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# SERVICE INSTRUCTION

DATE: April 4, 2018

Service Instruction No. 1070Z  
(Supersedes Service Instruction No. 1070Y)  
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 DEF-STAN 91-090 100LL and DEF-STAN 91-090 UL 91 fuels to Table 1; added DEF-STAN 91-090 100LL and DEF-STAN 91-090 UL 91 to column header; added listing for HIO-390-A engine model to Table 3

**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.



General Aviation  
Manufacturers Association

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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	<b><u>DEF-STAN 91-090</u></b> <i>Standard Specification for Aviation Gasolines</i>	100LL	Blue
	<b><u>ASTM D910:</u></b> <i>Standard Specification for Aviation Gasolines</i>	100 100LL 100VLL	Green Blue Blue
	<b><u>TU 38.5901481-96:</u></b> <i>High-Octane Gasoline for Gasoline Engines</i> Ukrainian National Standard	91	Yellow
	<b><u>GOST 1012-72:</u></b> <i>Aviation petrol</i> Russian National Standard	B91/115 B95/130	Green Amber
UNLEADED	<b><u>ASTM D7547:</u></b> <i>Standard Specification for Unleaded Aviation Gasolines</i>	UL 91 UL 94	Clear to Yellow (no dye)
	<b><u>DEF-STAN 91-090</u></b> <i>Standard Specification for Unleaded Aviation Gasolines</i>	UL 91	Clear to Yellow (no dye)
	<b><u>HJELMCO Oil, INC.:</u></b> 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.

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**Table 2**  
**Automotive Fuel Specifications and Fuel Grades**

FUEL SPECIFICATION	FUEL GRADES
<b><u>ASTM D4814-09b:</u></b> <b><i>Standard Specification for Automotive Spark-Ignition Engine Fuel</i></b> 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
<b><u>EN 228:2014:</u></b> <b><i>Automotive fuels - Unleaded petrol - Requirements and test methods</i></b> 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.

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**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)		
	DEF-STAN 91-090	ASTM D910	TU 38	GOST 1012		ASTM D7547	DEF-STAN 91-090	HJELMCO	ASTM D4814		EN228
	100LL	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	UL 91	91/96	91 AKI	93 AKI	Super Plus
<b>O-235</b>											
-C, -E, -H	•	•	•	•	•	•	•	•		•	•
-F, -G, -J	•	•			•	•	•			•	•
-K, -L, -N	•	•			•	•	•			•	•
-M, -P	•	•				•	•			•	•
<b>O-290</b>											
-D	•	•	•	•	•	•	•	•		•	•
<b>O-320</b>											
-A, -B, -C, -D, -E	•	•	•	•	•	•	•	•		•	•
-H	•	•									
<b>IO-320</b>											
-A, -B, -D, -E	•	•	•	•	•	•	•	•		•	•
-C, -F	•	•			•						
<b>AIO-320</b>											
-A, -B, -C	•	•	•	•	•	•	•	•		•	•
<b>LIO-320</b>											
-B	•	•	•	•	•	•	•	•		•	•
-C	•	•			•						
<b>AEIO-320</b>											
-D, -E	•	•	•	•	•	•	•	•		•	•
<b>O-360</b>											
-A, -B, -C, -D, -E, -G, -J	•	•	•	•	•	•	•	•		•	•
-F	•	•									
<b>HO-360</b>											
-A, -B	•	•	•	•	•	•	•	•		•	•
-C	•	•	•	•	•	•	•	•		•	•

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**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)		
	DEF-STAN 91-090	ASTM D910	TU 38	GOST 1012		ASTM D7547	DEF-STAN 91-090	HJELMCO	ASTM D4814		EN228
	100LL	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	UL 91	91/96	91 AKI	93 AKI	Super Plus
<b>IO-360</b>											
-A, -C, -D, -F	•	•			•						
-J, -K	•	•									
-B, -E, -L, -M, -N, -P	•	•	•	•	•	•	•	•		•	•
<b>LO-360</b>											
-A	•	•	•	•	•	•	•	•		•	•
-E	•	•									
<b>TO-360</b>											
-A, -C, -E, -F	•	•									
<b>VO-360</b>											
-A, -B	•	•	•	•	•			•			
<b>AIO-360</b>											
-A, -B	•	•			•						
<b>HIO-360</b>											
-A, -C, -D, -E, -F	•	•			•						
-B	•	•	•	•	•	•	•	•		•	•
-G	•	•	•	•	•	•	•	•		•	•
<b>IVO-360</b>											
-A	•	•	•	•	•	•	•	•		•	•
<b>LIO-360</b>											
-B, -M	•	•	•	•	•	•	•	•		•	•
-C	•	•			•						
<b>LTO-360</b>											
-A, -E	•	•									

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**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)		
	DEF-STAN 91-090	ASTM D910	TU 38	GOST 1012		ASTM D7547	DEF-STAN 91-090	HJELMCO	ASTM D4814		EN228
	100LL	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	UL 91	91/96	91 AKI	93 AKI	Super Plus
<b>TIO-360</b>											
-A, -C	•	•									
<b>AEIO-360</b>											
-A	•	•			•						
-B, -H	•	•	•	•	•	•	•	•		•	•
<b>LHIO-360</b>											
-C, -F	•	•									
<b>IO-390</b>											
-A, -C	•	•			•						
<b>HIO-390</b>											
-A	•	•									
<b>AEIO-390</b>											
-A	•	•									
<b>O-435</b>											
-A, -C (except -A2)	•	•	•	•	•	•	•	•			
-A2	•	•									
<b>GO-435</b>											
-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.											
<b>VO-435</b>											
-A, -6, -23	•	•	•	•	•			•			
-B	•	•			•						

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**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)		
	DEF-STAN 91-090	ASTM D910	TU 38	GOST 1012		ASTM D7547	DEF-STAN 91-090	HJELMCO	ASTM D4814		EN228
	100LL	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	UL 91	91/96	91 AKI	93 AKI	Super Plus
<b>TVO-435</b>											
-A, -B, -C, -D, -E, -F, -G, -25	•	•									
<b>O-480</b>											
-1, -3	•	•									
-A	•	•	•	•	•			•			
<b>GO-480</b>											
-B, -D, -F	•	•	•	•	•	•	•	•			
-C, -G	•	•			•						
<b>GSO-480</b>											
-A, -B	•	•									
<b>IGO-480</b>											
-A	•	•			•						
<b>IGSO-480</b>											
-A	•	•									
<b>O-540</b>											
-A, -B, -D, -E, -F, -G, -H, -J	•	•	•	•	•	•	•	•		•	•
-L	•	•									
-9, -9A	•	•									
<b>IO-540</b>											
-A, -B, -E, -G, -J, -K, -L, -M, -P, -R, -S, -U, -AA, -AC, -AE	•	•			•						
-C, -D, -N, -T, -V	•	•	•	•	•	•	•	•		•	•
-W, -AB, -AF	•	•				•	•			•	•

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**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)		
	DEF-STAN 91-090	ASTM D910	TU 38	GOST 1012		ASTM D7547	DEF-STAN 91-090	HJELMCO	ASTM D4814		EN228
	100LL	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	UL 91	91/96	91 AKI	93 AKI	Super Plus
<b>VO-540</b>											
-A, -B	•	•	•	•	•	•	•	•			
-C	•	•			•						
<b>HIO-540</b>											
-A	•	•			•						
<b>IGO-540</b>											
-A, -B	•	•			•						
<b>IVO-540</b>											
-A	•	•			•						
<b>TIO-540</b>											
-A, -C, -E, -F, -G, -H, -J, -K, -N, -R, -S, -T, -U, -V, -W, -AA, -AB, -AE, -AF, -AG, -AH, -AJ, -AK	•	•									
<b>TVO/TIVO-540</b>											
-A	•	•									
<b>AEIO-540</b>											
-D	•	•	•	•	•	•	•	•		•	•
-L	•	•									
<b>IGSO-540</b>											
-A, -B	•	•									
<b>LTIO-540</b>											
-F, -J, -K, -N, -R, -U, -V, - W	•	•									
<b>TIO-541</b>											
-A, -E	•	•									

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Engine Models	Leaded Aviation Fuels (Table 1)					Unleaded Aviation Fuels (Table 1)			Automotive Fuels (Table 2)		
	DEF-STAN 91-090	ASTM D910	TU 38	GOST 1012		ASTM D7547	DEF-STAN 91-090	HJELMCO	ASTM D4814		EN228
	100LL	100* 100LL 100VLL	91*	B91/115*	B95/130*	UL 91 UL 94	UL 91	91/96	91 AKI	93 AKI	Super Plus
<b>TIGO-541</b>											
-D, -E, -G	•	•									
<b>IO-580</b>											
-A, -B	•	•			•						
<b>AEIO-580</b>											
-B	•	•			•						
<b>IO-720</b>											
-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.

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