Hjelmco Oil

Aviation gasolines, turbo fuels & lubricants.

TO ALL INTERNATIONAL AVGAS CUSTOMERS

Edition: V

Sollentuna 97-Oct-17

THE UNLEADED AVIATION GASOLINE WITH IMPROVED ENVIRONMENTAL QUALITIES

AVIATION GASOLINE 91/96 UNLEADED (AVGAS 91/96 UL)

Who can use unleaded AVGAS 91/96 UL?

The use of unleaded AVGAS is approved by the major piston engine manufacturers Textron Lycoming and Teledyne Continental.
AVGAS 91/96 UL from Hjelmco Oil is an unleaded aviation gasoline with specific improved environmental qualities.
A leaded version of this fuel was sold during the 1970s and called AVGAS 91/96.
Approximately 70 % of all general aviation aircraft in the world today have engines from the aircraft engine manufacturers Textron Lycoming and Teledyne Continental, among others, which specify AVGAS 91/96 as an approved aviation gasoline.

In addition, the majority of the new aircraft engines manufactured today are certificated to use AVGAS 91/96.

These newly manufactured engines are found in brand new aircraft such as Piper PA28-181 (Archer), Piper PA28-161 (Warrior) Cessna C 172 among others.

AVGAS 91/96 UL is suitable for aircraft engines certificated to use AVGAS 91/96, AVGAS 82 UL, AVGAS 80/87, AVGAS 80.

WHAT IS THE DIFFERENCE BETWEEN AVGAS 91/96 UL AND AVGAS 100 LL?

AVGAS 91/96 UL is produced only from distillates which have been used by Hjelmco Oil in the production of an extra high quality grade of AVGAS 100 LL for many years.
AVGAS 91/96 UL is an extremely high quality grade of AVGAS 100 LL without lead, dyes and scavenger.

AVGAS 91/96 UL thus meets all the requirements of AVGAS 100 LL according to the US standard ASTM D-910, but with the following exceptions:

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PARAMETERS	AVGAS 100 LL	AVGAS 91/96 UL
octane numbers rich mixture	min. 130 octane	min 96 octane
octane numbers lean mixture	min. 100 octane	min 91 octane
colour	blue	transparent
scavenger	1,2 dibromoethane	not used or required
tetraethyllead	max 2 ml/Us gal	unleaded

WHAT ARE THE ENVIRONMENTAL QUALITIES OF AVGAS 91/96 UL?

AVGAS 91/96 UL is:

UNLEADED:
Lead is a heavy metal which when inhaled is absorbed and stored in the human body.
Lead can cause brain damage.

Gasoline without lead does not need to have any scavenger. For aviation gasoline, 1,2 dibromoethane is usually used, a substance which is carcinogenic and promotes the so-called greenhouse effect.
Unleaded fuels must according to Swedish regulations be transparent. The blue dye in the AVGAS 100 LL (1,4-dialkylamino-antraquinone) is said to cause skin irritation and allergic reactions.
Thus the absence of lead is desirable for a number of reasons.

ALMOST FREE FROM BENZENE
AVGAS may in Sweden contain a maximum of 5 % benzene - a toxic substance known to be carcinogenic.
AVGAS that contains more than 0,1 % benzene must according to Swedish regulations be labelled toxic and show a skull and crossbones.

AVGAS 91/96 UL contains less than 0,1 % benzene and no carcinogenic 1,2 dibromoethane and is for that reason labelled harmful and shows a Saint Andrew's cross.

ALMOST FREE FROM SULPHUR
AVGAS may contain up to 0,05 % sulphur. AVGAS 91/96 UL contains less than 0,001 % sulphur.
Sulphur is a substance connected with acid rain, human allergic reactions and respiratory diseases.

ALMOST FREE FROM N-HEXANE AND METHYL-N-BUTYL KETONE
AVGAS 91/96 UL contains less than 0,1 % Normal-Hexane and is normally free of Methyl-n-butyl ketone. Both these substances affect the peripheral nervous system.

WHAT IS THE DIFFERENCE BETWEEN UNLEADED FUELS AND FUELS FREE FROM LEAD?

AVGAS 91/96 UL from Hjelmco Oil is free from lead when it leaves the refinery - but it can be contaminated with very small amounts of lead during the transport to the final end user. One reason for this is that we attempt to keep distribution costs down for a transport of AVGAS 91/96 UL. If the previous cargo has been AVGAS 100 LL we do not presently clean our trucks.
This means that from time to time the surface of the truck tanks, when completely dry, may contain very small amounts of lead as a residue from the AVGAS 100 LL. This lead may mix with the AVGAS 91/96 UL and be delivered to the end user.

Motor gasoline for cars which today is sold as unleaded is not necessarily free from lead. The current Swedish standard allows unleaded gasoline for cars to contain a maximum of 0,013 grams of lead per litre.

Thus we cannot currently warrant our AVGAS 91/96 UL as suitable for engines equipped with catalytic converters.

DOES THE AVGAS 91/96 UL CONTAIN ANY SUBSTANCES HARZARDOUS TO HEALTH?

The answer is yes. It is not possible to produce an aviation gasoline that does not contain something that is hazardous in some respect. AVGAS 91/96 UL does contain toluene as a distillate in order to obtain proper octane ratings with a rich mixture. The amount of toluene in AVGAS 91/96 UL is, however, about the same as in AVGAS 100 LL.

WHY IS AVGAS 91/96 UL NOT SAID TO BE ENVIRONMENTALLY FRIENDLY?

There is a growing tendency to call too many products environmentally friendly today.
All combustion engines produce exhausts and residues that are harmful to the earth and the human race.

However, with AVGAS 91/96 UL we have advanced as far as possible in offering an aviation gasoline with improved environmental qualities. While developing AVGAS 91/96 UL we have considered, in particular, pilots and mechanics who are frequently exposed to aviation gasoline vapour (i.e. Benzene, Normal-Hexane and Methyl-n-butyl ketone). We have also concentrated on reducing pollution damaging to the earth in general (i.e. lead, 1,2 dibromoethane and sulphur).

The specifications of the ASTM D-910 for aviation gasoline and the engine-type certificates issued by the US Federal Aviation Authority (FAA) have set our limitations.

AVGAS 91/96 UL THE PUREST STANDARD AVIATION GASOLINE IN SWEDEN?

We who work for Hjelmco Oil claim that no standardized aviation gasoline in Sweden can compete with our AVGAS 91/96 UL when it comes to purity, handling- and environmental qualities.

In comparision with unleaded gasoline for cars (EUROSUPER 95), AVGAS 91/96 UL is 50 times purer.
AVGAS 91/96 UL is the second generation of unleaded AVGAS from Hjelmco Oil. However, we are not satisfied.

We are developing an even better unleaded AVGAS - but this new fuel will not see the market for some time.

DOES HJELMCO OIL HAVE ANY MATERIAL SAFETY DATA SHEET FOR AVGAS 91/96 UL?

Yes. The material safety data sheet is enclosed at the end of this pamphlet.
Regarding warning labels on the fuel pumps at airports, these will be provided by the fuel truck driver and posted by him upon delivery of your first batch of unleaded AVGAS 91/96 UL.

If you feel discouraged with the detailed information on the warning label of the AVGAS 91/96 UL, remember that this does not mean that AVGAS 91/96 UL is more dangerous than AVGAS 100 LL. The warning label of the AVGAS 91/96 UL fuel is made solely for Hjelmco Oil; and we have chosen to indicate its effects, in more detail.
A copy of the warning labels is enclosed at the end of this pamphlet.

WHY DOES HJELMCO OIL PROVIDE AN AVGAS WITH IMPROVED ENVIRONMENTAL QUALITIES FOR SMALL AIRCRAFT?

The current standard aviation gasoline is AVGAS 100 LL, but this fuel does not meet the current requirements for gasoline in Sweden, and is today temporarily exempted from the ban of lead.
Aviation gasoline in Sweden may contain a maximum of 0,8 grams/litre.

Since March 1 st. 1995 the production and import of leaded automotive gasolines is banned in Sweden.
In the USA there is a proposal to ban lead in automotive gasoline from 1996.

We assume that the legislation in Sweden for aviation gasoline will follow the legislation for automotive gasoline, as soon as this is practically possible.

In Sweden there is currently a law stating that if there is a better product for the environment and or human health on the market, everyone is obliged to use this better product.

Hjelmco Oil pioneered the development of unleaded aviation gasoline in 1980 with an unleaded AVGAS 80.
In 1981 this unleaded AVGAS was distributed nationwide. Compare this with the fact that unleaded gasoline for cars first achieved nationwide Swedish distribution in 1987, i.e. six years later.

The major customer for Hjelmco Oil and the unleaded AVGAS 80 during the 1980s was the Royal Swedish Airforce with their SAAB-SAFIR aircraft equipped with Textron Lycoming O-435 engines.
This aircraft is no longer used by the airforce and the consumption of unleaded AVGAS 80 has decreased considerably.

It is not yet economically or technically feasible to produce an unleaded AVGAS 100 and at the same time meet the current aviation gasoline standard, the ASTM D-910.

For this reason Hjelmco Oil began a project in 1988 to find a suitable alternative for the large majority of users that need an unleaded aviation gasoline.

With assistance from the engine manufacturers Textron Lycoming and Teledyne Continental, we have found that the majority of engines of general aviation aircraft have FAA certificates to use an aviation gasoline with octane ratings not exceeding 91 octane at lean mixture and 96 octane at rich mixture.
Contrary to an AVGAS with 100/130 octane, it is today, possible to obtain the octane numbers 91/96 in an AVGAS without lead, and still keep this unleaded AVGAS 91/96 within the standard for aviation gasoline, the ASTM D-910.

An aviation gasoline meeting the ASTM D-910 standard is approved for use without restrictions in Textron Lycoming and Teledyne Continental engines, among others.

By providing AVGAS 91/96 UL, we can offer the aviation gasoline users a product that meets the standard for AVGAS

and the requirements of the engine-type certificates issued by the US Federal Aviation Authority (FAA).

HOW CAN HJELMCO OIL BE SO SURE THAT AVGAS 91/96 UL WILL NOT CAUSE THE SAME ENGINE PROBLEMS AS AVGAS 100 LL DID WHEN IT WAS INTRODUCED IN THE LATE 1970s ?

When AVGAS 100 LL was introduced, it was not long before aircraft engines certificated to use AVGAS 80 developed problems.

The main problem was that AVGAS 100 LL, with a tetraethyllead content approximately four times that of AVGAS 80/87, was used on engines certificated to use AVGAS 80/87.

Engines certificated to use AVGAS 80/87 have a low compression ratio. This often results in low combustion temperatures. With these low combustion temperatures, the scavenger in the fuel does not always act as intended, resulting in lead deposits in the engine. Sometimes these deposits adhere to the engine valves, restricting their movement.

As a result of this, the engine could not aspirate properly, which can overheat the engine.
In some cases the valves became lodged open and were damaged the next time the piston reached it's highest point.
In other cases, the valves could not close properly resulting in the combustion flames passing through the valve and the valve seat. In that case, the valve head was damaged and could develop a mushroom-like appearance.

An unleaded gasoline will not cause such complications, however.
This is because the source of problems was lead.

HAVE THERE BEEN ANY FLIGHT TESTS CONDUCTED WITH AVGAS 91/96 UL?

Yes - In Stockholm in 1992 the Swedish Royal Institute of Technology, Department of Aeronautics, tested the fuel on a 1988 Piper Warrior II equipped with a 160 horsepower Textron Lycoming O-320-D.

The flight tests have been carried out using an advanced engine monitor system. One wing tank was filled with AVGAS 100 LL and the other wing tank with AVGAS 91/96 UL.

For various flight operations and during two seasons, temperature values have been recorded for cylinder heads (CHT), exhaust gases (EGT), simulated turbine inlet (TIT), engine oil and fuel flow.
The measurements for CHT and EGT were taken 10 times every second for each cylinder.

The recordings have been made with great accuracy, and often within +/- one degree Celsius. The flights were performed first using one wing tank, and a short time later the other wing tank was used.
The advantage of this method is that the flight conditions for both fuels were the same.

The report from the Swedish Royal Institute of Technology was written in English and concluded that the authors could not find any differences in engine performance using AVGAS 91/96 UL compared to AVGAS 100 LL.

The flight tests conducted by the Swedish Royal Institute of Technology were performed after consulting the engine manufacturer, Textron Lycoming.

The report (ISRN KTH/FPT/AR--63--SE) is available from Hjelmco Oil for a nominal fee.

WHY IS LEAD IN AIRCRAFT ENGINES NOT NEEDED TO LUBRICATE VALVES, ETC ?

In Sweden, Hjelmco Oil has produced and supplied unleaded AVGAS 80/87 between the years 1980 - 1992 for both military and civilian users.
Our experience with unleaded AVGAS is extensive and excellent.
Aircraft engines are better off without lead because they run cleaner, have fewer technical problems and lower maintenance costs.
Experience, although not statistically verified, indicates that an aircraft engine using an unleaded gasoline typically goes a longer period between major overhauls than do engines using a leaded gasoline.

There is a scientific report from the US FAA (DOT/FAA/CT-TN89/33) that compares valve wear on two Textron Lycoming engines, model IO-320-B, using AVGAS 100 LL and unleaded gasoline for cars.
(The above engines are certificated to use AVGAS 91/96).

Each engine was run for 150 hours and every 16 hours of engine time the valve wear was measured and controlled.

The conclusion in the report is that no significant difference in valve wear could be found in these engines when using AVGAS 100 LL or unleaded gasoline for cars.

The above report can be obtained from the US FAA.

Worldwide there is significant use of automotive gasoline in aircraft. In the US there are said to be more than 40 000 aircraft flying on automotive gasoline.
In most of the states in the US, only unleaded automotive gasolines are available. The use of unleaded gasoline in aircraft engines in the Unites States is extensive.
In smaller aircraft engines automotive gasoline sometimes is preferred to AVGAS 100 LL, because of the high amount of lead in AVGAS 100 LL.

In several parts of the world there are many years of experience using gasoline without lead in aircraft engines.

IS THERE ANY FLIGHT EXPERIENCE OF AVGAS 91/96 UL IN SWEDEN?

Yes, AVGAS 91/96 UL has been sold in Sweden at selected airports since April 1991, and nationwide since April 1993.
The members of the aeroclub at Stockholm Barkarby airport have the most experience. Here at the Experimental Aircraft Association (EAA) Sweden headquarters, you will find a large variety of aircraft, home built as well as factory made.

There have not been any reported problems to Hjelmco Oil on AVGAS 91/96 UL for the four years and more the fuel has been available.
During this time we have delivered fuel from 11 different batches. This has given us as producer the opportunity to evaluate the small variations in the fuel which are always observed between different production dates.

HAS ANYONE HAD ANY PROBLEMS WHEN USING AVGAS 91/96 UL?

Honestly - yes.

In very few cases, problems have been reported, and we have carefully analyzed them. In one case we also had the engine fully dismantled. In not a single case has the gasoline been found to be the reason for the engine problems.

ARE THERE ANY RESTRICTIONS FROM THE ENGINE MANUFACTURERS REGARDING USAGE OF UNLEADED AVIATION GASOLINE?

The answer is yes and no.

Teledyne Continental still recommends that a new or newly overhauled engine should be broken in with a leaded fuel. This is in order to reduce future valve/valve seat wear.

Information from Teledyne Continental indicates that 4 - 5 engine hours on a leaded fuel is sufficient before a shift can be made to an unleaded fuel.

Regarding engines manufactured by Textron Lycoming there are no known restrictions and AVGAS 91/96 UL is listed among the approved fuels in their Service Instruction No. 1070 L dated Jan. 20 1995.
If you have any questions, or feel you want to know more, always consult the engine manufacturer.

DOES HJELMCO OIL RECOMMEND ANYTHING MORE WHEN USING AVGAS 91/96 UL?

The answer is yes. Because sometimes aircraft engines without the knowledge of the customer contain parts not produced by the engine manufacturer, we always recommend breaking in a new, or overhauled engine with leaded AVGAS together with dedicated break-in oil. When change takes place to normal additive oil (such as W80, AD80, 15W-50) the use of unleaded AVGAS 91/96 UL can be resumed.

The choice of engine oil will determine how your engine will perform in an unleaded environment. Unless the engine manufacturer/overhauler recommends something different, we recommend our customers, use only the below listed engine oils together with AVGAS 91/96 UL:

ELF AD 80, AD 100, AD 120 all plus additive LW-16702
SHELL W 65, W 80, W 100, W 120 all plus additive LW-16702
SHELL 15W-50 with anti-friction + anti-corrosion additive

Do always use (not during engine break-in) Textron Lycoming LW-16702 oil additive together with AVGAS 91/96 UL. (The oil additive shall not be mixed with Shell 15W-50 which already contains this function). See Lycoming service instruction SI No. 1409 A.

CAN ANYONE GIVE ME A GUARANTEE THAT MY AIRCRAFT ENGINE WILL RUN BETTER ON AVGAS 91/96 UL THAN ON AVGAS 100 LL?

Sorry, but the answer is no. However, by using AVGAS 91/96 UL you may have created the conditions for your engine to run better.

A simple thing, such as spots of lead on the plugs does negatively affect the combustion in your engine. You will not have these problems if you use an unleaded gasoline.

A large portion of the lead coming into the engine with the gasoline will end up in the engine oil. If the engine oil comes in contact with hot spots in the engine, the oil will carbonize more easily if lead is present. Deposits of

carbon on valve stems affects/restricts the movements of the valve.

Getting rid of the lead in the engine will make your engine cleaner and the very low content of sulphur and lack of scavenger will reduce the conditions for corrosion.

The combination of AVGAS 91/96 UL and the semi-synthetic aircraft engine oil SHELL 15W-50, which you can obtain from Hjelmco Oil, is , when it comes to keeping your engine clean, considered superior.

WHEN WILL HJELMCO OIL INTRODUCE AN UNLEADED AVGAS 100?

The American Society for Testing and Materials (ASTM) has a committee within the US working on an unleaded alternative to AVGAS 100 LL and the aircraft engines certificated to use this fuel. Hjelmco Oil is a producer member in this committee.

In parallel to this, Hjelmco Oil is in Sweden working on a completely new AVGAS using unique synthetic distillates. This new AVGAS may not require a recertification process for aircraft or engines. The environmental qualities of this new fuel will be even better than those of the unleaded AVGAS 91/96 UL.

WHAT SHALL I DO IF MY AIRCRAFT ENGINE PLATE SPECIFIES MINIMUM AVGAS 91/96 FUEL AND THE FAA APPROVED FLIGHT MANUAL TELLS ME AVGAS 100 LL?

AVGAS 91/96 has not been produced since the early 1970s. If your aircraft engine plate specifies the minimum fuel AVGAS 91/96 and the FAA approved flight manual AVGAS 100 LL, this usually means that the aircraft manufacturer was not using AVGAS 91/96 when he certificated his aircraft. He was just using the fuel that was available to him at the time of certification.

It is thus important from a legal point of view to compare what minimum fuel grade the FAA approved flight manual specifies and what the aircraft engine manufacturers operating manual specifies.
Hjelmco Oil is cooperating with the Swedish Civil Aviation Authority (CAA) in order to solve the cases where this discrepancy exists between the two manuals.
If you have any questions in this respect we recommend you contact your local CAA or FAA branch.
It is also necessary to contact the aviation authorities if the labelling of the AVGAS grade on the aircraft tank does not correspond with the FAA approved flight manual (including revisions).

WHICH FUEL DOES THE AIRCRAFT ENGINE MANUFACTURER RECOMMEND FOR MY AIRCRAFT ENGINE?

At the end of this pamphlet we have listed the fuel specifications from Textron Lycoming and Teledyne Continental for each of their engine models.
The information regarding Textron Lycoming engines has been taken from their Service Instruction no 1070 L and the Teledyne Continental engines from their pamphlet "Continental Aircraft Engine Specifications" M5736X 02/85.

Each user of AVGAS should, regardless of the information from the aircraft engine manufacturer, always double check the engine identification plate against the FAA approved flight manual. Your aircraft might have been altered in such a way that the fuel requirements have changed.

There are aircraft engines manufactured by other than these companies already mentioned. Such manufacturers are Limbach, Rotax etc. Always read your aircraft and engine manuals.
If your aircraft engine is approved for AVGAS 100 LL or unleaded automotive gasoline there should be no restrictions on the use of AVGAS 91/96 UL because the research octane number of the AVGAS 91/96 UL is close to 100. The research octane number is frequently used as an octane number for automotive gasolines.
If there are instances where the aircraft engine manufacturer require automotive gasoline with lead or AVGAS 100 LL we suggest a mixture of our AVGAS 91/96 UL and 10 - 20 % of our AVGAS 100 LL, or our AVGAS 91/96 UL with a lead lubricating substitute.

Unfortunately you will lose some of the environmental qualities that are so unique to the AVGAS 91/96 UL if you mix it with AVGAS 100 LL.

If you use a lead lubricating substitute consisting of the alkali metals sodium and potassium, you have a special reason to be careful.
Later if, you use a leaded fuel the scavenger of that fuel will probably react with the above mentioned alkali metals and form inorganic salts. These salts are very corrosive to metals and thus your aircraft engine.

AVGAS 91/96 UL and AVGAS 100 LL produced by Hjelmco Oil are mixable because our components in AVGAS 91/96 UL are compatible with our AVGAS 100 LL components, the only difference being that they have a higher degree of purity.

IS THE ENGINE WARRANTY ISSUED BY THE AIRCRAFT ENGINE MANUFACTURER VALID IF I USE AVGAS 91/96 UL?

The use of unleaded AVGAS is approved by Textron Lycoming and Teledyne Continental.

Therefore, there are no reasons for anyone to oppose warranty claims if AVGAS 91/96 UL is used as an aviation gasoline.
AVGAS 91/96 UL meets the standard ASTM D-910 for AVGAS 91/96, except that the fuel is undyed and the colour is transparent. (Old AVGAS 91/96 was blue)

In Sweden there is a law specifying that unleaded gasolines shall be undyed and transparent.

HOW DO I CHANGE FUEL IN MY AIRPORT FUEL TANK IF I WANT TO GO UNLEADED WITH AVGAS 91/96?

If the change of fuel in the airport tank is an increase of the octane numbers for the fuel earlier delivered, i.e. you want to go from automotive gasoline or AVGAS 80/87 to AVGAS 91/96 UL, it is important that the product change is carried out in a controlled manner.
If the fuel you have today is AVGAS 100 LL and you want to change to AVGAS 91/96 UL with lower octane numbers, it will be sufficient to completely empty the AVGAS 100 LL tank (using the low point draining facility) and then add AVGAS 91/96 UL. For a short period of time the AVGAS 91/96 UL fuel might be slightly contaminated with lead from the inner surfaces of the storage tank - but the lead will disappear after some period of time.

Hjelmco Oil has issued a service instruction dated May 14 1993 (Exchange of aviation gasoline in airport tanks) which deals with the above issue. If you don't have this instruction available it can be ordered through our distribution service.

WILL ANY OTHER AVIATION FUEL SUPPLIER PROVIDE AVGAS 91/96 UL IN SWEDEN?

We are sorry - but we don't know. The total market in Sweden for AVGAS is limited. To set up a distribution system for a small product is very expensive.
Hjelmco Oil has the advantage in this case that our AVGAS 91/96 UL supercedes our AVGAS 80/87 UL and by doing so we can use the distribution system for AVGAS 80/87 UL and its storage tanks for this new product, without additional investment.
By 1993 AVGAS 91/96 UL achieved nationwide distribution in Sweden and now more than 55 airports are served.

GENERAL AVIATION NEEDS YOUR ASSISTANCE!

Our effort to market our new fuel AVGAS 91/96 UnLeaded is something that is good for the entire general aviation industry.

Local aero-clubs, airports and other types of aviation operations are carefully watched by people and organizations actively working for a better environment.

By providing AVGAS 91/96 UL to the aviation gasoline users, general aviation in Sweden is put in the forefront in respect of using fuels with improved environmental qualities.
AVGAS 91/96 UL more than meets most Swedish guidelines available today for automotive gasolines, with enhanced environmental qualities, to be available by the end of this century.

Help us to broadcast our message with the AVGAS 91/96 UL. Invite a newspaper reporter or your local TV-station to your aero-club or local airport. Call Hjelmco Oil beforehand and we will provide you with a set of information guidelines on how to achieve the best results. Don't hesitate to invite the reporter to fly a plane.

Telling your community that you are doing what you can in this field is a well allocated resource and will give your airport and general aviation a positive image.

Remember, unleaded aviation gasoline 91/96 from Hjelmco Oil has a 50 times lower concentration of certain environmental impurities than the maximum allowed today in unleaded, automotive gasoline. (Eurosuper 95 unleaded).

-end-

HJELMCO OIL AB

MATERIAL SAFETY DATA SHEET

Date 1991-Mar-11

Material safety data sheet in accordance with section 17 of the Decision of the Council of State on the Classification, Warning Labelling and Material Safety Data Sheets of Dangerous Chemicals and section 19 of the Chemicals Degree.

1 Product information

1.1 Trade name	Aviation gasoline 91, unleaded (AVGAS 91/96 UL)
1.2 Product use	Fuel (use as aviation gasoline only)
1.3 Manufacturer/Importer Address, telephone, telex Telefax, Official Employer Idenfication Number (LY code)	Hjelmco Oil, Runskogsvägen 4 B, S 191-48 Sollentuna Sweden Tel. int+46-8-6269386, telex int+54-15737 Hjelmco S, Fax int+46-8-6269416.

2 Product classification

2.1 Danger symbol	Extremely flammable, harmful	2.2 Transport class	3 c1, 3 b) (VAK and ADR)
2.3 UN number	1203	2.4 Carcinogenic substances	
2.5 Warning labelling	F+, X_n: R: 12-20/21/22: S: 16-23-24-29-46		

3 Substances hazardous to health

3.1 Substances	3.2 Concentration	3.3 Dangerous property
Petroleum product	100 %	Extremely flammable, readily volatile liquid. Harmful when inhaled, in contact with skin and if swallowed. HTP (1987, 8h) = 770 mg/m^3
Contains aromatics, maximum 20 vol-%		HTP (1987, 15 min) = 1020 mg/m^3 (solvent naphtha, aromatics 20 %, boiling range min 110° C.)

4 Chemical and physical properties of the product

4.1 Boiling point	Range 30 - 170° C	4.2 Melting point	Freezing point max. -60° C.
4.3 Vapour pressure	38 - 49 kPa (37,8° C)	4.4 Solubility in water	Insoluble
4.5 Density	Approx. 715 kg/m3 (15° C)	4.6 Evaporation rate (butyl acetate=1)	4.7 pH
4.8 Physical state, colour and odour	Clear liquid with an aromatic odour		

5 Fire and explosion data of the product

5.1 Flash point	Below - 50° C		
5.2 Flammable limits	1 - 8 vol-%	5.3 Auto-ignition temperature	Approx. 450° C.
5.4 Reactivity			

MATERIAL SAFETY DATA SHEET

Date 1991-Mar-11

Trade name	Aviation gasoline 91, unleaded (AVGAS 91/96 UL)

6 Health hazard

6.1 Route of exposure	Inhalation of vapour. Skin contact.
6.2 Local effects (skin, eyes, mucous membranes)	Liquid irritates the eyes and skin. Vapour irritates the eyes and mucose membranes in the nose and throat.
6.3 Effects of overexposure Short-term exposure	Vapour irritates mucous membranes in the nose and throat and produces narcotic effects, headache and nausea
6.4 Effects of overexposure Long-term exposure	Prolonged over-exposure to vapour causes fatigue, headache and nervous disorders.

7 Special safety measures

7.1 Technical safety measures	USE AS AVIATION GASOLINE ONLY. Avoid skin contact and breathing of vapour. When necessary, wear protective gloves (e.g. nitrile rubber) and a respirator (organic vapour filter, type A). Must not be stored in unsuitable or unlabelled containers. Vapour is flammable. Danger of spark formation caused by static electricity must be eliminated by earthing. Keep sources of ignition away from open containers, smoking forbidden.
7.2 Special first-aid measures	When cleaning tanks, special instructions must be followed. Splashes in the eyes: Irrigate with plenty of water. Ingestion: Slurry of medical carbon (25-50 g) in water and medical attention. DO NOT INDUCE VOMITING due to risk of aspiration and chemical pneumonitis

8 Special instructions

8.1 Storage	
8.2 Corrosive properties	
8.3 Cleaning methods	Do not flush into sewer (explosion risk), to the ground or to water systems. Collect leaks if possible. Small amounts can be soaked up by absorbent material.
8.4 Hazards to the environment	Danger of ground water pollution.
8.5 Rendering the substance harmless	To be treated as hazardous waste according to authorities' advice.
8.6 Instructions for fire	DO NOT EXTINGUISH WITH WATER. Extinguishing agents CO_2, dry chemical foam.

For further information please contact	Signature
Hjelmco Oil Oil product information tel. int+46-8-297281	HJELMCO OIL pp. Lars Hjelmberg

☐ Further information enclosed

Hjelmco Oil

Aviation gasolines, turbo fuels & lubricants.

REPRESENTATIVE QUALITY PARAMETERS.

Sollentuna, Oct 17 1997.

CERTIFICATE OF QUALITY
AVGAS 91/96 UL (UNLEADED)

Appearance		B & C	ASTM D 4176
Octane number, Aviation Rating		93,1	ASTM D 910
Performance number, Rich mixture		106,8	ASTM D 909
Octane number Research		> 99,6	ASTM D 2699
Tetraethyllead (TEL-B)	gPb/l	< 0,001	ASTM D 3237
1,2 dibromoethane		none	
Colour		undyed	Visual
Colour		.....	IP-17A
Calorific Value, net	MJ/kg	43,65	ASTM D 1405
Aniline Gravity Product		8249	ASTM D 611
Density at 15 degr C.	kg/m3	720,8	ASTM D 4052
Initial Boiling Point	degr C.	39	ASTM D 86
Evaporated 10 vol % at	degr C.	67	
Evaporated 40 vol % at	degr C.	101	
Evaporated 50 vol % at	degr C.	105	
Evaporated 90 vol % at	degr C.	111	
Final Boiling Point at	degr C.	135	
Sum of 10%+50%, evaporated	C.	172	
Recovery	vol-%	98,2	
Residue	vol-%	1,4	
Loss	vol-%	0,4	
Evaporated at 75 degr C.	vol-%	not recorded	
Evaporated at 105 degr C	vol-%	50	
Reid Vapour Pressure (RVP)	kPa	44,5	ASTM D 323
Freezing Point	degr C.	<-75	ASTM D 2386
Total Sulphur	wt -%	0,0007	ASTM D 3120
Copper Corrosion, 2 hours at 100 degr C.		1	ASTM D 130
Existent Gum	mg/100 ml	<0,5	ASTM D 381
Oxid.Stability, Potent Gum (16 h)	mg/100 ml	<0,5	ASTM D 873
Lead Precipitate	mg/100 ml	<0,5	ASTM D 873
Water reaction, Interface Rating		1	ASTM D 1094
Water reaction, Separation Rating		1	
Water reaction, Volume change	ml	0,5	
Total Acid Number (TAN)	mg KOH/g	.....	ASTM D 974
Dye	mg/l	none	
Antioxidant	mg/l	20	Shell Ionox
N-Hexane	mas-%	0,08	GC-method
Benzene	mas-%	0,04	GC-method
Methyl-n-butyl ketone	mg/kg	none	GC-MS

1 QUALITY.91/TXTPRIS

HJELMCO OIL AKTIEBOLAG.

A private company.
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Registered number: 556210-9156.
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TEXTRON Lycoming

Reciprocating Engine Division/
Subsidiary of Textron Inc.
652 Oliver Street
Williamsport PA 17701 USA

SERVICE INSTRUCTION

DATE: January 20, 1995

Service Instruction No. 1070L
(Supersedes Service Instruction No. 1070K)
Engineering Aspects are
FAA Approved

SUBJECT: Specified Fuels

MODELS AFFECTED: Textron Lycoming opposed series aircraft engines.

TIME OF COMPLIANCE: When refueling aircraft.

During the past several years significant changes have occurred in the grade designations and tetraethyl lead content of some of the commercial aviation fuels available on the world markets. These changes included the discontinuance of leaded commercial grades 91/96 and 115/145 fuels and the limited availability of 80/87 grade in U.S. as well as over seas countries. A low lead content fuel, currently designated "100LL" has been available. Also, a new unleaded, colorless AVGAS fuel, currently designated 91/96 UL has been introduced for use in a limited area of Europe. A summary of the current grades as well as the previous fuel designations are shown in the following chart.

FUEL GRADE COMPARISON CHART

Previous Commercial Fuel Grades (ASTM-D910)			Current Commercial Fuel Grades (ASTM-D910-75)			Current Military Fuel Grades (MIL-G-5572F)		
Grade	Color	Max. TEL ml/ U.S. gal.	Grade	Color	Max. TEL ml/ U.S. gal.	Grade	Color	Max. TEL ml/ U.S. gal.
80/87	red	0.5	80	red	0.5	80/87	red	0.5
91/96	blue	2.0	91/96 UL	none	0			
			*100LL	blue	2.0			
100/130	green	3.0	100	green	**3.0	100/130	blue	2.00
115/145	purple	4.6	none	none	none	115/145	purple	4.6

* - Grade 100LL fuel in some over seas countries is colored green and designated as "100L".

** - Commercial fuel grade 100 and grade 100/130 having TEL content of up to 4ml/U.S. gallons are approved for use in all engines certificated for use with grade 100/130 fuel.

The importance of using the fuel specified for a specific model Textron Lycoming engine has always been stressed in Textron Lycoming service publications. However, if the specified fuel is not available, a higher grade fuel may be used, subject in some instances to the restrictions described in the footnotes to the following Table of Specified Fuels. The chart showing specified and alternate fuels that can be safely used in no instance permits use of fuels of lower grade than that which is specified. Also, it is not permissible in any instance to use automotive fuel in aircraft engines, regardless of its octane or advertised features because of the corrosive effect of its chlorine contant and because of vapor lock that could result from its high vapor pressure. Any fuel used in Textron Lycoming engines must conform with Specifications ASTM-D910 or MIL-G-5572F.

NOTE

Isopropyl alcohol in amounts not to exceed 1% by volume may be added to the fuel to prevent ice formation in fuel lines and tanks. Although approved for use in Textron Lycoming engines, isopropyl alcohol should not be used in the aircraft fuel systems unless recommended by the aircraft manufacturer.

TABLE OF SPECIFIED FUELS

Engine Models	SPECIFIED FUELS		Alternate Military and Commercial Grades
	Certificated For Use With Grade	Commercial Grade Designation	
O-235-C,-E,-H; O-290-D; O-435-A,-C	80	80	91/96 UL or ①⑤100LL or ⑤②③ 100 or ⑤④ ②③ 100/130
O-290-D2; O-320-A,-C, -E; IO-320-A,-E; AEIO-320-E; O-340-B; O-360-B,-D; GO-435-C2*; VO-435-A; GO-480-B,-D,-F; O-540-B; VO-540-A,-B	80/87		

* - GO-435-C2 engines with Marvel-Schebler carburetor no. 10-3991 are certificated to use 91/96 fuel.

TABLE OF SPECIFIED FUELS (CONT.)

Engine Models	SPECIFIED FUELS		Alternate Military and Commercial Grades
	Certificated For Use With Grade	Commercial Grade Designation	
O-320-B,-D; IO-320-B,-D; LIO-320-B1A; AEIO-320-D; AIO-320-A,-B,-C; O-480-A; O-360-A,-C; IO-360-B,-E; AEIO-360-B,-H; VO-360-A,-B; IVO-360-A; HO-360-A,-B; HIO-360-B; O-435-A2; GO-435-C2*; O-540-A,-D,-E,-F,-G,-H; IO-540-C,-D,-N,-T; AEIO-540-D	91/96	100LL or 100	91/96 UL or ④100/130 or ④115/145
O-235-F,-G,-J,-K,-L; IO-320-C,-F; LIO-320-C1A; IO-360-A,-C,-D,-F; LIO-360-C; AEIO-360-A; AIO-360-A,-B; HIO-360-A,-C,-D,-E; TO-360-A,-C; LIO-360-A; TIO-360-A; VO-435-A,-B; TVO-435-A,-B,-C,-D,-E,-F,-G; GO-480-C,-G; IGO-480-A; GSO-480-A,-B; IGSO-480-A; IO-540-A,-B,-E,-G,-J,-K,-L,-M,-P,-R,-S,-U; HIO-540-A; TIO-540-A,-C,-E,-F,-G,-H,-J,-N,-R,-S; LTIO-540-F,-J,-N,-R; TIO-541-A,-E; VO-540-C; IVO-540-A; TIVO-540-A; IGO-540-A,-B; IGSO-540-A,-B; TIGO-541-B,-C,-D,-E,-G; IO-720-A,-B,-C,-D	100/130	100LL or 100	④100/130 or ④115/145
O-320-H; O-360-E; LO-360-E; O-540-J,-L	100LL or 100		

* - GO-435-C2 engines with Marvel-Schebler carburetor no. 10-3991 are certificated to use 91/96 fuel.

1 - Grade 100LL or 100L in which the lead content is limited to 2 ml. of TEL per gallon are approved for continuous use in all Textron Lycoming engines listed herein. Inspection procedures described in the following footnotes are not required for engines using this fuel.

2 - O-235-C, O-290-D, -D2 and O-435-A2, -K1 (O-435-4) engines are built with solid stem exhaust valves. The use of fuels with higher lead content of more than 2 ml. of TEL per U.S. gallon must be limited to 25% of the operating time. If used for longer periods of time the same 150 hour inspection requirement, described in the following note is applicable. O-235-C and O-290-D models can be converted to use sodium cooled exhaust valves. See latest edition of Service Instruction No. 1246 for procedure.

3 - Early production O-320-A, -C, -E; GO-435; VO-435-A; and GO-480-B, -D, -F were built with solid stem exhaust valves and their use with fuels having lead content of more than 2 ml. of TEL per U.S. gallon is limited to 25% of operating time. If specified fuel is not available and usage with high leaded fuel exceeds 25% of the operating time, the valve stems should be inspected at 150 hour intervals for erosion, or "necking". This inspection is accomplished by removing the exhaust manifold and visually inspecting the valves through exhaust ports. To determine if an engine has solid stem exhaust valves, remove the rocker cover and look for valve rotor caps which are used with sodium cooled valves but not with solid stem valve in these particular engines.

4 - Continuous use of military grade 100/130 or 115/145 fuel with 4.6 mililiters of TEL per U.S. gallon can result in increased lead deposits both in combustion chambers and spark plugs causing engine roughness and scored cylinder walls. It is recommended that the use of this fuel be limited wherever possible; however, when 115/145 fuel is used, periodic inspections of combustion chambers, valves and valve ports should be conducted more frequently and spark plugs rotated or cleaned whenever lead fouling is experienced.

5 - See latest edition of Service Letter No. L185 for operating recommendations.

NOTE: Revision "L" adds new 91/96 unleaded AVGAS fuel for use in a limited area of Europe.

AVCO LYCOMING WILLIAMSPORT DIVISION
AVCO CORPORATION
WILLIAMSPORT, PENNSYLVANIA 17701

Service Instruction

L

DATE: November 23, 1984

Service Instruction No. 1409A
(Supersedes Service Instruction No. 1409)
Engineering Aspects are
FAA Approved

SUBJECT: Avco Lycoming LW-16702 Oil Additive.

MODELS AFFECTED: All Avco Lycoming piston aircraft engines.

TIME OF COMPLIANCE: At initial oil fill and every oil change thereafter, or at every 50 hours, whichever occurs first.

Avco Lycoming has approved an oil additive LW-16702 that has an anti-scuffing agent. This characteristic serves to reduce wear. For engines already in service, the use of the additive may be started at the next oil change. Use oil additive, as shown in the following chart.

Use (one) 6 ounce can (LW-16702) per 6 - 8 quart sump.
Use (two) 6 ounce cans (LW-16702) per 12 - 15 quart sump.
Use (three) 6 ounce cans (LW-16702) per 17 - 19 quart sump.
Use (four) 6 ounce cans (LW-16702) per 23 quart sump.

This oil additive may be purchased from your Avco Lycoming distributor.

NOTE

"If it is determined that a FAA approved lubricating oil being used contains, in the proper amount, an oil additive equivalent to LW-16702, the provisions of this Service Instruction are being met."

NOTE: Revision "A" adds NOTE recognizing FAA-approved oils that contain an additive equivalent to Avco Lycoming oil additive, LW-16702.

21530, 21530A - This number for Avco Lycoming reference only.

Flygplansmotorer tillverkade av CONTINENTAL. Bränslekvalitet är angiven och återfinns under kolumnen "Fuel Grade".

CONTINENTAL MOTORER

SPECIFICATIONS
CURRENT PRODUCTION ENGINES

MODEL	NO. OF CYL.	TAKEOFF POWER HP@RPM	METRO POWER HP@RPM	BORE & STROKE	DISP. CU/IN	ENGINE DIMENSIONS			WEIGHT DRY LBS. BASIC ENG.	PROP. DRIVE	FUEL GRADE	COMP. RATIO
						LENGTH	WIDTH	HEIGHT				
O-200	4		100-2750	4.06 x 3.87	200	28.50	31.56	23.18	188	Direct	80/87	7.0:1
O-300-A* & C*	6		145-2700	4.06 x 3.87	300	39.75	31.50	23.25	270	Direct	80/87	7.0:1
O-300-D*	6		145-2700	4.06 x 3.87	300	36.00	31.50	27.00	272	Direct	80/87	7.0:1
IO-360-A*,C*,D*,G*,&H* †	6		210-2800	4.44 x 3.87	360	34.60	31.40	24.33	294	Direct	100/100LL	8.5:1
IO-360-J*,JB	6	210-2800	195-2600	4.44 x 3.87	360	34.60	31.40	24.33	294	Direct	100/100LL	8.5:1
IO-360-K*KB	6		195-2600	4.44 x 3.87	360	34.60	31.40	24.33	294	Direct	100/100LL	8.5:1
TSIO-360-A*	6		210-2800	4.44 x 3.87	360	35.84	33.03	23.75	300	Direct	100/100LL	7.5:1
TSIO-360-C*,CB	6		225-2800	4.44 x 3.87	360	35.84	33.03	23.75	300	Direct	100/100LL	7.5:1
TSIO-360-D,DB	6	225-2800	225-2800	4.44 3.87	360	34.60	31.40	24.33	278	Direct	100/100LL	7.5:1
L/TSIO-360-E*,EB	6		200-2575	4.44 x 3.87	360	*56.58	31.30	26.44	352*	Direct	100/100LL	7.5:1
TSIO-360-F*,FB	6		200-2575	4.44 x 3.87	360	*56.58	31.30	26.44	359*	Direct	100/100LL	7.5:1
TSIO-360-G*,GB,LB	6		210-2700	4.44 x 3.87	360	*33.57	33.88	31.90	354*	Direct	100/100LL	7.5:1
TSIO-360-H*,HB	6		210-2800	4.44 x 3.87	360	35.34	31.38	22.43	313	Direct	100/100LL	7.5:1
TSIO-360-K,KB	6	220-2800	220-2800	4.44 x 3.87	360	*56.58	31.30	26.44	359*	Direct	100/100LL	7.5:1
O-470-G*	6		240-2600	5 x 4	470	37.56	33.58	26.69	431	Direct	91/96	8.0:1
O-470-J*	6		225-2550	5 x 4	470	36.03	33.32	27.75	380	Direct	80/87	7.0:1
O-470-K* & L*	6		230-2600	5 x 4	470	36.03	33.56	27.75	404	Direct	80/87	7.0:1
O-470-M*	6		240-2600	5 x 4	470	43.31	33.56	19.62	409	Direct	91/96	8.0:1
O-470-R	6		230-2600	5 x 4	470	36.03	33.56	28.42	401	Direct	80/87	7.0:1
O-470-S	6		230-2600	5 x 4	470	36.03	33.56	28.42	412	Direct	100/100LL	7.0:1
O-470-U	6		230-2400	5 x 4	470	36.03	33.56	28.42	412	Direct	100/100LL	8.6:1
IO-470-C*	6		250-2600	5 x 4	470	37.93	33.58	26.81	431	Direct	91/96	8.0:1
IO-470-D* & E*	6		260-2625	5 x 4	470	43.31	33.56	19.75	426	Direct	100/100LL	8.6:1
IO-470-F*	6		260-2625	5 x 4	470	37.22	33.56	23.79	426	Direct	100/100LL	8.6:1
IO-470-H*	6		260-2625	5 x 4	470	38.14	33.58	26.81	431	Direct	100/100LL	8.6:1
IO-470-J* & K*	6		225-2600	5 x 4	470	38.14	33.39	26.81	401	Direct	80/87	7.0:1
IO-470-L	6		260-2625	5 x 4	470	43.17	33.56	19.75	430	Direct	100/100LL	8.6:1
IO-470-M*	6		260-2625	5 x 4	470	47.16	33.56	19.75	430	Direct	100/100LL	8.6:1
IO-470-N	6		260-2625	5 x 4	470	38.14	33.58	26.81	433	Direct	100/100LL	8.6:1
IO-470-S*	6		260-2625	5 x 4	470	41.41	33.56	19.75	426	Direct	100/100LL	8.6:1
IO-470-U*	6		260-2625	5 x 4	470	44.14	33.86	19.75	423	Direct	100/100LL	8.6:1
IO-470-V*,VO	6		260-2625	5 x 4	470	43.69	33.56	19.75	423	Direct	100/100LL	8.6:1
TSIO-470-B*,C* & D*	6		260-2600	5 x 4	470	39.52	33.56	20.25	423	Direct	100/100LL	7.5:1
IO-520-A* & J	6		285-2700	5.25 x 4	520	41.41	33.56	19.75	431	Direct	100/100LL	8.5:1
IO-520-B*,BA*,BB	6		285-2700	5.25 x 4	520	39.71	33.58	26.71	422	Direct	100/100LL	8.5:1
IO-520-C*,CB	6		285-2700	5.25 x 4	520	42.88	33.56	19.75	415	Direct	100/100LL	8.5:1
IO-520-D	6	300-2850	285-2700	5.25 x 4	520	37.36	35.46	23.79	430	Direct	100/100LL	8.5:1
IO-520-E	6	300-2850	285-2700	5.25 x 4	520	47.66	33.56	19.75	427	Direct	100/100LL	8.5:1
IO-520-F	6	300-2850	285-2700	5.25 x 4	520	41.41	35.91	19.75	430	Direct	100/100LL	8.5:1
IO-520-K	6	300-2850	285-2700	5.25 x 4	520	40.91	33.56	19.75	428	Direct	100/100LL	8.5:1
IO-520-L	6	300-2850	285-2700	5.25 x 4	520	40.91	33.56	23.25	431	Direct	100/100LL	8.5:1
IO-520-M*,MB	6		285-2700	5.25 x 4	520	46.80	33.56	20.41	413	Direct	100/100LL	8.5:1
IO-550-B	6	300-2700	300-2700	5.25 x 4.25	550	37.97	33.56	27.32	422	Direct	100/100LL	8.5:1
IO-550-C	6	300-2700	300-2700	5.25 x 4.25	550	43.31	33.56	19.78	433	Direct	100/100LL	8.5:1
TSIO-520-B*,BB	6		285-2700	5.25 x 4	520	39.75	33.56	20.32	423	Direct	100/100LL	7.5:1
TSIO-520-C & H	6		285-2700	5.25 x 4	520	40.91	33.56	20.04	433	Direct	100/100LL	7.5:1
TSIO-520-D*,DB	6		285-2700	5.25 x 4	520	43.25	33.58	22.34	423	Direct	100/100LL	7.5:1
TSIO-520-E*,EB	6		300-2700	5.25 x 4	520	39.75	33.56	20.32	421	Direct	100/100LL	7.5:1
TSIO-520-G	6	300-2700	285-2600	5.25 x 4	520	40.91	33.56	20.04	433	Direct	100/100LL	7.5:1
TSIO-520-J*,JB,N*,NB	6		310-2700	5.25 x 4	520	54.36	33.56	22.50	412	Direct	100/100LL	7.5:1
TSIO-520-K,KB	6		285-2700	5.25 x 4	520	54.36	33.56	20.32	412	Direct	100/100LL	7.5:1
TSIO-520-L*,LB	6		310-2700	5.25 x 4	520	50.62	33.56	20.02	514*	Direct	100/100LL	7.5:1
TSIO-520-M & P	6	310-2700	285-2600	5.25 x 4	520	40.91	33.56	20.04	436	Direct	100/100LL	7.5:1
TSIO-520-R	6	310-2700	285-2600	5.25 x 4	520	40.91	33.56	23.54	436	Direct	100/100LL	7.5:1
TSIO-520-T	6		310-2700	5.25 x 4	520	*38.20	33.56	32.26	426*	Direct	100/100LL	7.5:1
TSIO-520-U*,UB	6		300-2700	5.25 x 4	520	*44.73	33.56	28.86	536*	Direct	100/100LL	7.5:1
TSIO-520-V*,VB	6		325-2700	5.25 x 4	520	39.25	33.56	20.41	456	Direct	100/100LL	7.5:1
TSIO-520-W*,WB	6		325-2700	5.25 x 4	520	*50.62	33.56	20.02	539*	Direct	100/100LL	7.5:1
L/TSIO-520-AE	6	250-2400	250-2400	5.25 x 4	520	38.07	33.29	21.38	365	Direct	100/100LL	8.5:1
TSIO-520-AF	6	310-2600	285-2600	5.25 x 4	520	40.31	33.56	23.54	418	Direct	100/100LL	7.5:1
TSIO-520-BE	6	310-2600	310-2600	5.25 x 4	520	42.64	42.50	33.50	566*	Direct	100/100LL	7.5:1
TSIO-520-CE	6	325-2700	325-2700	5.25 x 4	520	41.00	34.00	25.00	527	Direct	100/100LL	7.5:1
GTSIO-520-C*	6		340-3200	5.25 x 4	520	42.56	34.04	23.10	481	Geared	100/100LL	7.5:1
GTSIO-520-D & H	6		375-3400	5.25 x 4	520	42.56	34.04	26.78	508	Geared	100/100LL	7.5:1
GTSIO-520-K	6		435-3400	5.25 x 4	520	*56.25	34.04	26.18	600*	Geared	100/100LL	7.5:1
GTSIO-520-L,N	6		375-3350	5.25 x 4	520	43.87	34.04	26.41	557	Geared	100/100LL	7.5:1
GTSIO-520-M	6		375-3350	5.25 x 4	520	43.87	34.04	26.80	507	Geared	100/100LL	7.5:1
Tiara 6-285*	6		285-4000	4.88 x 3.62	406	40.11	32.91	24.22	382	Geared	100/100LL	9.0:1

† Includes IO-360-AB,CB,DB,GB,HB * Rebuilt Only * Includes Turbo and exhaust system