-grade oils
- High film strength for protection against wear and piston scuffing, even under high-load conditions, such as takeoff, and at elevated operating temperatures
- Provides cleaner and quicker break-in than traditional all-mineral, non-additized, single-grade oils
- Protects against rust and corrosion
- Reduces oil consumption in most engines
- Suitable for year-round use

Figure 34: A portion of the Phillips X/C Oil Specification sheet, note fifth bullet.

Complete Paperwork

The FAA Form 8110-3 and FAA Form 337 should have the same date, the DER prepares the Form 8110-3 and the Form 337 is completed by the A&P. See Appendix 2 for an example of completed paperwork.

Note that prior to ordering the engine, Lycoming required an early copy of the Form 8110-3 from the DER, it was not complete as it has to have the serial number of the new engine to be installed.

Appropriate log book entries are prepared for the new engine logbook. The old engine logbook will be returned to Lycoming with the core.

Return Engine Core

There may actually be more paperwork to fill out to return the old engine than what it took to order the new engine. Airpower sent me Core Return Instructions which I passed on to my A&P. It required a RMA (Return Materials Authorization) number procured via phone. A worksheet of parts, a FedEx Freight Bill of Lading, a form that goes to Air Power so they can release the hold of the core funds.

Figure 35: Old engine being prepared for trip to Lycoming.

Figure 36: Old engine placed into same box a new one arrived in.

My A&P told me that Lycoming will probably strip a few items off the old engine, but a lot of it will be cut up and scrapped. I would think the old D-3000 Dual Magnetos is one of the things they will reuse, after all they don’t make them anymore.

Initial Engine Operation

Instructions from Lycoming can be found in Service Instruction No. 1427C. Section C has flight test portion. Interesting that the SI notes this is for “Field Overhauled” engines. High power settings, rich of peak are suggested after install to set the rings.

SECTION 5
PERFORMANCE

SOCATA
MODEL TB 20

LEVEL FLIGHT PERFORMANCE

PRESSURE ALTITUDE : 4500 ft

ISA : 42.8°F (6°C)

CONDITIONS : – Mixture adjusted to the BEST POWER
– Speed without antennas nor external lights
– Weight : 2943 lbs (1335 kg)

NOTE :
Bold–faced types represent recommended power.

%	N	PA	CAS		TAS		MIXTURE ADJUSTING		SPECIFIC CONSUMPTION	
BHP	RPM	in.Hg	MPH	kt	MPH	kt	l / h	U.S. Gal / hr	l / 100 NM	U.S. Gal / 100 NM
75 %	2500	22.5	168	147	180	157	61.3	16.2	39.1	10.3
	2400	23.2					60.4	16.0	38.5	10.2
	2300	24.0					59.4	15.7	37.9	10.0
70 %	2500	21.4	164	143	176	153	58.4	15.4	38.3	10.1
	2400	22.1					57.4	15.2	37.7	10.0
	2300	22.8					56.5	14.9	37.0	9.8
	2200	23.6					55.5	14.7	36.4	9.6

Figure 37: From the TB-20 Trinidad POH, Best Power at 4,500 Feet.

SOCATA
MODEL TB 20

SECTION 5
PERFORMANCE

LEVEL FLIGHT PERFORMANCE

PRESSURE ALTITUDE : 6500 ft

ISA : 35.6°F (2°C)

CONDITIONS : – Mixture adjusted to the BEST POWER
– Speed without antennas nor external lights
– Weight : 2943 lbs (1335 kg)

NOTE :
Bold–faced types represent recommended power.

%	N	PA	CAS		TAS		MIXTURE ADJUSTING		SPECIFIC CONSUMPTION	
BHP	RPM	in.Hg	MPH	kt	MPH	kt	l / h	U.S. Gal / hr	l / 100 NM	U.S. Gal / 100 NM
75 %	2500	22.1	167	145	184	160	61.3	16.2	38.4	10.1
70 %	2500	20.9	162	141	178	155	58.4	15.4	37.6	9.9
	2400	21.6					57.4	15.2	37.0	9.8
	2300	22.3					56.5	14.9	36.3	9.6

Figure 38: From the TB-20 Trinidad POH, Best Power at 6,500 Feet.

Initial test flight plan (extrapolated data) is for 2.5 hours at 5,500 feet using 2500 RPM, 22.3 inches with 16.2 GPH. The POH shows this to yield 158.5 KTS (not accounting for antennas).

First test flight was just once around the pattern, land and the engine was again inspected for leaks and issues. None were found.

The second break-in flight, the real-world weather prevented my 4,500 foot and 6,500 as initially planned break-in flight. Rather a much lower altitude was required to avoid clouds. Between 2,500 and 3,500 was used for the initial 2.5 hour flight. The CHT temperatures stayed mostly right below 400° F, in the mid 390's most of the time. However, there was a couple occasions where it reached around 437° F. Oil pressure went into the yellow on the high side during take-off. The A&P was going to look at adjusting this. Also, the Mixture Control needed a minor adjustment. Both adjustments were done after the flight and the aircraft approved for return to service.

Engine Break-in Operation

The continued use of high-power setting is recommended by Lycoming until oil usage stabilizes. I assume this means the piston rings are then set. We had a cross country trip planned from Dallas, TX area to Green Bay, WI and then Mackinac Island, MI and back. High power settings were used, all flights were between 1.5 hours and 4.8 hours. Oil consumption started at about 0.43 quarts per hour. At 12 hours oil consumption dropped to 0.24 quarts per hour. At 15 hours through 25 hours the oil usage has stabilized at 0.17 quarts per hour. Take-off power still sends the oil pressure higher than normal, but soon settles to normal. Close attention to temperatures continues.

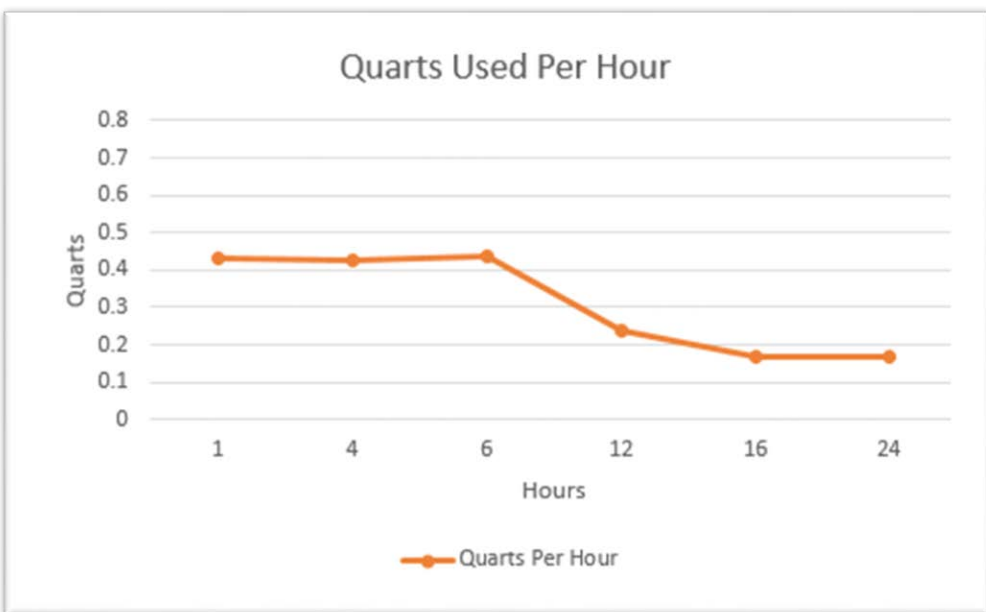

Figure 39: Oil usage per hour first 24 hours of operation.

An oil change at about 25 hours reveals no metal or other issues in the oil. Conversion to Phillip X/C 20W50 is now completed. No CamGuard as the break-in continues. Again, a detailed inspection of the engine is done to verify any issues. Everything looks really good.

Continued Engine Operation

After the initial break-in is completed, resume use of the engine as described in the SOCATA TB-20 POH. Previously, with my old engine, I used mostly “Best Economy” settings for cruise set forth in the POH. Note this is NOT LOP (Not Lean of Peak). Going forward I may use more of the “Best Power” setting for cruise as set forth in the POH. These both are acceptable options based on the POH.

Appendix 1:

Contact information for parties used in upgrade.

Bobby W. Minnis
209 River Laurel Way
Woodstock, GA 30188
Phone: (678) 494-0797
E-mail: bobminnis@comcast.net

Airspeed & Altitude Aviation
Anthony Arispe, Owner
10160 Doolittle Dr
McKinney, TX 75071
Phone: 972-375-5284
E-mail: anthony@airspeedattitude.com

Airpower, Inc
Steven Vacek, Engine Sales
4900 S Collins
Arlington, TX 76018
Phone: 800-247-7693 Ext-134
E-mail: svacek@airpowerinc.com

Appendix 2:

The following are copies of the paperwork. Note: Only good for the aircraft listed, this is NOT an STC that any Trinidad could use. A new FAA form 8110-3 must be created by a DER for an aircraft serial number to get an upgrade.

1. The FAA form 8110-3 prepared by DER, Bobby Minnis.
2. The FAA form 337 prepared by A&P (IA), Anthony Arispe.
3. Engine Logbook and entries.

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

STATEMENT OF COMPLIANCE WITH AIRWORTHINESS STANDARDS

1. DATE: **21 July 2021**

AIRCRAFT OR AIRCRAFT COMPONENT IDENTIFICATION

2. MAKE	3. MODEL NO.	4. TYPE (Airplane, Engine, Propeller, etc.)	5. NAME OF APPLICANT
Socata	TB-20 Trinidad	Airplane	William W. Bennett 2820 Roundrock McKinney, TX 75072

LIST OF DATA

6. IDENTIFICATION	7. TITLE
FAA Form 337 Dated: 21 July 2021 (Engineering data only)	1. Removal of Textron Lycoming IO-540-C4D5D engine, Serial Number RL-22449-48A equipped with single magneto drive. 2. Installation of Textron Lycoming IO-540-C4D5 engine, Serial Number RL-16468-48E equipped with dual magneto drives. 3. Aircraft: Make - Socata Model – TB-20 Trinidad N67RL S/N 445 Reference: a. No Acoustical change, engine power, RPM, exhaust system & propeller are unchanged. b. Continued Airworthiness Instruction is unchanged. c. POH – Unchanged. Notes: a. This approval is for the engineering data only. It indicates the data listed above demonstrates compliance only with the regulation specified by paragraph and subparagraph listed below as "Applicable Requirements." b. This form constitutes FAA approval of all the engineering data necessary for substantiation of compliance to necessary requirements for FAA Form 337 data as described in Item 8. ------------------------------ END ----------------------------------

8. PURPOSE OF DATA:

1. Make findings of compliance to applicable FAR's as specified in Item 9.
2. In support of Data Approval for Socata Model – TB-20 Trinidad N67RL S/N 445

9. APPLICABLE REQUIREMENTS (List specific sections)

14 CFR FAR 23.901(a)(b) Amdt 23-51, 23.903(a) Amdt 23-62, 23. 23, 23.1301(a)(b)(c) Amdt 23-62,

10. CERTIFICATION - Under authority vested by direction of the Administrator and in accordance with conditions and limitations of appointment under Part 183 of the Federal Aviation Regulations, data listed above and on attached sheets numbered 0 have been examined in accordance with established procedures and found to comply with applicable requirements of the Federal Aviation Regulations.

I (We) Therefore ☐ Recommend approval of these data

☒ Approve these data

11. SIGNATURE(S) OF DESIGNATED ENGINEERING	12. DESIGNATION NUMBER(S)	13. CLASSIFICATION(S)
Bobby W Minnis *Bobby W Minnis*	DERT- 510258-CE	Propulsion Powerplant & Engines

FAA Form 8110-3 (03/10) SUPERSEDES PREVIOUS EDITION

US Department of Transportation
Federal Aviation Administration

MAJOR REPAIR AND ALTERATION
(Airframe, Powerplant, Propeller, or Appliance)

OMB No. 2120-0020
Exp. 8/31/2014

Electronic Tracking Number

For FAA Use Only

INSTRUCTIONS: Print or type all entries. See Title 14 CFR §43.9, Part 43 Appendix B, and AC 43.9-1 (or subsequent revision thereof) for instructions and disposition of this form. This report is required by law (49 U.S.C. §44701). Failure to report can result in a civil penalty for each such violation. (49 U.S.C. §46301(a))

1. Aircraft	Nationality and Registration Mark: N67RL	Serial No.: 445	
	Make: Socata	Model: TB-20	Series:
2. Owner	Name (As shown on registration certificate): Bennet William W	Address (As shown on registration certificate): Address 2820 Roundrock; City McKinney; State TX; Zip 75072-4210; Country US	

3. For FAA Use Only

4. Type		5. Unit Identification			
Repair	Alteration	Unit	Make	Model	Serial No.
☐	☒	AIRFRAME	————————	(As described in item 1 above)	————————
☐	☐	POWERPLANT			
☐	☐	PROPELLER			
☐	☐	APPLIANCE	Type: Manufacturer:		

6. Conformity Statement

A. Agency's Name and Address	B. Kind of Agency		C. Certificate No.
Name: Arrapa Aviation	X	U. S. Certificated Mechanic	☐ Manufacturer
Address: [illegible]		Foreign Certificated Mechanic	
City: McKinney State: TX		Certificated Repair Station	3381156
Zip: 75071 Country: US		Certificated Maintenance Organization	

D. I certify that the repair and/or alteration made to the unit(s) identified in item 5 above and described on the reverse or attachments hereto have been made in accordance with the requirements of Part 43 of the U.S. Federal Aviation Regulations and that the information furnished herein is true and correct to the best of my knowledge.

Extended range fuel per 14 CFR Part 43 App. B ☐	Signature/Date of Authorized Individual: 21 JUL 21

7. Approval for Return to Service

Pursuant to the authority given persons specified below, the unit identified in item 5 was inspected in the manner prescribed by the Administrator of the Federal Aviation Administration and is ☒ Approved ☐ Rejected

BY							
	☐	FAA Flt. Standards Inspector	☐	Manufacturer	☐	Maintenance Organization	☐ Persons Approved by Canadian Department of Transport
	☐	FAA Designee	☐	Repair Station	X	Inspection Authorization	Other (Specify)

Certificate or Designation No. 3381156	Signature/Date of Authorized Individual: 21 JUL 21

FAA Form 337 (10/06)

NOTICE

Weight and balance or operating limitation changes shall be entered in the appropriate aircraft record. An alteration must be compatible with all previous alterations to assure continued conformity with the applicable airworthiness requirements.

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

Nationality and Registration Mark	Date
N67RL	21Jul21

IRemoved IO-540-C4D5D S/N RL-22449-48A Engine Total Time 1481.2
Installed Lycoming Remanufactured IO-540-C4D5 S/N RL-16468-48E Engine Total Time 0.0 I.A. with 8110-3 DERT-510258-CE Bobby W Minnis
Installed 4 Each New Engine Lord Mounts J-9613-40
Serviced engine with 9 Qts. Phillisp 20W-50W Mineral Oil
Owner has been informed of Service Instructions No. 1427C for Test Flight and Break-In

The aircraft identified above was maintained and altered in accordance with the current Federal Aviation Agency Regulations, Aircraft Service Manual, Radio Manufacturers Installation Manuals, and is hereby approved for return to service with respect to work performed.

End

☐ Additional Sheets Are Attached

ENGINE LOG BOOK

LYCOMING

LYCOMING

Rebuilt Engine Certificate of Conformance

This is to certify that the engine as described hereinafter has been REBUILT in accordance with the applicable Lycoming specifications. It has been determined airworthy to return to service and is in a condition for safe operation. All applicable Federal Aviation Administration Airworthiness Directives and Lycoming Service Publications have been complied with. All accessories as part of the type certificate are new or newly rebuilt. Refer to enclosed Form ET001 for applicable accessory part numbers and serial numbers.

Part Number	RENPL-RT8724
Serial Number	RL-16468-48E
Engine Model	IO-540-C4D5
Work Order	KM781858
Total Time	0

Lou Adams 6/24/21

Authorized Representative Date

Production Certificate #3

652 Oliver Street Williamsport, PA 17701 U.S.A.
Lycoming Engines is a division of Avco Corporation

Form 2481 Rev 05/13

Engine Log

Serial

Arispe Aviation LLC 10160 Doolittle Dr. McKinney, Tx 75071
Socata TB-20 N67RL S/N 445 Total Time 3097.2 Date 22Jul21
Lycoming IO-540-C4D5D S/N RL-22449-48A ETT 1481.2

Removed IO-540-C4D5D S/N RL-22449-48A Engine Total Time 1481.2
Installed Lycoming Remanufactured IO-540-C4D5 S/N RL-16468-48E Engine Total Time 0.0 I.A. with 8110-3
Installed 4 Each New Engine Lord Mounts J-9613-40
Installed Skytec 149-NL Sky-Tec Starter, Installed New Slick EDM-900 Tach Sensor
Installed New PHT Oil Cooler Hose
Serviced engine with 9 Qts. Phillisp 20W-50W Mineral Oil
Owner has been informed of Service Instructions No. 1427C for Test Flight and Break-In
See Corresponding Form 337

Anthony Arispe I.A. 3381156

Signature 22JuL21
Date

Appendix 3:

The following are the basic breakdown of cost in 2021 for the sources I used. Note you may not want to read this section as it can be quite frightening.

Item	Vendor	Amount	Comment
FAA DER Research and Document Preparation	Bob Minnis, DERT	$1,200	Bob had already done N5543T for Jon Miller in 2015.
Engine Order	Air Power Inc	$10,000	Engine Deposit
Engine Order	Air Power Inc	$39,496	Engine $44,700 plus tax of $3,772 and shipping of $1,024
Engine Core Hold	Air Power Inc	$21,600	ACH Draft if core not returned, funds stay in my account
Engine Core Hold	Air Power Inc	-$21,600	ACH Draft destroyed on return of the old engine
Alternator		$0	Recent OH/IRAN performed
Prop		$0	Recent OH/IRAN performed
Vacuum Pump		$0	Recent OH/IRAN performed
Engine Mounts	Airspeed & Altitude Inc	$780	New
Exhaust System		$0	Recent OH/IRAN performed
Hoses		$0	Found in good condition, continue to use
Prop Governor		$0	Found in good condition, continue to use
Starter	Airspeed & Altitude Inc	$612	SkyTec 149NL New
Slick RPM Sensor	Airspeed & Altitude Inc	$269	Used for EDM-900
Labor to remove old engine and accessories, install new	Airspeed & Altitude Inc	$3,600	
Misc parts and supplies	Airspeed & Altitude Inc	$380	Includes a new oil hose of different length than before
TOTAL		$56,337	Does not include sales tax

*Rounding to nearest dollar