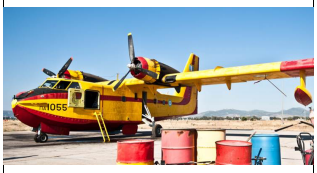
# European Aviation Industry Response to REACH Application for Authorisation: Use of tetraethyl lead in the formulation of aviation fuel / REF: EC 201-075-4 / CAS 78-00-2 (Application by Shell Nederland Raffinaderij B.V.)

The General Aviation Manufacturers Association (GAMA), the European branch of the International Council of Aircraft Owners and Pilots Associations (IAOPA) and Europe Air Sports (EAS), representing the manufacturers, owners and operators of piston-engine aircraft in Europe wish to express strong and positive support for the REACH Authorisation Application by Shell Nederland Raffinaderij B.V. for the continued use of Tetra-ethyl lead (TEL) in the formulation of aviation fuel. This fuel is essential for the continued operation of thousands of piston-engine aircraft in the European Union; thousands of aircraft owners, operators and pilots; and the critical operations that these aircraft need to perform such as pilot training, medical flights, state services, and more. The aviation and fuels industries at a global level are investing heavily in the research, development and safety approvals for alternative unleaded fuels, but to date no alternatives are available on the market in the EU or globally. Therefore, it is essential that this Authorisation Application is approved.

## Essential Role of Piston-Engine Aircraft for the EU Economy

| Firefighting | Flight Training (civil and military) | Private Transport |
|---|---|---|
|  |  |  |
| **Medical** | **Humanitarian** | **Air Sports** |
|  |  |  |

| EU-registered Aircraft Affected: | EU Pilots Affected: |
|---|---|
| 18,000 | 650,000 |

Tetra-ethyl lead (TEL) is a key component in 100LL aviation gasoline (high-octane, low-lead / ref. ASTM standard D910), which is the only fuel that is currently certified and approved by the European Union Aviation Safety Agency (EASA) for use in over 18,000 General Aviation aircraft registered in the European Union. This represents around one third of the registered European civil aviation fleet, which typically have less than 6 passenger seats. These aircraft perform critical functions for European society, including firefighting, aerial surveillance/surveying, medical transport, citizen mobility and pilot training. Indeed, the vast majority of pilots trained in Europe, including those for commercial airlines and the military, require these aircraft for at least part of their training.

Alternative solutions to power/fuel this category of aircraft for the above-mentioned use cases are either not yet available on the market, or are not a financially viable solution for the operators / owners. Lower power piston-engines up to approx. 180 hp are increasingly capable of running on lead-free aviation or automotive fuels, but the availability of these fuels remains limited at many EU aerodromes. New technologies such as electric propulsion are under development, but the power-density of state-of-the-art aviation-capable batteries limits their use beyond very short-range pilot training.

Even when new aircraft solutions are available on the market, the costs of replacing legacy aircraft with new aircraft that use alternative fuels/power sources is not an economically viable solution for many owners and operators or flight schools. The average age of the EU piston-engine aircraft fleet is approximately 40 years so the cost of replacement with new aircraft is a financial impossibility for many SMEs and private owners.

The above associations fully support the efforts of the EU concerning European environmental objectives in general, and, more specifically, in the case of TEL. Obviously, hazardous substances need to be carefully controlled, and the protection of citizens' health should always be a top priority. Our industry is already working in a globally coordinated effort on finding a replacement high octane unleaded aviation gasoline. However, to date, such a replacement fuel without TEL has not yet been approved or made available on the market. We therefore support this application for a REACH Authorisation for TEL by Shell Nederland Raffinaderij B.V. as this is essential for the continued operation of thousands of General Aviation aircraft in the European Union.

## EFFORTS TO IDENTIFY ALTERNATIVES TO LEADED AVIATION FUELS

The efforts to phase out leaded aviation fuels for piston-engine aircraft are led by the United States, as the U.S. has the world's largest fleet of piston-engine aircraft (over 220,000) and is also home to the majority of the manufacturers of these aircraft and their engines. The General Aviation industry associations, the American Petroleum Institute, and the Federal Aviation Administration (FAA) established the **Eliminate Aviation Gasoline Lead Emissions (EAGLE)** initiative in 2022 with the goal of eliminating aviation gasoline lead emissions before the end of 2030 or sooner without adversely affecting the safe and efficient operation of the General Aviation fleet. Consistent with the recommendations of the 2021 Consensus Study Report "Options for Reducing Lead Emissions from Piston-Engine Aircraft," published by the National Academies of Sciences, Engineering, and Medicine, EAGLE's initiatives focus on a multi-faceted approach to reduce and eliminate lead emissions by way of four integrated pillars:

**Met opmerkingen [PM1]:** This was a bit confusing. I've simplified it.

A) Facilitate supply chain and infrastructure readiness for commercial market acceptance and deployment of unleaded aviation fuels from refining to distribution into the wing. Provide options for airports wanting to pursue near-term reductions of lead emissions.
B) Concurrently conduct research and development on technical solutions or modifications that may be necessary for certain aircraft to safely facilitate transitioning to an unleaded fuel.
C) Support the development and deployment of a viable unleaded fuel to replace 100LL that meets the safety needs of the fleet; this includes fuels assessed through the industry/FAA Piston Aviation Fuels Initiative (PAFI) test program and traditional FAA type certification program.
D) Support governmental regulatory and programmatic activities focused on safely transitioning to an unleaded replacement and eliminating lead emissions from aircraft engines.

The U.S. Government funded Piston Aviation Fuels Initiative (PAFI) programme referred to above was established several years before the launch of the EAGLE initiative and has now been integrated within it, with the objective of finding a lead-free replacement fuel. The PAFI programme has made good progress to date, defining comprehensive safety, and testing criteria and evaluating several candidate fuels. In this context we would strongly suggest dedicated EU funding to support European research activity on finding a TEL-replacement. Over time such research could be complemented by further research towards bringing a carbon-free piston-engine fuel to market. We are aware that this recommendation is clearly supported by EASA, the European Union´s Aviation Safety Agency. In the absence of any dedicated EU funded unleaded fuels programme, the European General Aviation industry, and its safety regulator, EASA, will have to follow the outcomes of these US-lead initiatives.

Finally, we would like to draw your attention to the potential adverse environmental and economic impacts, should a REACH Authorisation for TEL not be granted. In the worst scenario, all Avgas 100LL supplied to aircraft in the EU would have to be made by shipping TEL from the supplier in the United Kingdom to the USA or Asia, blending it there, then importing it into the EU. This would uneccessarily lengthen and complicate the supply chain, increase associated transport emissions, substantially increase the fuel costs for end-users, and ultimately impose this economic burden on EU citizens, including aspiring commercial airline pilots, medical rescue service providers, aerial firefighters etc.

In conclusion, the above associations see a significant risk that a failure to approve this application would be massively economically damaging to European General Aviation industry, which mostly consists of SMEs and private individuals, affecting an estimated 16,000 aircraft across all EU Member States. Furthermore, this will not serve to improve the health and safety of European citizens, and in fact could adversely impact aviation safety as no other fuels are certified for use in these aircraft. It could even lead to a greater environmental burden resulting from longer distribution channels, as well as doing little to reduce lead emissions.

**A replacement fuel without TEL has yet not been approved and made available on the EU or global market. Therefore, we strongly support this Authorisation Application from Shell Nederland Raffinaderij B.V. as this is the only viable path for ensuring the continued operation of thousands of aircraft in the European Union. This is no way detracts from our industry's continued intensive global efforts to support the development, approval and commercialisation of a lead-free replacement fuel.**

# ANNEX: Additional Background Information

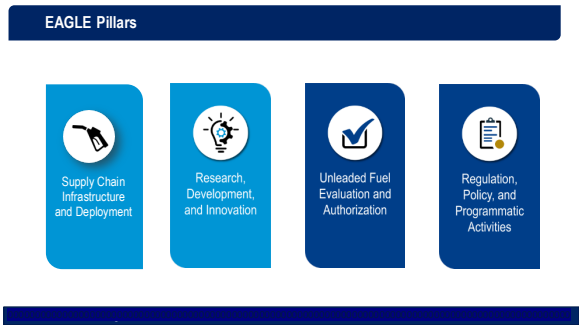
## Near Term Actions to Reduce Lead Emissions

The transition to an unleaded fuel for the entire general aviation fleet is complex and has implications for the safe operation of aircraft. The FAA and industry will move cooperatively, smartly, and with purpose toward a safe and effective transition to viable replacement unleaded fuel(s).

A primary tenet of EAGLE is to ensure that 100LL remains available for the safe operation of the current fleet during an orderly transition. Maintaining safe operations for pilots, other operators at airports and local communities is an essential part of a safe transition to replacement unleaded fuel(s).

## Eliminate Aviation Gasoline Lead Emissions (EAGLE) Initiative – Commitment to Unleaded Fuel(s)

The general aviation industry associations, the American Petroleum Institute, and the FAA established the EAGLE initiative in 2022 with the goal of eliminating aviation gasoline lead emissions before the end of 2030 or sooner without adversely affecting the safe and efficient operation of the general aviation fleet. Consistent with the congressionally directed NASEM 2021 Consensus Study Report "*Options for Reducing Lead Emissions from Piston-Engine Aircraft*," EAGLE's initiatives focus on a multi-faceted approach to reduce and eliminate lead emissions by way of four integrated pillars:




These pillars are committed to the following:

A) Facilitate supply chain and infrastructure readiness for commercial market acceptance and deployment of unleaded aviation fuels from refining to distribution into the wing. Provide options for airports wanting to pursue near-term reductions of lead emissions.
B) Concurrently conduct research and development on technical solutions or modifications that may be necessary for certain aircraft to safely facilitate transitioning to an unleaded fuel.
C) Support the development and deployment of a viable unleaded fuel to replace 100LL that meets the safety needs of the fleet; this includes fuels assessed through the industry/FAA Piston Aviation Fuels Initiative (PAFI) test program and traditional FAA type certification program.

D) Support governmental regulatory and programmatic activities focused on safely transitioning to an unleaded replacement and eliminating lead emissions from aircraft engines.

## Unleaded Fuels

When considering a replacement fuel, there are many characteristics to consider such as performance, detonation resistance, materials compatibility, durability, maintenance impacts, potential health effects, and the potential need for related aircraft alterations. There are also other market considerations such as availability, consistency/quality control, and comingling with other avgas options (100LL and other unleaded options). Industry has adopted motor octane number (MON) as a primary indicator of performance, recognizing that fuels with the same MON may not have identical performance due to other, second-order characteristics.

There are two pathways available to obtain FAA approval for the use of a new fuel: (1) the FAA aviation fuel fleet authorization process; and (2) the traditional FAA aircraft Type Certificate (TC)/Supplemental Type Certification (STC) process.

For Europe, for both pathways, it is anticipated that the European Union Aviation Safety Agency (EASA) will validate any such approvals issued by the FAA under the terms of their Bilateral Aviation Safety Agreement (BASA).

## FAA Fleet Authorization Process

The fleet authorization process works in tandem with the PAFI program and allows the FAA to approve data necessary to authorize an unleaded fuel for use without the need for an applicant to apply for an STC or amend an existing TC. Instead, the FAA works with the fuel offeror and engine and aircraft original equipment manufacturers (OEMs) through the PAFI program to ensure that the characteristics of the fuel are well understood. The data obtained through PAFI testing and evaluation will be used to support development of the industry consensus ASTM International production specification for the candidate unleaded fuel. During the fleet authorization process the FAA will consider type certificate data for aircraft and aircraft engines, test reports, and other data generated during the testing to determine which makes and models of aircraft and aircraft engines can safely operate with the qualified unleaded avgas. The FAA will use that information to develop a report and will also evaluate the available data for the fuel's use in non-type certificated piston engines and aircraft, to include experimental aircraft.

Aircraft owners must take specific actions to implement a fleet authorization by revising the operating limitations in the flight manual on their particular aircraft and replacing the fuel placard. Detailed instructions for doing so will be included as a part of each authorization.

The FAA is working to provide a fleet authorization for UL94, which would also authorize the use of UL91 in the same aircraft. UL94 and UL91 are mid-octane fuels that are adequate for the majority of the general aviation fleet and have gone through extensive testing and the industry consensus process.

## FAA Type Certification (TC) / Supplemental Type Certification (STC) Process

Individual companies may also request FAA certification to allow the use of a fuel through the type certificate or supplemental type certificate process. This process requires the applicant to establish that each model of aircraft and aircraft engine for which approvals are requested are compliant to FAA regulations when using the alternate fuel. Each applicant develops a means of compliance to the

regulations; however, equivalency to 100LL is not required. In this case, the applicant retains ownership of the compliance data.

As with a fleet authorization, aircraft owners must take specific actions to implement changes to the aircraft typically via Service Bulletins or installation of an STC. For aircraft with a standard airworthiness certificate, the alteration is performed by a certificated mechanic or authorized entity and must comply with the TC/STC. Owners of Special Light Sport Aircraft (SLSA) can implement the authorization after the SLSA aircraft manufacturer issues an authorization to do so. Owners of experimental aircraft must individually determine appropriate unleaded fuels. Those owners may develop their own compatibility or solicit input from the TC/STC holder for data pertinent to their aircraft. Many experimental aircraft have engines and fuel systems in common with aircraft with standard airworthiness certificates.

## Fuel Authorization Status

There are a number of fuels that have been authorized for use in many aircraft via the STC process:

| Fuel | Approval | Fuel Specification |
|---|---|---|
| 100LL (Reference case) | TCs for all piston aircraft | ASTM D910 |
| Autogas (No ethanol) | STCs covering lower-compression aircraft | ASTM D4814 |
| UL91 | STC AML covering ~ 68% of certified aircraft | ASTM D7547 |
| SWIFT Fuels UL94 | STC AML covering ~ 73% of certified aircraft | ASTM D7547 |
| GAMI G100UL | STC AML covering all certified piston engines and airplanes | Independent Specification (Contact GAMI) |

In addition to the existing fuels and approvals, fuel offerors and the FAA are working towards additional fuels and authorizations:

| Fuel | Authorization Pathway | Test/ Approval Status | Fuel Specification |
|---|---|---|---|
| UL 94/UL 91 | Fleet authorization | Fleet Authorization in progress | ASTM D7547 (UL 94/ UL 91) |
| GAMI G100UL | STC (AML) | Applied for initial rotorcraft approval | Independent Specification (Contact GAMI) |
| Swift Fuels 100R | STC (AML)* | Applied for initial engine and aircraft approvals | Applied for ASTM Specification |

| Fuel | Authorization Pathway | Test/ Approval Status | Fuel Specification |
|---|---|---|---|
| Afton Chemical/ Phillips 66 | Fleet authorization | FAA testing | ASTM D8434 |
| LyondellBasell /VP Racing | Fleet authorization | FAA testing | Applied for ASTM Specification |

**Swift Fuels has indicated they may merge their certification efforts with the PAFI Fleet Authorization process in the months ahead, if this can accelerate approvals or help expand their deployment efforts to experimental and Light Sport Aircraft.*

## Unleaded Fuel Production and Deployment

The FAA fleet authorization and STC processes both provide pathways for the FAA to authorize fuel for use in engines and aircraft. While the industry is confident in both the fleet authorization and STC approval process, other stakeholders such as producers, distributors, fixed-base operators (FBOs), airports, and engine/aircraft manufacturers need to have an adequate understanding of the fuel necessary to make business decisions. These decisions span the purchasing, producing, distributing, transporting, handling, dispensing, and supporting the operation and use of the fuel. For manufacturers, this also includes extending warranty coverage of their respective products. The FAA will also monitor the safe use of each fuel and work with fuel suppliers and aircraft and engine OEMs to address any issues that arise in service. EAGLE is encouraging fuel developers that hold or are pursuing STC approvals or fuel developers engaged in the fleet authorization process to collaborate with key stakeholders on the necessary information to support the commercial deployment of these fuels.

## The Role of Industry Consensus Standards in Fuel Deployment

Historically, the standards for refining, blending, and distributing avgas, and all other transportation fuels including jet fuel, are developed and maintained collaboratively by the petroleum, liquid fuels, and aviation industries. These standards facilitate the international handling of petroleum products and have been a key factor in the consistent and safe production, sale, transportation and use of fuel in transportation industries. Aviation fuel has been self-regulated through these standards.

ASTM International has served as the primary body for this process, resulting in standards with broad industry understanding and consensus. ASTM International is the globally recognized industry consensus body in which the producers, distributors, providers, users, and many other subject matter experts regarding aviation fuels conduct peer review assessments toward the establishment of testing standards and fuel production specifications.

Currently, the FAA does not directly regulate, approve or oversee any fuel. The approval to use a fuel for a given aircraft or engine is accomplished through a reference to a fuel specification. For consensus-standard specifications, the FAA participates in the review and approval as one of the many stakeholders to ensure that the specification is adequate. For independent specifications, the FAA reviews the specification and approves it once it is found to provide an equivalent specification of property,

performance and quality control. In both cases, the actual production and distribution of fuel are outside of the FAA's purview.

### EAGLE's Commitment to Supporting All Unleaded Fuel Candidates

EAGLE continues its efforts to support all fuel sponsors. Industry stakeholders, including engine and airframe manufacturers, provide technical support to the PAFI testing and fleet authorization of the Afton Chemical/Phillips 66 and LyondellBasell/VP Racing Fuels candidates. Additionally, GAMI and Swift Fuels are supported in their efforts as EAGLE stakeholders.

Each fuel developer makes its own business decisions in choosing which FAA approval/authorization pathway to pursue and its approach to commercializing and deploying their fuel to the market. EAGLE is committed to providing the outreach, education, and sharing of information needed by stakeholders directly involved in the deployment of aviation fuel. This information is used by pilots, consumers, government, and industry to help ensure a safe and smart transition to unleaded aviation fuel(s).

## AVIATION SAFETY

There is currently no demonstrated unleaded replacement for 100LL avgas that meets the safety and operational requirements of the entire piston GA fleet, which is yet available on the market. Unlike the transition away from leaded gas in automobiles, performance issues in aircraft have potential life-and-death consequences for pilots and passengers.

Those living underneath flight paths also face risks associated with potential accidents caused by poorly performing aircraft. While the general health risks associated with lead are well documented, we must also ensure the safe operation of the sizable EU GA fleet. An EASA study from July 2021 showed a total of 54,000 piston engines operating in Europe, of which, 18,000 were identified as requiring a high- octane 100LL avgas.

There have been significant historical and current efforts to develop an unleaded high-octane aviation gasoline that maintains the properties necessary for the safe operation of aircraft engines. Tetraethyllead is the key compound that raises octane, which reduces gasoline's tendency to suddenly and instantaneously ignite from compression (also known as detonation or "knocking") during a reciprocating engine's combustion cycle. Sustained detonation can cause catastrophic engine failure. There is a direct relationship between the amount of horsepower a high-performance aircraft engine can produce and the octane level it requires to operate safely. In addition, the alloys used in aviation engine construction are chosen for their durability and synergistic relationship with the lubricating properties of lead. As a result, engine wear and maintenance issues arise in the absence of leaded fuel. Increased maintenance has an economic impact, but also raises safety concerns due to the increased potential for engine component failure. The current international avgas specification, ASTM D910, defines the acceptable limits for several physical and performance properties necessary for an aviation gasoline to ensure safe operation of aircraft across a broad range of very demanding conditions.

The lead additive and high-octane rating detonation protection it provides is just one of several safety issues that must be addressed when developing a lower-lead or unleaded alternative to 100LL..

There is a potentially significant safety risk associated with a potential restriction or complete interruption of the availability of 100LL fuel for General Aviation, as aircraft operators may be forced or inadvertently

use unapproved fuels, which may well result in partial power loss or complete engine failure, and thus potentially lead to the loss of life of those onboard the aircraft and/or those on the ground.

## SOCIETAL AND ECONOMIC IMPACTS

General Aviation is a key component of Europe's transportation infrastructure and economy. Public use airports are often the only available option for fast, reliable, flexible air transportation to small and rural communities in every corner of the continent. General Aviation directly supports jobs in these communities, provides a lifeline for small to mid-sized enterprises, and provides critical services to remotecities and towns, particularly in time of natural disaster or crisis. As a result, general aviation is uniquely situated to serve some of the public's most crucial transportation needs.

The economic impact of General Aviation is also significant. General Aviation contributes to the EU economy by creating output, employment, and earnings that would not otherwise occur. Direct impacts, such as the purchase of a new aircraft, multiply as they trigger transactions and create jobs elsewhere in the economy (e.g., sales of materials, electronics, and a wide range of other components required to make and operate an airplane). Indirect effects accrue as General Aviation supports other facets of the economy, such as small business, rural economies, and tourism.

Any regulatory action by the Commission related to tetraethyllead could directly affect General Aviation. Without appropriate consideration of aviation safety, technical feasibility, and economic impact, a transition to an unleaded replacement for 100LL could have a significant impact upon the viability and long-term health ofthe General Aviation industry and related SMEs and rural communities.

## EASA COORDINATION

We recognize and appreciate the need to ensure the appropriate and safe use of chemicals to protect citizens. However, any actions impacting the use of TEL in aviation fuel could have a significant impact on European aviation, so it is important to appropriately consider aviation safety implications. Therefore, in accordance with the new provisions of Article 87(2) of Regulation EU 2018/1139, the Basic Regulation of the European Aviation Safety Agency (EASA), we strongly urge ECHA and the relevant European Commission services to consult the expert opinion of EASA on the impact of implementing any restrictions on the use of TEL in aviation fuel before promulgating any such restrictions. As defined in this regulation, there is a need to balance the interdependencies between health, aviation safety, environmental and economic impacts as well as technological feasibility of alternative fuels.

## ECHA Risk Assessment and the TEL Supply Chain in the EU

There is currently only one supplier of the TEL additive used in 100LL aviation gasoline, Innospec, based in the United Kingdom. Our current understanding is that they supply the additive to four fuel producers in the European Union who blend the additive with the fuel to produce 100LL fuel compliant with the ASTM D910 standard. Fuel companies are better positioned to provide additional details about the control and protection measures in place for the handling of TEL during these mixing operations. However, we would like to highlight that this is clearly a highly controlled and very limited supply chain, and therefore the risk to EU citizens from the handling and mixing of TEL is minimal.

Furthermore, in 2018 when ECHA conducted its risk assessment for TEL, the United Kingdom was at that

point still a member state of the EU, and therefore Innospec's full global production volumes were included in the volumes of TEL used to perform ECHA's risk assessment for this substance. However, as the UK is no longer a Member State and the volumes of TEL in the EU are therefore reduced by at least a factor of 10, we encourage the Commission to request ECHA to update their risk assessment for TEL to take into account this changed situation and lower risk score.

## CONCLUSION

For the reasons stated above, including current efforts to identify, test, authorize, and transition to a viable, high-octane unleaded fuel; adverse safety impacts; societal and economic impacts; and the need to coordinate with EASA and other stakeholders, we fully support the REACH Authorisation Application by Shell Nederland Raffinaderij B.V. for the continued use of Tetra-ethyl lead (TEL) in the formulation of aviation fuel. Only after careful consideration of all the issues and collaboration with both industry and government stakeholders would an inclusion be appropriate and ensure both the safety and vitality of this important segment of the EU economy.

The risk to aviation safety must be considered to be of critical importance when considering any limitations on the use of TEL, as aviation safety has a direct impact on the lives of millions of EU citizens compared to the very small number of EU citizens who might have any direct contact with the TEL additive used by 4 fuel companies in the EU.

## Signatory Associations:

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|---|---|
| EUROPEAIRSPORTS | Europe Air Sports (EAS) is the voice of sports and recreational aviation in Europe.<br>Established in 1988 as a non-profit organisation, and since 1994 affiliated to the global Fédération Aéronautique Internationale (FAI), our objective is the long-term promotion and protection of sports and recreational aviation in Europe. In particular our mission is to represent the interests of pilots and light aircraft owners / operators in civil aviation regulatory developments. https://www.europe-air-sports.org/ |
| General Aviation Manufacturers Association | The General Aviation Manufacturers Association (GAMA) represents more than 140 of the world's leading manufacturers of Business and General Aviation aeroplanes, rotorcraft, engines, avionics, components, and related services and technologies. GAMA members are also providers of maintenance and repair services, fixed-based operations, pilot and maintenance training, and aircraft management. Additionally, GAMA represents companies in the emerging sector of new air mobility, which includes the development of vertical take-off and landing (VTOL) aircraft as well as electric, hybrid and hydrogen propulsion and autonomous systems for civil purposes. GAMA member companies have facilities in over 30 countries. www.gama.aero |
| IAOPA EUROPE | The International Council of Aircraft Owner and Pilot Associations (IAOPA) is a nonprofit federation of 82 autonomous, nongovernmental, national General Aviation organizations. IAOPA Europe has affiliates in 32 European states. The combined total of individuals represented by these constituent member groups of IAOPA is nearly 400,000 pilots, who fly General Aviation aircraft for business, fun, and personal transportation. www.iaopa.eu |