



652 Oliver Street
Williamsport, PA. 17701 U.S.A.

Telephone +1 (800) 258-3279 U.S. and Canada (Toll Free)
Telephone +1 (570) 323-6181 (Direct)
Facsimile +1 (570) 327-7101

www.lycoming.com

SERVICE INSTRUCTION

DATE: April 24, 2013

Service Instruction No. 1070S
(Supersedes Service Instruction No. 1070R)
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

NOTE

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 that can be used when refueling aircraft with Lycoming 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.

Fuels approved for use in Lycoming engines 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.

CAUTION

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 listed in Table 1: *Aviation Fuel Specifications and Fuel Grades* and Table 2: *Automotive Fuel Specifications and Fuel Grades*.

Engine Fuel Approvals

Table 3: *Fuels Approved for Use in Lycoming Engine Models* identify approved fuels for each Lycoming engine model.

Although the aviation and automotive fuels identified in Table 1 and Table 2 can be used as designated in Table 3, airframe approval is necessary. Refer to the Pilot Operating Handbook (POH), Type Certificate Data Sheet or Supplemental Type Certificated (STC) for aircraft approved fuels.

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Table 1
Aviation Fuel Specifications and Fuel Grades

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

NOTE

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* |
|--|--------------------------|
| <p><u>ASTM D4814-09b:</u> <i>Standard Specification for Automotive Spark-Ignition Engine Fuel</i> Ordering Requirements: Vapor Pressure: Class A-4 Oxygenate Content: For blends containing one or more oxygenates, oxygenate content shall not exceed 1.0 volume percent. Prohibited Oxygenates: Ethanol, Methanol</p> | <p>91 AKI 93 AKI</p> |
| <p><u>EN 228:2008(E):</u> <i>Automotive fuels - Unleaded petrol - Requirements and test methods</i> Ordering Requirements: Vapor Pressure: Class A Oxygenate Content: For blends containing one or more oxygenates, oxygenate content shall not exceed 1.0 volume percent. Prohibited Oxygenates: Ethanol, Methanol</p> | <p>NB 3 93AKI</p> |



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



WHEN USING THE UNLEADED 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.

NOTE

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 clear to yellow (colorless) unleaded automotive fuels in Table 2 must be in conformance with ASTM D4814-09b or EN 228:2008:E. In these specifications, the automotive fuel is identified by an Anti-Knock Index (AKI) or in the case of EN 228 Super Premium, 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).

$$(RON + MON)/2 = AKI$$

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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 ethanol-based fuels could not be compatible with some fuel system components. In cases of material incompatibility, deterioration of metallic and non-metallic components can occur. Therefore, fuels containing ethanol are not approved in this Service Instruction.

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, oxygenate content and ethanol content can vary widely and are generally known only at the wholesale terminal.

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Table 3
Fuels Approved for Use in Lycoming Engine Models

| Engine Models | Leaded Aviation Fuels (Table 1) | | | | Unleaded Aviation Fuels (Table 1) | | Unleaded 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 | 91/96 | 91 AKI | 93 AKI | NB.3 |
| 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 | ● | | | | | | | | |

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Fuels Approved for Use in Lycoming Engine Models

| Engine Models | Unleaded Aviation Fuels (Table 1) | | | | Unleaded Aviation Fuels (Table 1) | | Unleaded 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 | 91/96 | 91 AKI | 93 AKI | NB.3 |
| HO-360 | | | | | | | | | |
| -A, -B | ● | ● | ● | ● | | ● | | | |
| -C | ● | ● | ● | ● | ● | | | ● | ● |
| IO-360 | | | | | | | | | |
| -A, -C, -D, -F | ● | | | ● | | | | | |
| -J, -K | ● | | | | | | | | |
| -B, -E, -L, -M | ● | ● | ● | ● | ● | ● | | ● | ● |
| 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 | ● | ● | ● | ● | ● | ● | | ● | ● |

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Table 3 (Cont.)
Fuels Approved for Use in Lycoming Engine Models

| Engine Models | Leaded Aviation Fuels (Table 1) | | | | Unleaded Aviation Fuels (Table 1) | | Unleaded 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 | 91/96 | 91 AKI | 93 AKI | NB.3 |
| LTO-360 | | | | | | | | | |
| -A, -E | ● | | | | | | | | |
| TIO-360 | | | | | | | | | |
| -A, -C | ● | | | | | | | | |
| AEIO-360 | | | | | | | | | |
| -A | ● | | | ● | | | | | |
| -B, -H | ● | ● | ● | ● | | ● | | | |
| LHIO-360 | | | | | | | | | |
| -C, -F | ● | | | | | | | | |
| IO-390 | | | | | | | | | |
| -A | ● | | | ● | | | | | |
| AEIO-390 | | | | | | | | | |
| -A | ● | | | | | | | | |
| O-435 | | | | | | | | | |
| -A, -C | ● | ● | ● | ● | ● | ● | | | |
| 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 | ● | | | ● | | | | | |

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Fuels Approved for Use in Lycoming Engine Models

| Engine Models | Leaded Aviation Fuels (Table 1) | | | | Unleaded Aviation Fuels (Table 1) | | Unleaded 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 | 91/96 | 91 AKI | 93 AKI | NB.3 |
| 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, -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 | ● | | | | ● | | | ● | ● |

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Fuels Approved for Use in Lycoming Engine Models

| Engine Models | Leaded Aviation Fuels (Table 1) | | | | Unleaded Aviation Fuels (Table 1) | | Unleaded 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 | 91/96 | 91 AKI | 93 AKI | NB.3 |
| VO-540 | | | | | | | | | |
| -A, -B | ● | ● | ● | ● | ● | ● | | | |
| -C | ● | | | ● | | | | | |
| HIO-540 | | | | | | | | | |
| -A | ● | | | ● | | | | | |
| IGO-540 | | | | | | | | | |
| -A, -B | ● | | | ● | | | | | |
| IVO-540 | | | | | | | | | |
| -A | ● | | | ● | | | | | |
| TIO-540 | | | | | | | | | |
| -A, -C, -E, -F, -G, -H, -J, -N, -R, -S, -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, -N, -R, -U, -V | ● | | | | | | | | |

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| Engine Models | Leaded Aviation Fuels (Table 1) | | | | Unleaded Aviation Fuels (Table 1) | | Unleaded 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 | 91/96 | 91 AKI | 93 AKI | NB.3 |
| TIO-541 | | | | | | | | | |
| -A, -E | ● | | | | | | | | |
| TIGO-541 | | | | | | | | | |
| -D, -E, -G | ● | | | | | | | | |
| IO-580 | | | | | | | | | |
| -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.

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