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**THE GRADES OF AVIATION GASOLINE AND INTERCHANGEABILITY
OF DOMESTIC AND FOREIGN AVIATION GASOLINE GRADES**

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Aviation gasoline is regularly used in civil aviation: namely regional, local, and agricultural airlines, and for military intentions such as mock and command aircrafts.

Avgas (aviation gasoline), also known as aviation spirit in the UK, is an aviation fuel used in spark-ignited internal-combustion engines to propel aircraft.

Modern gasoline should meet a strict requirements, ensuring gas-saving reliable engine performance, and operating requirements such as sufficient vaporability of gasoline, ability to maintain permanent hydrocarbon composition and commit no harmful effects to storage tanks, engine, or environment [4].

In Russia avgas is classified by GOST 1012-72 according to its antiknock properties. Usually avgas is graded by stroke: numerator stands for octane number and denominator stands for rich mixture rating, like B-91/115 and B-95/130, but there are still some brands produced under TU, which graded only by octane number, such as B-70 and B-92 [1].

Abroad avgas ratings are a bit different. Avgas has two different ratings, although it is referred to only by the lower of the two. One is referred to as the "aviation lean" rating and is the same as the MON of the fuel up to 100. The second is the "aviation rich" rating and corresponds to the octane rating of a test engine under forced induction operation common in high-performance and military piston aircraft [5].

The most common type of octane rating worldwide is the Research Octane Number (RON). RON is determined by running the fuel in a test engine with a variable compression ratio under controlled conditions, and comparing the results with those for mixtures of iso-octane and n-heptane.

Another type of octane rating, called Motor Octane Number (MON), is determined at 900 rpm engine speed instead of the 600 rpm for RON. MON testing uses a similar test engine to that used in RON testing, but with a preheated fuel mixture, higher engine speed, and variable ignition timing to further stress the fuel's knock resistance. Depending on the composition of the fuel, the MON of a modern pump gasoline will be about 8 to 12 octane lower than the RON, but there is no direct link between RON and MON. Pump gasoline specifications typically require both a minimum RON and a minimum MON.

In Russia RON is determined by GOST 8226-82 and MON by GOST 511-82.

Gasoline's rich mixture rating is determined according to GOST 3338-68.

Some grades of avgas still contain tetraethyllead (TEL), a toxic substance used to prevent engine knocking (detonation), with ongoing experiments aimed at eventually reducing or eliminating the use of TEL in aviation gasoline. Avgas is currently available in several grades with differing maximum lead concentrations. Because TEL is an expensive and polluting ingredient, the minimum amount needed to bring the fuel to the required octane rating is used; actual concentrations are often lower than the permissible maximum.

Russia's primary avgas grade is the B-91/115, which is commonly used on engines with compression ratio $6,5 \pm 0,1$ such as the ASh-62IR, the M-9F, the AI-26V, and the M-14 modified and mounted on the An-2, the An-14, and the Su-49 aircrafts. The B-91/115 contains up to 2,5 grams per kilogram TEL, providing required antiknock properties. The B-91/115 is dyed green.

Russia's secondary avgas grade is the B-92, containing at most 2 grams per kilogram TEL. Another secondary avgas was the B-95/130; its antiknock value was graded higher than the B-92. By GOST 1012-72 it might contain up to 3,1 grams per kilogram TEL, and the B-95/130 was used on such aircraft as the IL-14 [2].

In Russia as of 2015 there are no known commercial scale avgas producers, but in France, Netherlands, Sweden, USA, Canada, and Australia avgas is produced by Bp, Exxon, Mobil, Shell, Texaco and so on [6].

Avgas 100 is standard aviation gasoline for piston aircraft. There are two primary standard specifications for Avgas 100: ASTM D 910 and UK DEF STAN 91-90. They are essentially equal.

Avgas 100 is dyed green.

Avgas 100LL is the most commonly used aviation gasoline. LL stands for low leaded, but low leaded is tentatively due to containing up to 0,56 grams per litre lead. Standard specifications are same as Avgas 100.

Avgas 100LL is dyed blue.

Avgas 82UL is similar to automobile gasoline but without automotive additives. UL stands for unleaded. As of 2008 82UL is not being produced and no refiner has announced plans to put it into production.

Avgas 82UL is dyed purple.

Information about avgas grades is presented in table 1 [5].

TEL found in leaded avgas and its combustion products are potent neurotoxins that have been shown in scientific research to interfere with brain development in children. The United States Environmental Protection Agency (EPA) has noted that exposure to even very low levels of lead contamination has been conclusively linked to loss of IQ in children's brain function tests, thus providing a high degree of motivation to eliminate lead and its compounds from the environment.

The information about interchangeability of domestic and foreign avgas grades is presented in the table 2 [3]. Information is usually obtained by testing of samples in the laboratory and test-bench, according to foreign specifications, the data of production technology, and experience of using it on the technological machines and equipment.

Table 1 – avgas grades

Grade	Dye	Lead (Pb) content, g/L	Additives	Uses	Availability
80/87 ("avgas 80")	красный (красный + светлоголубой)	0,14	ТЭС	Использовался в двигателях с низкой степенью сжатия.	
82UL	purple (red + blue)	0	ASTM D6227; similar to automobile gasoline but without automotive additives	As of 2008, 82UL is not being produced and no refiner has announced plans to put it into production.	
85UL	none	0	oxygenate-free	Used to power piston-engine ultralight aircraft.	
B91/115	green (yellow + blue)	1,6	TEL	Uses on piston engines with compression ratio 6,5	Produced exclusively by OBR PR., Poland. Available in CIS.
100LL	blue	0,56	TEL	Most commonly used aviation gasoline.	Pretty much worldwide
100SF	none	0	mesitylene	Swift Fuel LLC blend of 83% mesitylene, 17% isopentane	Limited quantities are produced for testing.

Table 2 – The interchangeability of domestic and foreign avgas grades

Country, manufacturing company	Normative and technical documentation, product brand, corporate name
Russian Federation	ГОСТ 1012 Б-95/130
BP	BP Avgas 100LL
Exxon	Esso Aviation Gasoline 100
Mobil	Mobil Avgas 100LL; Mobil Avgas 100
Shell	Shell Avgas 100LL; Shell Avgas 100
Texaco	Aviation Gasoline 100/130; Aviation Gasoline 100LL
Australia	DEF[Aust] 5215
Belgium	BA-PF-5D Grade 100/LL
UK	DERD 2485 Grade 100LL
Germany	DERD 2485 Grade 100LL
Country, manufacturing company	Normative and technical documentation, product brand, corporate name
Russian Federation	ГОСТ 1012 Б-95/115
Romania	STAS 43-85 91/115
Country, manufacturing company	Normative and technical documentation, product brand, corporate name
Russian Federation	ТН 38.401-58-47 Б-92
Germany	TGL 21138 FOK 91/115
Romania	STAS 43-85 91/115

To sum up, avgas usage nowadays is limited due to the practical usage of the piston engines in modern aviation is very limited as well. Russia's primary avgas grade is B-91/115, secondaries are B-92 and B-95/130. Most commonly used Avgas is 100LL, which is available pretty much worldwide. It is produced by numerous giant oil companies all over the world, while production of avgas in Russia is inappropriate and meet strict requirements of the regulatory framework for environmental sanitation.

СПИСОК ИСПОЛЬЗОВАННОЙ ЛИТЕРАТУРЫ

1 Бондаренко, Б. И. Каталитический крекинг: науч. изд. / Б. И. Бондаренко, Д. Д. Никулин, В. П. Суханов. – М.: Государственное научно-техническое издательство нефтяной и горно-топливной литературы, 1956. - 209 с.

2 ГОСТ 1012-72 Бензины авиационные. – Введ. 01.01.73. – Москва.

3 Инструкция по взаимозаменяемости горючего, смазочных материалов и специальных жидкостей, вырабатываемых в Российской Федерации и зарубежных странах. – Введ. 1997 г. – Москва: Министерство обороны РФ. – 59 с.

4 Резников, М. Е. Авиационные топлива и смазочные материалы (авиационная химмотология): учебник / М. Е. Резников. – М.: 2003. – 234 с.

5 ASTM D910 Standard Specification for Aviation Gasolines. – Введ. 1947 г. – West Conshohocken: 2011. – 8 с.

6 AVGAS producers - endangered species [Электронный ресурс] // Hjelme Oil Knowledge data base. – Режим доступа: <http://www.hjelmco.com>