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SERVICE INSTRUCTION

DATE: April 6, 2017

Service Instruction No. 1070V
(Supersedes Service Instruction No. 1070U)
Engineering Aspects are
FAA Approved

SUBJECT: Specified Fuels for Spark-Ignited Gasoline Aircraft Engine Models

MODELS AFFECTED: Lycoming engine models as detailed in Table 3

TIME OF COMPLIANCE: When refueling aircraft

REASON FOR REVISION: Added a new CAUTION on page 1; added UL 94 fuel to Table 1; in Table 2, updated EN228 row, replaced 93 AKI with Super Plus, and in Table 3 added engine models, added UL 94 to UL 91 to column header, and under EN228 column header, replaced 93 AKI with Super Plus

NOTICE: Incomplete review of all the information in this document can cause errors. Read the entire Service Instruction to make sure you have a complete understanding of the requirements.

This Service Instruction identifies approved fuels for Lycoming spark-ignited gasoline aircraft engines. Fuels no longer known to be in production and distribution have been removed from this Service Instruction. For historical information, refer to the engine model Type Certificate Data Sheet or previous revisions of this Service Instruction.

⚠ **CAUTION:** AIRFRAME APPROVAL IS NECESSARY. THIS SERVICE INSTRUCTION IDENTIFIES APPROVED FUELS FOR ENGINES BASED ON THE ENGINE OPERATING LIMITATIONS INCLUSIVE OF OUTSIDE AIR TEMPERATURE, CYLINDER HEAD TEMPERATURE AND OIL TEMPERATURE.

AIRFRAME OPERATING LIMITATIONS CAN BE DIFFERENT THAN ENGINE OPERATING LIMITATIONS. REFER TO THE PILOT OPERATING HANDBOOK (POH), AIRFRAME TYPE CERTIFICATE (TC), AIRFRAME SUPPLEMENTAL TYPE CERTIFICATE (STC) OR OTHER APPLICABLE REGULATORY GUIDANCE FOR FUELS APPROVED AT THE AIRFRAME LEVEL.

Fuels approved for use in Lycoming engines in Table 3 include the following types:

- Aviation Fuels (Table 1)
- Automotive Fuels (Table 2)

⚠ **CAUTION:** ANY MIXTURE OF UNAPPROVED FUELS AND ADDITIVE MATERIALS THAT MAKES A LOWER THAN SPECIFIED OCTANE RATING, CAN CAUSE ENGINE DAMAGE. USE OF LOWER-THAN-SPECIFIED OCTANE FUEL COULD CAUSE DETONATION AND MECHANICAL DAMAGE TO THE ENGINE.

IF INCORRECT FUEL OR ADDITIVES ARE USED, REFER TO THE LATEST REVISION OF SERVICE BULLETIN NO. 398 FOR INSTRUCTIONS TO CORRECT THE FUEL CONTAMINATION.

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Fuel Specifications and Grades

Specifications that identify fuel types and grades approved for Lycoming engines are identified in Table 1: *Aviation Fuel Specifications and Fuel Grades* and Table 2: *Automotive Fuel Specifications and Fuel Grades*.

Engine Fuel Approvals

Table 3: *Fuels and Fuel Grades Approved for Use in Lycoming Engine Models* identify the approved fuel specifications and the associated fuel grade for each Lycoming engine model.

NOTICE: The fuel grades in Table 3 represent the Minimum Fuel Grade required for the engine specified and the associated Engine Operating Limitations. Higher fuel grades under the same specification can be used. For example, ASTM D7547 Grade UL 94 can be used in place of ASTM D7547 Grade UL 91.

Table 1
Aviation Fuel Specifications and Fuel Grades

	Fuel Specification	Fuel Grades	Color
LEADED	***ASTM D910:*** ***Standard Specification for Aviation Gasolines***	100 100LL 100VLL	Green Blue Blue
LEADED	***TU 38.5901481-96:*** ***High-Octane Gasoline for Gasoline Engines*** Ukrainian National Standard	91	Yellow
LEADED	***GOST 1012-72:*** ***Aviation petrol*** Russian National Standard	B91/115 B95/130	Green Amber
UNLEADED	***ASTM D7547:*** ***Standard Specification for Unleaded Aviation Gasolines***	UL 91 UL 94	Clear to Yellow (no dye)
UNLEADED	***HJELMCO Oil, INC.:*** HJELMCO 91/96 UL is the registered trade-name for colorless unleaded fuel made by HJELMCO Oil, Inc. of Sollentuna, Sweden	HJELMCO 91/96 UL	Clear to Yellow (no dye)

⚠ **CAUTION:** WHEN USING THE UNLEADED FUELS IDENTIFIED IN TABLE 1, LYCOMING OIL ADDITIVE P/N LW-16702, OR AN EQUIVALENT FINISHED PRODUCT SUCH AS AEROSHELL 15W-50, MUST BE USED.

NOTICE: Isopropyl alcohol in amounts not to exceed 1% by volume can be added only to **aviation fuel** (not automotive fuel) to prevent ice formation in fuel lines and tanks. Although approved for use in Lycoming engines, do not use isopropyl alcohol in the aircraft fuel systems unless approved by the aircraft manufacturer.

Table 2
Automotive Fuel Specifications and Fuel Grades

FUEL SPECIFICATION	FUEL GRADES
ASTM D4814-09b: ***Standard Specification for Automotive Spark-Ignition Engine Fuel*** Ordering Requirements: Vapor Pressure: Class A-4 Oxygenate Content: For blends containing one or more oxygenates, oxygenate content are not to exceed 1.0 volume percent.	91 AKI 93 AKI
EN 228:2014: ***Automotive fuels - Unleaded petrol - Requirements and test methods*** Ordering Requirements: Vapor Pressure: Class A Oxygenate Content: For blends containing one or more oxygenates, oxygenate content are not to exceed 1.0 volume percent.	Super Plus (Minimum 88 MON and 98 RON)

⚠ **CAUTION:** IN COMPLIANCE WITH THIS SERVICE INSTRUCTION, THE AUTOMOTIVE FUEL MUST AGREE WITH ALL SPECIFICATIONS IN TABLE 2. AUTOMOTIVE GASOLINE THAT IS NOT IN CONFORMANCE WITH THE SPECIFICATIONS IN TABLE 2 IS NOT TO BE USED.

WHEN USING THE AUTOMOTIVE FUELS IDENTIFIED IN TABLE 2, LYCOMING OIL ADDITIVE P/N LW-16702, OR AN EQUIVALENT FINISHED PRODUCT SUCH AS AEROSHELL 15W-50, MUST BE USED.

NOTICE: Refer to the latest revision of Service Instruction No. 1534 for information on service recommendations for long-term storage of engines that use automotive fuel.

The automotive fuels in Table 2 must be in conformance with ASTM D4814-09b or EN 228:2014. In these specifications, the automotive fuel is identified by an Anti-Knock Index (AKI) or in the case of EN 228 as "Super Plus," a grade designation. The AKI is an octane rating and is the arithmetic average of the Research Octane Number (RON) and Motor Octane Number (MON).

(RON + MON)/2 = AKI

Automotive fuels usually have Reid Vapor Pressure (RVP) values between 7 and 9.3 psi (48 and 64 kPa) in summer seasons but specifications for the RVP can be as high as 15 psi (103 kPa) in the winter. In some geographic regions, there is no upper limit to RVP in the winter season. As vapor pressure increases, the tendency for vapor lock will increase as well as fuel "boil off" at altitude. It is also possible that highly oxygenated fuels are not compatible with some fuel system components. In cases of material incompatibility, deterioration of metallic and non-metallic components can occur.

Automotive ground transportation fuels available direct to consumers (e.g. "pump gas") usually do not have labels with sufficient information to identify compliance with the requirements in Table 2. While indicated octane is generally necessary for display at retail points of sale, octane rating methods, fuel vapor pressure and oxygenate content can vary widely and are generally known only at the wholesale terminal.

Table 3
Fuels and Fuel Grades Approved for Use in Lycoming Engine Models

Engine Models	Leaded Aviation Fuels (Table 1)				Unleaded Aviation Fuels (Table 1)		Automotive Fuels (Table 2)		
	ASTM D910	TU 38	GOST 1012		ASTM D7547	HJELMCO	ASTM D4814		EN228
	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	91/96	91 AKI	93 AKI	Super Plus
O-235									
-C, -E, -H	●	●	●	●	●	●		●	●
-F, -G, -J	●			●					
-K, -L, -N	●			●	●			●	●
-M, -P	●				●			●	●
O-290									
-D	●	●	●	●	●	●		●	●
O-320									
-A, -B, -C, -D, -E	●	●	●	●	●	●		●	●
-H	●								
IO-320									
-A, -B, -D, -E	●	●	●	●	●	●		●	●
-C, -F	●			●					
AIO-320									
-A, -B, -C	●	●	●	●	●	●		●	●
LIO-320									
-B	●	●	●	●	●	●		●	●
-C	●			●					
AEIO-320									
-D	●	●	●	●		●			
-E	●	●	●	●	●	●			
O-360									
-A, -B, -C, -D, -F, -G, -J	●	●	●	●	●	●		●	●
-E	●								

Table 3 (Cont.)

Fuels and Fuel Grades Approved for Use in Lycoming Engine Models

Engine Models	Leaded Aviation Fuels (Table 1)				Unleaded Aviation Fuels (Table 1)		Automotive Fuels (Table 2)		
	ASTM D910	TU 38	GOST 1012		ASTM D7547	HJELMCO	ASTM D4814		EN228
	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	91/96	91 AKI	93 AKI	Super Plus
HO-360									
-A, -B	●	●	●	●		●			
-C	●	●	●	●	●			●	●
IO-360									
-A, -C, -D, -F	●			●					
-J, -K	●								
-B, -E, -L, -M, -N	●	●	●	●	●	●		●	●
LO-360									
-A	●	●	●	●	●	●		●	●
-E	●								
TO-360									
-A, -C, -E, -F	●								
VO-360									
-A, -B	●	●	●	●		●			
AIO-360									
-A, -B	●			●					
HIO-360									
-A, -C, -D, -E, -F	●			●					
-B	●	●	●	●	●	●		●	●
-G	●	●	●	●	●			●	●
IVO-360									
-A	●	●	●	●	●	●		●	●
LIO-360									
-C	●			●					
-M	●	●	●	●	●	●		●	●

Table 3 (Cont.)

Fuels and Fuel Grades Approved for Use in Lycoming Engine Models

Engine Models	Leaded Aviation Fuels (Table 1)				Unleaded Aviation Fuels (Table 1)		Automotive Fuels (Table 2)		
	ASTM D910	TU 38	GOST 1012		ASTM D7547	HJELMCO	ASTM D4814		EN228
	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	91/96	91 AKI	93 AKI	Super Plus
LTO-360									
-A, -E	●								
TIO-360									
-A, -C	●								
AEIO-360									
-A	●			●					
-B, -H	●	●	●	●		●			
LHIO-360									
-C, -F	●								
IO-390									
-A, -C	●			●					
AEIO-390									
-A	●								
O-435									
-A, -C (except -A2)	●	●	●	●	●	●			
-A2	●								
GO-435									
-C, -C2 (See note below for -C2)	●	●	●	●	●	●			
NOTE: GO-435-C2 engine models equipped with carburetor setting 10-3391 must use 91/96 HJELMCO grade or better fuel. Engines equipped with carburetor settings 10-3391-1 or PS-5BD can use fuels specified for GO-435-C model engines.									
VO-435									
-A, -6, -23	●	●	●	●		●			
-B	●			●					

Table 3 (Cont.)

Fuels and Fuel Grades Approved for Use in Lycoming Engine Models

Engine Models	Leaded Aviation Fuels (Table 1)				Unleaded Aviation Fuels (Table 1)		Automotive Fuels (Table 2)		
	ASTM D910	TU 38	GOST 1012		ASTM D7547	HJELMCO	ASTM D4814		EN228
	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	91/96	91 AKI	93 AKI	Super Plus
TVO-435									
-A, -B, -C, -D, -E, -F, -G, -25	●								
O-480									
-1, -3	●								
-A	●	●	●	●		●			
GO-480									
-B, -D, -F	●	●	●	●	●	●			
-C, -G	●			●					
GSO-480									
-A, -B	●								
IGO-480									
-A	●			●					
IGSO-480									
-A	●								
O-540									
-A, -B, -D, -E, -F, -G, -H, -J	●	●	●	●	●	●		●	●
-L	●								
-9, -9A	●								
IO-540									
-A, -B, -E, - G, -J, -K, -L, -M, -P, -R, -S, -U, -AA, -AC, -AE	●			●					
-C, -D, -N, -T, -V	●	●	●	●	●	●		●	●
-W, -AB, -AF	●				●			●	●

Table 3 (Cont.)

Fuels and Fuel Grades Approved for Use in Lycoming Engine Models

Engine Models	Leaded Aviation Fuels (Table 1)				Unleaded Aviation Fuels (Table 1)		Automotive Fuels (Table 2)		
	ASTM D910	TU 38	GOST 1012		ASTM D7547	HJELMCO	ASTM D4814		EN228
	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	91/96	91 AKI	93 AKI	Super Plus
VO-540									
-A, -B	●	●	●	●	●	●			
-C	●			●					
HIO-540									
-A	●			●					
IGO-540									
-A, -B	●			●					
IVO-540									
-A	●			●					
TIO-540									
-A, -C, -E, -F, -G, -H, -J, -K, -N, -R, -S, -T, -U, -V, -W, -AA, -AB, -AE, -AF, -AG, -AH, -AJ, -AK	●								
TVO/TIVO-540									
-A	●								
AEIO-540									
-D	●	●	●	●		●			
-L	●								
IGSO-540									
-A, -B	●								
LTIO-540									
-F, -J, -K, -N, -R, -U, -V, -W	●								

Table 3 (Cont.)

Fuels and Fuel Grades Approved for Use in Lycoming Engine Models

Engine Models	Leaded Aviation Fuels (Table 1)				Unleaded Aviation Fuels (Table 1)		Automotive Fuels (Table 2)		
	ASTM D910	TU 38	GOST 1012		ASTM D7547	HJELMCO	ASTM D4814		EN228
	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	91/96	91 AKI	93 AKI	Super Plus
TIO-541									
-A, -E	●								
TIGO-541									
-D, -E, -G	●								
IO-580									
-A, -B	●			●					
AEIO-580									
-B	●			●					
IO-720									
-A, -B, -C, -D	●			●					

*** -** Continuous use of high lead fuels can cause increased lead deposits both in combustion chambers and spark plugs causing roughness in engine operation and scored cylinder walls. It is recommended that the use of this fuel be limited wherever possible. However, when high lead fuel is used, do periodic inspections of combustion chambers, valves, and valve ports more frequently and rotate or clean spark plugs whenever lead fouling is found. See the latest revision of Service Letter No. L192.