

**TELEDYNE CONTINENTAL[®] AIRCRAFT ENGINE
MANDATORY SERVICE BULLETIN**

**The Subject Matter Of This Service Bulletin Is Incorporated In
Whole Or In Part In An FAA Issued Airworthiness Directive**

**Category 1
MSB94-8D**

**SUPERSEDES MSB94-8,
8A, 8B, 8C
Technical Portions FAA
Approved**

SUBJECT: MAGNETO TO ENGINE TIMING

PURPOSE: To provide magneto to engine timing procedures for all TCM engines.

The importance of establishing and maintaining correct magneto to engine timing cannot be over-emphasized. Incorrect timing, in addition to producing a rough running engine, can lead to detonation, pre-ignition and internal engine damage or failure.

COMPLIANCE: At every 100 hour inspection, annual inspection, progressive inspection, whenever magneto maintenance is performed or whenever magnetos are removed or replaced. Magneto maintenance and internal magneto timing must be conducted in accordance with magneto manufacturers instructions.

MODELS AFFECTED: ALL Magneto Equipped Engines

WARNING


Magneto-to-engine timing maintenance does not assure magneto, harness and spark plug performance. Failure to properly maintain the magneto, harness and spark plugs will lead to internal engine damage and failure. Magneto, ignition harness and spark plugs must be maintained in accordance with the manufacturer's instructions.

CAUTION: A single “kick back” while cranking can cause failure of components of the cranking system. Kick back can be caused by intermittent operation of the impulse couplings or shower of sparks system. Perform the following operational test at the specified intervals to ensure that these systems are functioning properly. It is important to note that these operational tests (paragraph I and II) do not supersede inspection, maintenance and overhaul instructions set forth in current manufacturer’s service bulletins and overhaul manuals.

WARNING

Failure to properly ground magnetos will result in ignition and possible injury to personnel.

As part of the routine 100 hour, annual or progressive inspection, whichever occurs most often, for all TCM engine incorporating impulse coupled magnetos, perform the following “Magneto impulse coupling operational test”.

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1. Assure that both magnetos are properly grounded. With all spark plugs installed in all cylinders, remove all spark plug harness lead ends from the spark plugs and ground to the engine to prevent ignition.
2.
 - a. Magneto switch, if separate from starter switch – OFF.
 - b. Mixture – IDLE CUTOFF.
 - c. Throttle – CLOSED.
 - d. Fuel Selector – OFF.
 - e. Master switch - ON.
3. Crank engine several revolutions.

WARNING

Use extreme caution in the area of the propeller while performing this test.


- a. Impulse coupling operation is audible and can also be felt through the magneto housings. They should click together and consistently while cranking the engine.
- b. If “no clicking” or “intermittent clicking” is discovered, remove the magnetos and service per manufacturers instructions.

NOTE: Some engine installations incorporate only one impulse coupling on the left magneto, with the right magneto grounded through the ignition switch during starting. Verify the number of impulse couplings that are used for the particular magneto/engine installation. For those that use only one impulse coupling, verify that the non-impulse coupling magneto is grounded during starting. See following paragraph 2.

As part of the routine 100 hour, annual or progressive inspection, whichever occurs most often, for all TCM engines incorporating a shower of sparks ignition system, perform the following tests:

1. Confirm that the right magneto is grounded during start:
 - a. Remove the P-lead from the right magneto and connect an ohmmeter between the P-lead and ground.
 - b. With the starter motor disconnected from the aircraft power, actuate the aircraft start switch to the “start” position and confirm that the P-lead has continuity with ground as long as the switch is in the start position.
 - c. If the P-lead does not show continuity during “start”, repair or replace the P-lead assembly and/or the ignition switch.
2. Confirm retard timing and vibrator circuit operation:
 - a. Verify that the magnetos are timed to the engine at the proper degrees before top center on number one cylinder. See timing table.
 - b. Disconnect the starter motor from the aircraft power. Move the propeller/crankshaft to top dead center compression stroke on number one cylinder.
 - c. Remove the number one cylinder bottom spark plug lead and position the lead end tip 3/16” from engine ground. Turn aircraft master switch “on” and turn the start switch to he “start” position for a maximum of twenty seconds.

CAUTION: Do not operate the starting vibrator for longer than twenty seconds in a two minute period as overheating will occur.

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- d. Verify a constant, strong blue spark and confirm that the spark begins a few degrees (8 degrees max) before top dead center on the compression stroke.
- e. If no spark is observed during the test, test magneto starting circuit and components so that the problem can be isolated and repairs can be accomplished. If a spark is observed before the maximum advanced position, inspect the left magneto for the main and retard contact point timing. All tests and repairs must be accomplished in accordance with the applicable ignition system maintenance manual.

MAGNETO TO ENGINE TIMING PROCEDURE

In conducting magneto timing checks, the use of a positive Top Dead Center (TDC) locator, protractor and pointer such as the Eastern Technology Corp. Model E-25 Timing Indicator, or equivalent, are the most accurate tools to use. (Reference the applicable tool manufacturer's instructions for use.) Tools which call for a specific arm on the piston dome are more susceptible to error due to bending or excessive carbon buildup. **The following basic timing procedure must be used to assure that timing is accomplished in accordance with the required specifications.**

CAUTION: When using a positive TDC locator, the propeller / crankshaft must be rotated slowly to prevent damage to the piston.

A. DIRECT DRIVE ENGINES


CAUTION: Prior to checking or adjusting engine magneto timing, the aircraft must be situated in a normal attitude on a level surface. If the engine has been removed from the airframe, then the engine must be verified to be level prior to performing magneto timing.

1. When utilizing the Eastern Technology Corp. Model E-25 Timing Indicator, use the Eastern Technology Corp. Model E-25 operating instructions. (Reference Figure 3, page 7)
2. When using a timing tool other than the Eastern Technology Corp. Model E-25 Timing Indicator, contact the applicable tool manufacturer for magneto timing instructions.

B. GEARED ENGINES

CAUTION: Prior to checking or adjusting engine magneto timing, the aircraft must be situated in a normal attitude on a level surface. If the engine has been removed from the airframe, then the engine must be verified to be level prior to performing magneto timing.

1. Remove all spark plugs. Rotate piston to the start of the compression stroke on No. 1 cylinder. Install the TDC locator into the No. 1 cylinder top spark plug hole.
2. Install the timing disc of the indicator being used on the crankshaft flange, propeller spinner, hub or blade. Ensure that the timing disc support is stationary throughout the timing procedure to prevent error.

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3. Turn the propeller slowly in the direction of normal rotation until the piston lightly but positively touches the TDC locator.
4. Rotate the disc of the timing indicator until 0 degrees aligns with the pointer. A light tap of the finger against the dial will ensure that the pointer is centered.
5. Slowly turn the propeller in the opposite direction of normal rotation until the piston lightly but positively touches the TDC locator. Observe the reading, (total degrees of travel) and record. This is the “X” value.
6. Rotate the disc to align 0 degrees with the pointer. Use the following formula, as applicable, to determined the TDC.

GO-300, GIO-470, GTSIO-520-C X Degrees Divided By 2 + 135 Degrees = Y Degrees

GTSIO-520-D,H,F,K,L,M,N X Degrees Divided By 2 + 120 Degrees = Y Degrees

Tiara 6-285, 6-320 X Degrees Divided By 2 + 90 Degrees = Y Degrees

Y = DEGREES OF PROP ROTATION FROM 0 DEGREES (PARAGRAPH 6) TO TDC.

7. Remove the TDC locator from the cylinder.
8. With the Y degrees determined, move the propeller that number of degrees (Y degrees) in the direction of normal rotation. This will place the piston at TDC.
9. Once the TDC has been established and set, reset the timing disc to 0 degrees at TDC.
10. Now the correct timing can be set by using the appropriate propeller shaft angle for the corresponding engine model. Move the propeller in the opposite direction of normal rotation past the specified “propeller shaft angle” magneto timing setting and then back in the direction of normal rotation until the specified “propeller shaft angle” before TDC is under the pointer. (This removes the factor of gear backlash) reference the following example and TABLE 1 for “propeller shaft angle”.

EXAMPLE:

For a geared engine with a .75 propeller to crankshaft RPM ratio and timing specification of 24 degrees BTC, the propeller shaft angle would be .75 x 24 degrees, or 18 degrees BTC. If the propeller shaft to crankshaft ratio was .667, then the propeller shaft timing angle would be .667 x 24 degrees, or 16 degrees BTC.



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TABLE 1
MAGNETO TIMING SPECIFICATIONS FOR GEARED ENGINE MODELS.

ENGINE MODEL	CRANKSHAFT ANGLE	PROPELLER GEAR RATIO	PROPELLER SHAFT ANGLE
GO-300	28 DEGREES BTC	.75	21 DEGREES BTC
GIO-470	24 DEGREES BTC	.75	18 DEGREES BTC
GTSIO-520-C	22 DEGREES BTC	.75	16.5 DEGREES BTC
GTSIO-520-D,H,F,K	20 DEGREES BTC	.667	13.3 DEGREES BTC
GTSIO-520-L,M,N	24 DEGREES BTC	.667	16 DEGREES BTC
TIARA 6-285	30 DEGREES BTC	.500	15 DEGREES BTC
TIARA 6-285	30 DEGREES BTC	.500	15 DEGREES BTC

TABLE 2
MAGNETO TIMING SPECIFICATIONS FOR DIRECT DRIVE ENGINE MODELS

MODEL	RIGHT MAG [3]	LEFT MAG [3]	NOTES
A65	30 DEGREES BTC	30 DEGREES BTC	
A75, A80	29 DEGREES BTC	32 DEGREES BTC	
C75, C85	28 DEGREES BTC	30 DEGREES BTC	
C90	26 DEGREES BTC	28 DEGREES BTC	
O-200-A, B, C	24 DEGREES BTC	24 DEGREES BTC	[5]
O-200-D	24 DEGREES BTC	24 DEGREES BTC	
IO-240-A	22 DEGREES BTC	22 DEGREES BTC	
IO-240-B	26 DEGREES BTC	26 DEGREES BTC	
C-125	28 DEGREES BTC	30 DEGREES BTC	
C-145, O-300	26 DEGREES BTC	28 DEGREES BTC	
E165, E185, E225	26 DEGREES BTC	26 DEGREES BTC	
O-470-A, E	26 DEGREES BTC	26 DEGREES BTC	
O-470-B, G, M, P & U	24 DEGREES BTC	24 DEGREES BTC	
O-470-J	20 DEGREES BTC	20 DEGREES BTC	
O-470-K, L, R & S	22 DEGREES BTC	22 DEGREES BTC	
IO-346	24 DEGREES BTC	24 DEGREES BTC	
IO-360	20 DEGREES BTC	20 DEGREES BTC	[1]
IO-360-ES	24 DEGREES BTC	24 DEGREES BTC	
IO-470-C, G, R & P	26 DEGREES BTC	26 DEGREES BTC	
IO-470-D,E,F,H,L,M,N,S,U,V,VO	20 DEGREES BTC	20 DEGREES BTC	
IO-470-J,K	22 DEGREES BTC	22 DEGREES BTC	
IO-520-SERIES	22 DEGREES BTC	22 DEGREES BTC	[1]
IO-550-SERIES	22 DEGREES BTC	22 DEGREES BTC	
LTSIO & TSIO-360-SERIES	20 DEGREES BTC	20 DEGREES BTC	[1], [1A]
TSIO-470	22 DEGREES BTC	22 DEGREES BTC	
LTSIO-520-AE	20 DEGREES BTC	20 DEGREES BTC	
TSIO-520-B,C,D,E,H,J,K,L,N VB,WB,AE & CE	20 DEGREES BTC	20 DEGREES BTC	[1]

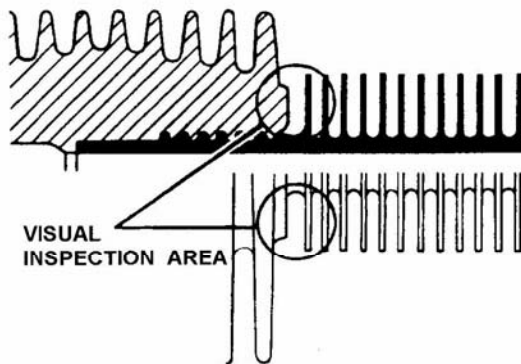
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**TABLE 2 Cont'd
MAGNETO TIMING SPECIFICATIONS FOR DIRECT DRIVE ENGINE MODELS**

MODEL	RIGHT MAG [3]	LEFT MAG [3]	NOTES
TSIO-520-M,R,T,UB,AF &P	22 DEGREES BTC	22 DEGREES BTC	[1][4]
TSIO-520-BE	24 DEGREES BTC	24 DEGREES BTC	
TSIO-550-A,B,C,E,G, K	24 DEGREES BTC	24 DEGREES BTC	
TSIOL-550-A,C	20 DEGREES BTC	20 DEGREES BTC	
TSIOL-550-B	24 DEGREES BTC	24 DEGREES BTC	
W-670	32 DEGREES BTC	32 DEGREES BTC	
W-670-23	5 DEGREES BTC	14 DEGREES BTC	[2]

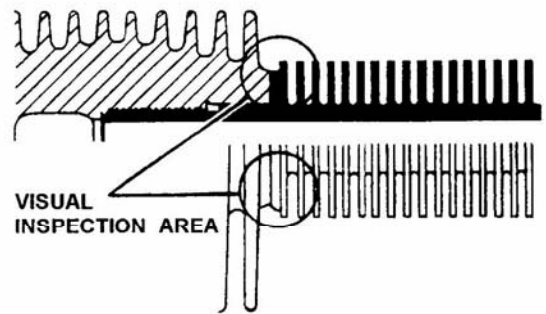
NOTES:

- [1] "B" Models (i.e. IO-360-DB, etc) same as standard models.
- [1A] T/LTSIO360RB timing is to be set at 22 degrees BTC
- [2] This engine has one magneto on left position and battery ignition on right. Both have automatic advance and are in retarded position.
- [3] Magneto setting tolerance to be plus or minus one (1) degree unless otherwise noted.
- [4] Magneto setting tolerance of TSIO-520-P to be plus zero (0) or minus one (1) degree.
- [5] O-200-A and -B model engines that have a complete set (4 each) of P/N 641917 or subsequent (higher) part number cylinders installed are eligible to have the timing advanced to 28 degrees BTC. This may include a combination of 641917, 649543, 653246, 654377, 653816, 655483, 657454, 657455 and subsequent (higher) part number cylinders. The P/N 641917 was first produced beginning in 1977. The cylinder part number is stamped on the barrel flange. The absence of a cylinder part number usually indicates cylinders manufactured prior to P/N 641917. Visual acceptance can be determined by the examples listed in FIGURES 1 and 2. For those engine that have the applicable cylinders and timing advanced, restamp the engine data plate to indicate magneto timing of 28 degrees BTC and make a log book entry noting the change and the part number of the qualifying TCM cylinders installed. Subsequent installation of cylinders must be of the part numbers listed above to retain the advanced 28 degree BTC timing. ONLY cylinders manufactured by TCM qualify for the advanced timing under this service bulletin.



P/N 641917 AND SUBSEQUENT CYLINDER CONSTRUCTION - ACCEPTABLE FOR 28° BTC TIMING ON O-200.

FIGURE 1.



OLD STYLE CYLINDER CONSTRUCTION NOT ACCEPTABLE FOR 28° BTC TIMING ON O-200.

FIGURE 2.


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Figure 3
Model E-25 TIMING INDICATOR
INSTRUCTIONS

CAUTION: *Prior to checking or adjusting engine magneto timing, the aircraft must be situated in a level cruise attitude on a level surface. If the engine has been removed from the airframe, then the engine must be verified to be secure and level prior to performing magneto timing.*

1. Remove all top spark plugs. Rotate the piston to the start of the compression stroke on #1 cylinder. Install the piston stop into the #1 cylinder top spark plug hole.
2. Install the timing disc indicator on aircraft propeller spinner or hub using the supplied rubber bands. Make sure the timing disc indicator is securely fastened to prevent movement during the timing test.
3. Turn the propeller slowly in the direction of rotation until the piston lightly touches piston stop.
4. Rotate the disc of the timing indicator [while ensuring that the timing indicator base (aluminum flower pot) does not move] until Top Center (T.C.) mark is under the point of the weighted pendulum pointer.
5. Slowly turn the propeller in the opposite direction until the piston again lightly touches the piston stop. Observe the reading on the indicator disc under the pointer and rotate the disc (while ensuring that the timing indicator base (aluminum flower pot) does not move) to exactly one half of the number of degrees toward the Top Center (T.C.) mark.
6. Remove the piston stop from the cylinder. Move the propeller back in the direction of normal rotation and verify the engine is on the compression stroke of #1 cylinder by placing a finger over the spark plug hole until building pressure is felt. Continue the rotation until the pointer is under T.C. You now have found top center on the compression stroke.
7. To either check the magneto timing or to time the magnetos to the engine, move the propeller opposite direction of rotation past the specified magneto timing setting and then back in direction of rotation until the desired setting before top center is under the pointer (this removes the factor of gear backlash). NOTE: Engines equipped with impulse couplings must be turned in the direction of rotation until the impulse coupling(s) trip prior to centering the pointer on the desired timing setting.
8. The breaker points should just be starting to open at this setting. Breaker points opening should be checked with an Eastern Model E-50 Synchronizer.

Note:

- A. A light tap of the finger against the dial will insure absolute correct timing.
- B. An occasional drop of oil at the pointer bushing is all that's required to keep the timer in good operating condition.


WARRANTY

Eastern Technology Corporation agrees to repair or replace any of its products (parts and labor) if there is a defect in materials or workmanship within one year of the date of purchase. Eastern Technology Corporation limits its obligation to repair or replacement, the choice of which is at its sole discretion. This warranty does not apply to equipment that has been damaged by accident, negligence or misuse, or altered or modified in any way.

For repairs return to:



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Phone: 860-528-9821 Fax: 860-289-7639

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