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GP-4 Builders & Flyers Newsletter

January 2006
GP4BFN49

News for Builders of Fast Wooden Aircraft!

John Reinhart of Texas and his beautiful GP-4

Inside this issue:

Hydraulic Gear Plans Now Available

The prototype GP-4 uses a manual landing gear retraction system. After numerous repeated requests from builders, George developed an electric hydraulic gear for the GP-4.

The advantages of the hydraulic system are obvious, Flip and switch and fly the airplane. The disadvantages include extra weight, possible electric/hydraulic failure, a back-up system, and maybe some more expense.

No machine work if required for any of the components. Plans are available for $150 from Osprey Aircraft. You can find the address and an order form on the website and on the last page of this newsletter.

George's Corner

By George Pereira

Fellow GP-4 Builders:

I recently received a call from fellow GP-4 builder Mike Mahar in Cleveland, Ohio. Mike is a professional aircraft builder. His company is called Mahar Spar Industries. After building two Lancair Legacies, Mike decided that his personal aircraft would be a GP-4. I was flattered after learning something about Mike's background with fast airplanes.

His two years of work has produced a fuselage ready for finish paint, a wing ready for skin, and all three hydraulic gears working well.

Mike purchased the plans in November, 2003. His expertise was mainly working metal and fiberglass, but he seemed undaunted building an airplane out of wood. This is another testimonial that, if you are good at one craft, your skills will follow as you pursue other crafts. Another example of that is Bernie Griffin's Grand Champion fabrication.

My point is, don't despair if you feel over your head in unfamiliar territory. With study and perseverance one skill will feed another.

Mike calls me about once a week, mostly to tell me how much fun it is sweeping up sawdust. His two years of work has produced a fuselage ready for finish paint, a wing ready for skins, and all three hydraulic gears working well. His last call were questions about aligning the wing ribs to the spar.

The 63 series airfoil will not tolerate any miss-alignment of the chord lines on each side of the mail spar. I addressed this issue in the November 1999 newsletter, GP4BFN27. I have ask Elton to reprint the article for those who haven't already read it.

Regards to all,

George

(reprint begins next page)

BUILDER'S RESOURCE

BY BOB FOSTER

Many GP-4 builders who have completed their fuselage have installed Jim Weir's antenna kit. Jim has many more "can't live without" electronic designs that will save you beaucoup bucks or as he says, "A champagne panel on a beer budget." He has published a full panels' worth of designs in Kitplanes for several years, from about 1996 to present. I have listed all the publications and subject that I have, perhaps someone else could fill in the blanks

KitPlanes Magazine

Jan 97, pg 87, Coaxial cable

Mar 97, pg 69, Extending landing light life

May 97, pg 72, ELT antenna

July 97, pg 79, Wire rack

Oct 97, pg 62, Radio Connectors

Feb 98, g 86, Radio "stuff"

Apr 98, pg 20, Altitude chamber

June 98, pg 86, Auto Am FM Radio

Oct 98, pg 60, Inexpensive intercom

(I missed most of 1999 & 2000)

Dec 99, pg 115, VHF nav antenna

Oct 00, pg 49, LED position lites

Nov 00, pg 65, GPS

Jan 01, pg 88, Dim Bulbs

Feb 01, pg 61, Antennas

Apr 01, pg 61, lamp dimmer

Aug 01, pg 68, Aviation software

Feb 02, pg 43, Engine monitor

Apr 02, pg 79, Battery sulfate buster

REPRINT

GEORGE'S CORNER

BY GEORGE PEREIRA

Fellow GP-4 Builders:

Recently a friend of mine and fellow GP-4 builder asked me for some help in building his wing. The builder, Mike Traud, had all of the ribs and spars built. We were looking at more of an assembly and fairing project. Mike had optioned for the hydraulic gear and had all of the components ready to install. I had previously built a full-scale model of the mockup of the hydraulic gear, yet I still wanted to see how well the components fit in a plans built wing.

Mike flies a corporate jet for a local company, and a busy season has him working almost seven days a week. He is also a fine craftsman, so with the limited amount of time available from Mike and myself, the wing is going together surprisingly fast.

It was 1981 or 1982 since I built the prototype GP-4 wing, and don't laugh, but I have to read and reread the plans to make sure I wasn't making any mistakes. Fortunately, I remembered how important it is to reshape the main spar prior to installing the ribs and rear spar. We first drew straight accurate chord lines on both sides of the main spar and on the front side of the two rear spar sections. Lines were then drawn for rib locations on both spars. Mike already had chord lines on both sides of all the ribs. We could then hold up a rib to the spar, mating the rib and spar chord lines, and sees how much of the spar needed to be planed away before final rib installation.

If you install the ribs before you preshape the spar, it is very hard to plane down to the rib height without breaking the rib away from the spar with your plane. Most of the spar wood is removed on the forward topside of the main spar. This will become apparent when you match up the rib spar chord lines. I used a 10 inch hand plane, keeping it very sharp in order to plane the spar down to rib height. A belt sander was used for final finish. We then glued and nailed corner blocks to the spar. We used 20 gauge aircraft nails, available from Wicks Aircraft or Aircraft Spruce. These are brass, cement coated nails that are small enough so they won't split your corner blocks. Two sizes were used, 3/4" long for corner blocks, and 5/8" long for attaching the ribs. T-88 adhesive was used for all the wood attachments.

The main spar was then blocked and clamped to our 'very' level 24 foot tabletop. The spar face, or web, was 90 degrees to the tabletop. A leveling string was attached from spar tip to spar tip. The positioning blocks to hold the spare were screwed to the tabletop. The spar must not move once you start installing the ribs.

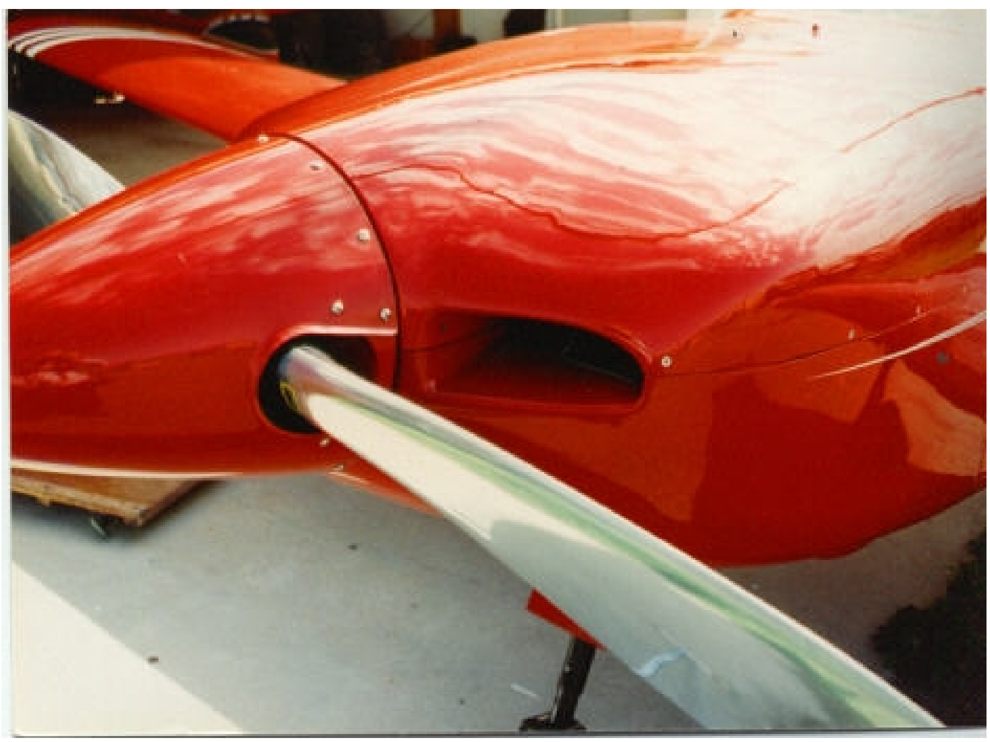
The retract link trunion bearing and the main gear trunion locations were marked on the aft side of the main spar. This is shown on drawing M-5 of the hydraulic gear plans. All measurements start from a centerline on the spar. The spar plates that hold these trunion components were bolted to the spar. It is important to use drill blocks to keep the bolts aligned when drilling the spar. Mike had some 3" oak that we used for drill blocks. You drill a 1/4" hole through the block on your drill press. You then have a block that will guide your long, 1/4" drill through the spar cap by clamping the block to the spar. With the trunion plates now in-

GEORGE'S CORNER

BY GEORGE PEREIRA

stalled, we were ready to attach all of the rear ribs. The tip rib, which is a full one-piece rib, glues to the main spar tip. You match the chord line to the spar chord line and level the rib chord line.

I stapled a temporary batten to the outside of the tip rib along the chord line to lay a level on, as it was checked often during assembly. A batten was also stapled to the chord line of the #1 rib, to ease leveling when attaching the rib to the spar. We then had the tip ribs and the butt ribs #1 attached and blocked to the table so they can't move. Remember the aft ribs are all 1/8" longer than required to allow fitting them to the main spar. Be sure to use this 1/8" tolerance to fit and shorten the #1 rib when attached to the spar.



With the main spar blocked and level in two planes, the tip ribs and the #1 ribs in place, and chord lines level, we were ready to attach the rear spar, ribs, seat rails, and main landing gear.

I will cover this in the next newsletter.

Regards to all,

George

HOW DOES OXYGEN WORK

By Michael D. Sebastian, M.D.
From an Avweb Safety Article

As pilots we all "know" that oxygen is important to aviation safety and comfort. Our FAA written exams contain questions on the subject: the physiologic effects of inadequate oxygen; the regulations pertaining to oxygen use. But how does oxygen really "work?" How does the oxygen we breathe get to where it's going, what does it do on arrival, and what happens when we don't get enough? Let's answer some of these questions in terms that won't leave your heads spinning (a symptom of hypoxia or of confusion!)

Let me state up front that I am not an AME, nor do I play one on television. I am a private pilot who is also an anesthesiologist and an internist, so oxygen is near and dear to my heart in my job. While reviewing the subject for my recent oral board exam in anesthesiology I decided that I had never read a really adequate, concise, and pertinent treatment of the subject in aviation publications for the non-medical pilot. This article is the result; the reader may judge whether I have succeeded.

What Does Oxygen "Do?"

In a nutshell, oxygen enables the cells of the body to release the energy stored as high-energy chemical bonds in our food, and enables them to use that energy to do what cells do: namely, to keep us alive, heart beating, brain thinking, and kidneys turning our Diet Cokes into unplanned pit stops. Virtually every cell in the body needs oxygen in order to perform its part in the complex symphony of skills and judgement that enables us to fly an airplane.

Many cells in the body can function for a short time using *anaerobic* metabolism, or metabolism without oxygen. Alas, the brain and heart, while skilled at many things, are notoriously poor anaerobic performers. Four or five minutes with no oxygen and the brain and heart throw in the towel. This is what happens when, for instance, a person suffers a cardiac arrest and is not resuscitated quickly. There is no flow of oxygen-carrying blood to the brain and other vital organs when the heart is not beating, so they are damaged irreversibly in a very short time.

Name: Oxygen
Symbol: O
Atomic Number: 8
Atomic Mass: 15.9994 amu
Melting Point: -218.4 °C (54.750008 K, -361.12 °F)
Boiling Point: -183.0 °C (90.15 K, -297.4 °F)
Number of Protons/Electrons: 8
Number of Neutrons: 8
Classification: Non-metal
Crystal Structure: Cubic
Density @ 293 K: 1.429 g/cm^3
Color: colorless

In aviation, however, rarely do we function in a completely oxygen-free environment. We commonly function in a *hypoxic*, or low-oxygen, environment, however, since the partial pressure (more later) of oxygen we breathe decreases as our altitude increases. When we function in a hypoxic environment, the end result may be *hypoxemia*, or a state of inadequate oxygen content in the bloodstream. Hypoxemia in turn leads to inadequate delivery of oxygen to our vital organs. Though our cells and organs don't die outright because of the decrease in oxygen, they don't work at maximum efficiency either. This oxygen-deprived state has significant effects on our perfomance of complex tasks, like flying.

Aviators are most concerned with hypoxia's effects on the brain. Hypoxic symptoms can be present even at modest altitudes, lower than those at which we're required to put on the cannula. The symptoms become progressively worse along a continuum as we continue to ascend or as our time at a given altitude increases.

We might notice fatigue or degradation of night vision beginning at pressure altitudes as low as 5000 or 6000 feet. Headache, drowsiness, hyperventilation (breathing fast), unconsciousness, coma, and ultimately death can occur as oxygen partial pressure declines with increasing altitude -- first in the environment, thence the bloodstream, and finally in our cells. As an approximation, the ceiling for an aviator in a non-pressurized cockpit not breath-

HOW DOES OXYGEN WORK

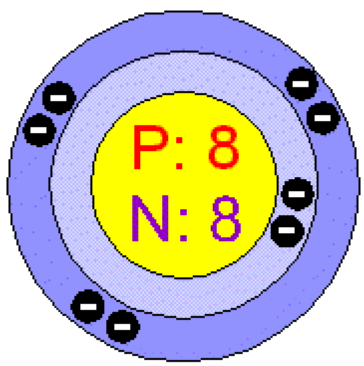
ing oxygen is about 23,000 feet. At this altitude, his blood contains only half the oxygen present at sea level. Any higher, or any longer than a brief exposure, and he is unconscious. This is a state more conducive to absorbing arcane aviation articles than to flying an aircraft.

How Does Oxygen Get Where It's Going?

We all remember from high-school biology that when we take in a breath the air enters our lungs and the oxygen in it goes through our bloodstream to our body. We also know that the bloodstream picks up carbon dioxide from the body and brings it back to the lungs where it is exhaled, and the process starts all over again. But what actually "pushes" or "pulls" the oxygen "in" and the carbon dioxide "out"? We will discuss some of these concepts now, since a basic understanding of respiratory physiology will make our reading here easier and more meaningful.

A word about units of pressure before we begin. I will state pressures here in millimeters of mercury (or mm Hg, or just "mm") unless otherwise noted. Even though pilots are used to thinking of pressures in terms of inches of mercury or millibars, most of the physiologic equations dealing with oxygen use either mm Hg, pascals, atmospheres, so I have chosen to go with mm and forget about constant unit conversions. The concepts still make sense regardless of which unit is used.

The air we breathe consists of about 78% nitrogen and 21% oxygen (O2) with trace gases making up the rest. These percentages remain constant throughout the atmosphere, from the Dead Sea to the stratosphere, regardless of altitude. In any mixture of gases, such as the air, each gas exerts a partial pressure (PP) which is the product of its concentration and the total pressure of the mixture. For the air, that total pressure is the barometric pressure (Pbaro). In a roomful of air at sea level the PP of nitrogen is 78% of 760 mm Hg, or about 593 mm, while the corresponding O2 PP is 21% of 760, or 160 mm. In Denver, where Pbaro is about 624 mm,



that same 21% oxygen gives us a partial pressure of 131 mm; and at FL180, with Pbaro at about 404 mm, only about 85 mm O2 PP. These may not seem like huge differences, but they are physiologically significant as we will see in a moment.

The important concepts to take away are that 1) partial pressure, not concentration, of oxygen decreases with increasing altitude; and 2) The partial pressure of oxygen, not its concentration, is the most important determinant of how much oxygen gets from the atmosphere into our cells. Within certain limits, your body does not care whether you are breathing 50% oxygen at 320 mm Hg pressure or 21% oxygen at 760 mm, because in each case you are breathing an oxygen PP of 160 mm.

Where Does Oxygen Go?

With each breath the gases you inspire , or breathe in, are transported into the *alveoli*, which are the millions of tiny air sacs within the lung. Picture them as bunches of grapes, with branching hollow stalks (the air tubes that bring the air into the lungs) terminating in the fruit (the air sacs themselves.) Each alveolus (one air sac) has at least one blood vessel, a capillary, lying in close contact with it; the alveolus and the capillary share a common, gas-permeable membrane which separates the inside of the capillary, where the blood is, and the inside of the alveolus, where the air is. The oxygen you breathe in moves across the membrane from alveolus into the bloodstream. At the same time the carbon dioxide in the bloodstream moves in the opposite direction, into the alveolus, from which it is exhaled to the atmosphere the next time you breathe out.

The driving force for the movement of these gas molecules is the difference in partial pressures of each gas on either side

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of this gas-permeable membrane. Gases separated by a permeable barrier want to equilibrate their partial pressures across that membrane. They want to move from an area of high PP, where they are more crowded, to an area of lower PP, where they are less crowded.

Consider only oxygen for the moment. When you inhaled you filled the alveolus with oxygen-rich air. But across that alveolar membrane is the capillary blood, which has just returned from the oxygen-hungry cells of the body and is thus depleted of its oxygen. The oxygen molecules want to try to equalize their partial pressures across the alveolar membrane. Therefore , the oxygen molecules move from the oxygen-rich alveolus into the oxygen-poor capillary blood until the partial pressure of oxygen is roughly equilibrated across that membrane.

The same thing is happening simultaneously with CO2, but in the opposite direction. The alveolar capillary blood has just returned from body tissues, where it picked up a load of '"refuse", the CO2 expelled by cells and tissues, and has brought it back to the alveolar capillary. Since that breath of air you took in has a very low CO2 PP, the molecules of CO2 move out of the capillary blood and cross the membrane into the alveolus to be exhaled to the atmosphere.

The key concept, therefore, is that all other things being equal, the alveolar partial pressure of oxygen largely determines how much oxygen winds up in the bloodstream. The alveolar PP is determined by the inspired O2 PP, and in turn this inspired O2 PP is the product of the inspired O2 concentration (which remains a constant 21% throughout the atmosphere) and of the barometric pressure (which varies with altitude). The bottom line is that the higher we fly, the lower the partial pressure of oxygen in the bloodstream, and ultimately the less oxygen we have available for our brain and other organs to use.

What Happens to Oxygen in the Bloodstream?

Once an oxygen molecule makes it into the bloodstream it is immediately attached to a hemoglobin (Hb) molecule, the special protein within your red blood cells that is nature's oxygen delivery truck. Depending on the blood O2 PP, which in turn depends on the alveolar O2 PP, the Hb molecules may or may not be fully "saturated", or filled to capacity, with oxygen. At sea level, the Hb molecules in the arteries just downstream from the alveolar capillaries, after the oxygen has made it into the bloodstream, are about 97% saturated in the normal person.

Those fully-saturated Hb molecules are then pumped by the heart out to the body's cells where they deliver their oxygen cargo, pick up the CO2 from those same cells, and return via the veins back to the heart. The heart next pumps this deoxygenated, CO2-rich blood into the alveolar capillaries where our gas exchange takes place and the whole process begins again. The blood in those veins just prior to its arrival in the alveolar capillaries is only about 75% saturated with oxygen. The difference in saturation ("sat") between venous and arterial blood is due to the consumption of oxygen by the tissues.

Oxygen Facts

Date of Discovery: 1774
Discoverer: Joseph Priestly
Name Origin: From the Greek words *oxus* (acid) and *gennan* (generate)
Uses: supports life
Obtained From: from liquid air

How Do We Adapt to Altitude?

In order to survive the low oxygen partial pressures that exist at high altitudes we must either acclimatize (adapt) to that altitude by staying there for long periods of time, or we must increase the oxygen PP we breathe. Since the aviator's stay at altitude is measured in hours, and acclimatization requires days or weeks, raising our oxygen PP is the only practical strategy available to the pilot.

Consider people who have lived all their lives at altitude, like the

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Sherpas in Nepal or the residents of the Andes. Barometric pressures, and thus oxygen partial pressures, are low up there, so alveolar and ultimately blood O2 PP's will be low as well. They must make the most of the limited oxygen PP in their alveoli. They want their hemoglobin to pick up the scarce alveolar oxygen greedily as the blood passes through the alveolar capillaries, and to release it readily to the oxygen-starved tissues of the body after it picks up its oxygen load in the lungs. And furthermore, the more hemoglobin molecules that can be packed into a given volume of blood, the more oxygen can be carried per volume of blood. High-altitude dwellers involuntarily make these adaptations through certain chemical changes within their red blood cells that alter hemoglobin's grip on oxygen, and which cause an increase in the hemoglobin content of the blood. More trucks, more cargo.

When inspired oxygen partial pressures decrease, the speed and depth of our respiration increases as a compensatory mechanism. This accounts for the hyperventilation which is a symptom of hypoxia. This increase in ventilation (the product of speed and depth of breathing) causes CO2 to be exhaled faster and thus decreases CO2 PP in the bloodstream. Since CO2 is acidic when dissolved in the blood, getting rid of it causes the blood to become less acidic than normal, and this change in acidity changes how eagerly hemoglobin grabs onto oxygen. In addition, other chemicals are produced within the red blood cell that aid in this adaptation. The net effect is that hemoglobin releases its oxygen to the tissues more efficiently.

Furthermore, the amount of hemoglobin in the Sherpa's blood is significantly higher than that of the average sea level dweller; chronic exposure to low oxygen partial pressures stimulates the production of more red blood cells, each packed with hemoglobin. Again, more trucks, more cargo. Oxygen is picked up more efficiently from alveolus to blood; and more of the available oxygen can be carried in the blood because there is more hemoglobin to carry it. However, these adaptations occur only with long-term exposure to hypoxia, and go away shortly after returning to sea level. Within the brief time frames with which we are concerned in aviation, these adaptations to altitude do not come into play.

How Can We Increase the Oxygen in the Bloodstream?

This is the crux of the matter for the general aviation pilot. How can the pilot increase the PP of O2 in her bloodstream, in order to attenuate or eliminate the effects of hypoxia on safety and performance? She can either pressurize the cabin, which increases her Pbaro, or she can breathe supplemental oxygen, which increases her inspired oxygen concentration. In either case, she increases her inspired, alveolar, and blood O2 PP's.

Pressurization systems cause air to enter the aircraft cabin slightly more rapidly than it can leave, raising the pressure of the air in the cabin by a certain amount. You are breathing air with the same old 21% O2. However, its pressure is considerably higher than that of the surrounding flight-level atmosphere, though not as high as that at sea level. Most airliner cabins are pressurized to a pressure altitude of about 5000-6000 feet which produces an inspired oxygen PP adequate for a healthy person for the duration of most commercial flights.

How Much Oxygen is Enough?

Good question, since this tells us how high we can safely go with and without oxygen. There is no absolute safe level of blood O2 PP or O2 sat. However, some rough guidelines exist regarding hypoxemic tolerance.

Judgement and fine motor control begin to deteriorate appreciably at a blood O2 sat less than about 85% in the healthy but unacclimatized pilot.. This corresponds to a blood oxygen PP of about 55-60 mm Hg. Unconsciousness ensues after all but the shortest exposure to a blood O2 saturation of about 50% or less; you will encounter this level of hypoxemia at an altitude of about 23,000 feet as I mentioned earlier. Of course, one's tolerance for hypoxemia is significantly diminished by smoking or by certain heart or

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lung diseases such as emphysema or congestive heart failure. You are unlikely to qualify for a medical with these problems, but you may well be allowed to board a commercial flight.

FAR's require the pilot in a non-pressurized aircraft to don oxygen above 12,500 feet MSL for that part of the flight exceeding 30 minutes. Further, the pilot is required to use oxygen for the entire flight above 14,000 feet. At the latter altitude the pilot's blood O2 sat would be expected to be around 80% without oxygen, clearly below the "safe" minimum level . So physiologically, the altitude regulation makes some sense.

For many GA pilots, flying non-pressurized aircraft (the planes I rent usually aren't watertight, much less airtight!), the alternative is to wear a cannula or mask and breathe supplemental oxygen. The conserving cannula systems generally consist of a cylinder of oxygen with a regulator valve and a reservoir which release the oxygen in a controlled manner to decrease waste of the gas. The valve mechanism senses the start of an inhalation and releases oxygen only during the inhalation. The reservoir accumulates a reserve of oxygen so that the air inhaled at the very start of inspiration has a high oxygen concentration.

A nonconserving system, by contrast, simply administers the oxygen at a steady, constant flow rate regardless of whether the user is inhaling or exhaling, and has no reservoir to enrich the early-inspiration flow of oxygen. By how much are we able to enrich the oxygen concentration we breathe using such equipment?

The average person breathes about 5-6 liters of air per minute. In addition, the rate at which a person inhales is not uniform; it is highest at the start of inspiration and declines to zero as the lungs approach their "full" point. At the start of inspiration airflow rates may be 40-60 liters per minute or more. At this airflow, most of what the pilot inhales when wearing a nonconserving cannula is normal cockpit air entrained, or sucked in around the cannula. If we increase the oxygen flow rate in order to increase the concentration of oxygen inhaled, the resulting gas jet

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may be uncomfortable; and oxygen is wasted as it pours out uselessly during exhalation (which makes up 2/3 of each breathing cycle), emptying the cylinder far short of the destination. At an oxygen flow rate of 5 liters per minute, a 22 cubic-foot aviation oxygen cylinder will be expend its 700 liters of oxygen in a little over 2 hours. And that's with just the pilot alone breathing from the system. Add a few passengers on oxygen and you are refilling your cylinder much more often than your fuel tanks.

With the conserving cannula, on the other hand, the oxygen flow rates can be set quite low and still get the job done. Oxygen accumulates in the reservoir so that with each inspiration one gets a "blast" of high-concentration oxygen; during exhalation no oxygen leaves the system, dramatically decreasing waste. Using that same 22-cubic-foot cylinder a pilot wearing a conserving cannula might get 20 hours of flow at 18,000 feet., for an average oxygen flow of about a half a liter per minute.

The tradeoff we accept in using a cannula is that at best we can increase only slightly the oxygen concentration we breathe. For this reason, cannula systems are approved only for altitudes up to 18,000 feet. Above this altitude, the small increase in oxygen concentration from the cannula is inadequate to offset the drop in barometric pressure and produce an inspired O2 PP sufficient to keep the blood adequately saturated with oxygen. For altitudes above 18,000 feet, masks which allow higher concentrations of oxygen must be used. These masks,of course, require higher oxygen flow from the cylinder and consequently use up the available supply much faster.

In preparing this article I spoke with Tom Armao of Aerox Systems, a manufacturer of aviation oxygen equipment. He told me that his company's conserving cannulas are designed to increase the inspired oxygen concentration to about 24 percent, compared with the normal 21 percent. This means that at FL180, where Pbaro is about 404 mm , this cannula can increase our inspired oxygen PP from about 84 mm (400 times 0.21) to about 96 mm (400 times 0.24) This increase in inspired O2 PP translates into a jump in blood oxygen PP from a non-supplemented value of around 45 mm to about 55 mm with the cannula on. As mentioned earlier, this puts you just about at the 55-60 mm point (about 85% sat) below which your judgement and motor skills begin to go seriously to pot. You can see that above FL180 the cannula will not be able to provide a sufficient increase in blood oxygen content for you to be able to function adequately for long. A regulation with an actual reason!

To illustrate this point, let's consider the hot shot aviator who decides to take her Turbo-Brand-X up to FL250, where Pbaro is only about 282 mm Hg. Up there her blood O2 PP will be only about 20 mm Hg with a saturation in the mid-20's or so without oxygen, assuming she survives long enough to climb to that altitude. Using her 24% cannula she would improve her blood O2 PP or saturation only marginally, not even enough to enable her to regain consciousness. But using an oxygen mask supplying 50% oxygen, she could improve things quite a bit. With an inspired O2 PP of 141 mm (50% of 282 mm) her blood oxygen PP would be expected in the low-60 mm range, giving her a sat of 90% or better. This is well above our 55mm/85% sat silliness threshold. However, she would have to turn up her oxygen flow rates fairly high, resulting in rapid exhaustion of her oxygen cylinder, to maintain her oxygenation. One can see why a pressurized cockpit makes practical sense for the pilot who regularly flies her aircraft at the flight levels: no nose-hose to wear, no cylinders to refill, and no limit on endurance at altitude other than those imposed by the aircraft's fuel reserves and the pilot's bladder capacity!

I have tried here to give an overview of the physiology of oxygen metabolism, the dangers of hypoxia, and the rationale for the use of supplemental oxygen at altitude. Now when you head for the flight levels you should better understand just what you are doing, and why, when you put on that cannula or glance at your cabin-pressure gauge.

Just remember, OXYGEN, like altitude, IS GOOD!

Uncle Bob Gets Shot Down

The teacher gave her fifth grade class an assignment: Get their parents to tell them a story with a moral at the end of it. The next day the kids came back and one by one began to tell their stories.
"Johnny, do you have a story to share?"
"Yes, ma'am, my daddy told a story about my Uncle Bob. Uncle Bob was a pilot in the war and his plane was hit. He had to bail out over enemy territory and all he had was a small flask of whiskey, a pistol and a survival knife. He drank the whiskey on the way down so it would not break and then his parachute landed right in the middle of twenty enemy troops.
He shot fifteen of them with the gun until he ran out of bullets, killed four more with the knife, 'till the blade broke and then he killed the last one with his bare hands."
"Good heavens," said the horrified teacher, "What kind of moral did your daddy tell you from that horrible story?
"Stay away from Uncle Bob when he's been drinking!

Pilot Recruitment

The chief of staff of the US Air Force decided that he would personally intervene in the recruiting crisis affecting all of our armed services. He directed a nearby Air Force base that will be opened and that all eligible young men and women be invited. As he and his staff were standing near a brand new F- 15 Fighter, a pair of twin brothers who looked like they had just stepped off a Marine Corps recruiting poster walked up to them.
The chief of staff walked up to them, stuck out his hand and introduced himself. He looked at the first young man and asked, "Son, what skills can you bring to the Air Force?" The young man looks at him and says, "I'm a pilot!" The general gets all excited, turns to his aide and says, "Get him in today, all the paper work done, everything, do it!" The aide hustles the young man off.
The general looks at the second young man and asked, "What skills to you bring to the Air Force?" The young man says, "I chop wood!" "Son," the general replies, "we don't need wood choppers in the Air Force, what do you know how to do?" "I chop wood!"
"Young man," huffs the general, "you are not listening to me, we don't need wood choppers, this is the 20th century!" "Well," the young man says, "you hired my brother!" "Of course we did," says the general, "he's a pilot!" The young man rolls his eyes and says, "Dang it, I have to chop it before he can pile it!"

Good knowledge of radio procedure..

Scene 1: it's night over Las Vegas, information Hotel is current and mooney 33W is unfamiliar with procedure and talking to approach control...
Approach: 33W confirm you have hotel.
33W: Uhhhmm, we're flying into McCarren International. Uhhhmm, we don't have a hotel room yet.
Approach control was laughing too hard to respond. The next several calls went like this:
Approach: United 5, descend to FL220.
United 5: United 5 down to FL220; we don't have a hotel room either

THE CANOPY INSTALLATION, PART 3

by Mike Traud, Gold River Facility

In Part 2 of this series, we fabricated and basically completed the inside skirt to the extent that it was installed and sliding on the fuselage. The canopy glass was carefully fitted to the fuselage on the inside skirt and drilled using special plexiglass drill bits (reference drawing #47). It is important to note that the drilling process starts with small drill bits increasing the hole size with progressively larger bits. If you haven't yet drilled the canopy glass, take a few minutes and recheck the fit of the glass on the inside skirt and how all this fits on the fuselage. You are checking the fit of the canopy glass forward as it meets the windshield as well as how the glass will meet the fuselage aft (i.e. the contour). Reference Part 2 of this discussion for relevant points on fitting the canopy glass.

Once the canopy glass is drilled and you are completely satisfied with the fit of the canopy on the fuselage, you can tape the lower outside edge of the glass in preparation for the outside skirt layup. Be generous in taping as you do not want this process to mar the canopy glass. (I left the original coat of Spray Lat [reference Part 1] on the glass for protection.) The fuselage will also have to be taped in the perimeter areas where the outside skirt meets the fuselage.

(Concurrent with this effort, you will have to fabricate and drill the .050 6061 T-6 canopy strap which secures the canopy glass to the canopy bow. I'll get to this in a minute.) During the taping process, you may find it necessary to fair in the fuselage in areas where the canopy glass doesn't quite meet the fuselage the way you want it. No sweat, simply get the fuselage contours the way you want them and then apply the tape in preparation for the outside skirt fabrication. (This occurred on my project, especially in the aft areas of the fuselage where the canopy transition occurs. So, all I did was apply additional foam and glass and sanded until the proper contour was achieved.)

The outside skirt layup is achieved with three plys of 8 oz. glass cloth using West Systems 105 resin and 206 hardener. Once the outside skirt has cured, back drill the outside skirt through the inside skirt and glass using three or four existing holes from the original canopy glass to inside skirt. These holes will secure the outside skirt in place during the initial sanding process. Trim the lower areas of the outside skirt to match the fuselage juncture (i.e. the canopy sill). It is quite normal to apply additional glass layups during this process as you trim and fair in the outside skirt to the fuselage. Once the outside skirt is trimmed to meet the fuselage, remove the outside skirt from the structure and set it aside. Remove the canopy from the inside skirt. (This removing and replacing of the canopy is a pain in the butt, however it is a necessary part in this process.) Now, fabricate several wood strips which are identical in thickness to the canopy glass. Reinstall the outside skirt on the inside skirt (without the canopy glass) using the wood spacers to simulate the canopy glass. Once this is complete, you can trim the upper edge of the outside skirt to match the inside skirt height. Additional fairing of the outside skirt can occur at this juncture. (Actually, the fairing process is an ongoing one even to the point where you are applying primer to the fuselage. This is painstaking process but will yield a premium canopy to fuselage transition and the compliments of many to include, quite possibly, attractive women.)

It is also important to keep checking the sliding action of the canopy during this process so any binding that occurs can be corrected. After trimming the outside skirt to match the height of the inside skirt, reinstall the canopy, checking the symmetry of the structure, fit and working action. When you are satisfied with the system as a whole, you can finish drilling the outside skirt using the back drill process utilized for the three or four initial holes as described above. Take your time as mistakes can be quite maddening to correct. An important note at this juncture is the size of the holes in the canopy glass as compared to the skirts. The holes in the canopy glass are 3/8th inch in diameter, while the holes in the skirt are sized to accommodate a #10 machine screw. The reason for this is to allow the glass to ex-

THE CANOPY INSTALLATION, PART 3

pand and contract as temperature and humidity fluctuate. Otherwise the damn thing would bind up no matter what you did to try and correct it.

Once drilling is complete and you are satisfied with the placement of the outside skirt on the canopy glass, you can now install the nutplates which will secure the machine screws that hold the whole thing together. For my installation, I utilized MS24693 (#10) machine screws with MS21047-L3 nutplates. Keep in mind that the machine screws may vary in length due to the thickness of the inside and outside skirt layups. The nutplates were carefully riveted to the inside skirt using a small amount of T-88 structural epoxy mixed with cotton flox for a strong bond. These nutplates are not the floating type so you have to be dead-on with hole alignment or you will experience mismatches. The process takes a bit of time but works very well when complete. I have had my canopy apart several times and had no difficulty in this assembly/disassembly process. Completion of the outside skirt can be accomplished once you have the hole placement on the outside skirt and can see how the canopy will close on the fuselage. Your eye is the best resource for determining the desired contour and gap thickness between canopy and fuselage. I chose a very close gap to minimize drag in this area. This however, required a lot of work to achieve but was worth the effort. I have seen many GP-4's which did not have a narrow, precise gap between canopy and fuselage and these examples looked very nice and performed well. It is up to the builder as to how much precision is desired in this area. (Just make sure you can get the canopy opened and closed easily.)

Concurrent with the above process, you will need to secure the canopy to the windshield bow with the canopy strap. Drawings #49 and #50 detail the canopy latch mechanism which is a significant part of the system. There is a revision to this design, previously published by Osprey Aircraft. The canopy strap, as mentioned above, is fabricated from .050 6061T-6 aluminum. You will have to make a template for this strap because it is not a straight narrow piece as it appears. There is a slight curve to it do to the angle and curve of the canopy bow. The strap integrates with the outside skirt at the bottom where the bow is secured to the canopy base/inside skirt structure. As you can see on drawing #49 (top center of page) the edge of the strap does not coincide with the edge of the canopy bow. This is to allow the canopy to slide under the windshield strap for a snug and secure closure. Remember, at normal cruise speeds, the lift force on the GP-4 canopy can be as much as 400 pounds. With the canopy closed properly, it is held very securely by the windshield strap (as well as the side and aft rails) and kept closed by the latch mechanism. Flat head wood screws are utilized to hold the strap to the bow. Be careful not to remove and install the wood screws too many times as this will lessen the grip in the canopy bow. With this complete, you can finish the structure by radiusing the inside skirt around the inside perimeter of the canopy using foam and glass. I utilized liquid foam which was poured into this area, one section at a time, with the canopy tilted to keep the foam from running out the top and bottom of the skirt. The foam is sanded to the desired contour and then glassed with two plys of 4oz cloth. In the accompanying photographs you can get an idea of how my canopy was finished in this area. The shape and extent of the contour here is up to the builder.

Your canopy is essentially complete at this juncture. The canopy latch mechanism can be "fine tuned" when the windshield bow and windshield are installed. Remember to factor in the windshield glass thickness (if there is a difference) when planning this process.

Canopy Accessories and Approved Modifications

On the prototype GP-4, sometimes the canopy will not stay open during taxi operations when you would like a little fresh air in the cockpit. George Pereira and I came up with a simple canopy friction lock installation which is easy to incorporate into your canopy. It is a small machined barrel which is

THE CANOPY INSTALLATION, PART 3

tapped with a #4 or #5 course thread. The barrel length can very to the extent that it must fit into the foamed/glassed radiused inside skirt area. (See accompanying photo.) An associated #4 or #5 "bolt" is threaded into the barrel to the point where it contacts the fuselage canopy base thereby holding the canopy in place anywhere in the sliding range. Bonded to the bottom of the bolt is a corresponding piece of thick fabric which keeps the canopy base from being marred or scratched when pressure is applied to hold the canopy. The top of the bolt incorporates a larger diameter knob so you can get a better grip when enabling this mechanism.

A second addition to your canopy may include a vent system. George designed an aft vent on the prototype canopy which works very well and provides ample air flow into the cockpit. (Remember the 400 pounds of lift on the canopy? Well this means low pressure and low pressure means suction. A vent in a low pressure area will allow air to flow very nicely into the aft cockpit forward, cooling off the pilot and passenger.) The vent is a sliding mechanism actuated by a knob on one side. (George developed a plans revision for this system which is reprinted here for your review.) The vent incorporated in my canopy is very similar to the original design except that instead of the aft knob actuator, I ran a small cable around the perimeter of the canopy (buried in the foam and glass contoured area) which terminates to a knob forward at the canopy bow so I don't have to reach around behind to modulate the vent. (See accompanying photos.)

A third canopy accessory, not mentioned in the plans (or revisions) are canopy mirrors. These are very cool, small mirrors radiused to the shape of the canopy bow which allow you to look behind. (Like any one is gonna be there anyway with the speeds this thing goes.) I designed a small Kevlar bracket to attach the mirrors which allow some articulation to get the desired view. The bracket design was derived from the canopy mirror on a North American OV-10 Bronco. To test the design, I made several flights with George in the prototype using small mirrors stolen from my wife and other women around the airport. These were temporarily placed on the canopy bow to check the view, obstructions, angles, etc. This allowed optimum placement of the mirrors on the bow for the best aft view. The photographs should give you and idea of the design and placement of the mirrors.

This concludes the series on the GP-4 canopy. The information included here is really only a brief discussion of one builder's processes and procedures to get the canopy complete. The drawings are the final word on the subject as well as consultation with the designer, George Pereira. Other builders who have been through this process can provide a wealth of information as well. Actually looking at a finished canopy can be of significant benefit. Deciding not to build it in the first place might even be better.

In the next issue, I will delve into what it takes to fly a GP-4, and the type of training required to fly high performance aircraft safely, problems you may encounter with this type of design and other matters relating to flight operations. Any questions or concerns, please don't hesitate to contact me at traud@hotmail.com.

Mike

If the government stops funding NASA

Aft canopy sill detail including fuselage "lip" where canopy intersects fuselage.

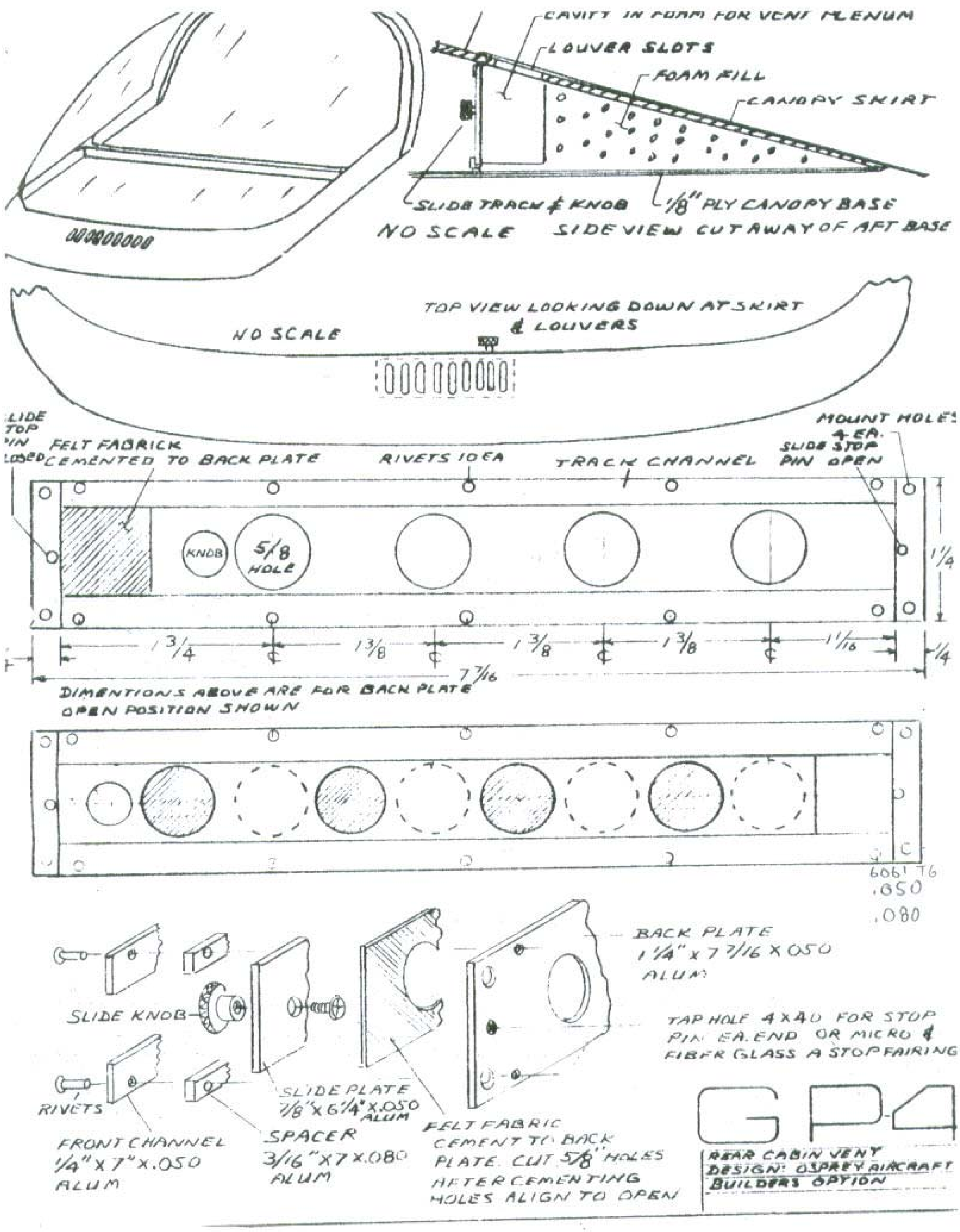
Vent control knob. Note canopy friction knob location aft of vent knob

Roller bearing detail.

Canopy mirror, starboard side

Canopy strap and outside skirt juncture

Canopy Vent Outlets



CAVITY IN FOAM FOR VENT PLENUM
LOUVER SLOTS
FOAM FILL
CANOPY SKIRT
SLIDE TRACK & KNOB
1/8" PLY CANOPY BASE
NO SCALE
SIDE VIEW CUT AWAY OF AFT BASE
TOP VIEW LOOKING DOWN AT SKIRT & LOUVERS
NO SCALE
SLIDE STOP PIN CLOSED
FELT FABRICK CEMENTED TO BACK PLATE
RIVETS 10 EA
TRACK CHANNEL
MOUNT HOLES 4 EA.
SLIDE STOP PIN OPEN
KNOB
5/8 HOLE
1 1/4
1 3/4
1 3/8
1 3/8
1 3/8
1 1/16
1/4
7 7/16
DIMENTIONS ABOVE ARE FOR BACK PLATE
OPEN POSITION SHOWN
6061 T6
.050
.080
BACK PLATE
1 1/4" x 7 7/16 x .050
ALUM
TAP HOLE 4 X 40 FOR STOP PIN EA. END OR MICRO & FIBER GLASS A STOP FAIRING
SLIDE KNOB
RIVETS
SLIDE PLATE
7/8" x 6 1/4" x .050
ALUM
FRONT CHANNEL
1/4" x 7" x .050
ALUM
SPACER
3/16" x 7 x .080
ALUM
FELT FABRIC CEMENT TO BACK PLATE. CUT 5/8" HOLES AFTER CEMENTING HOLES ALIGN TO OPEN
GP4
REAR CABIN VENT
DESIGN: OSPREY AIRCRAFT
BUILDERS OPTION

Header Fuel Tank Construction

By Bob Ringer

Construction of the fuel tanks are quite time consuming, especially the header tank with its' many curves and corners. The following is an alternate method to construct the header tank.

I think the main tanks should be made as per the plans to ensure the 8 foot long tank is construct true and straight.

The type of fiberglass resin to be used is up to the builder who should research the various products available and select one they feel is best suited to their needs, leaning heavily towards a gasoline resistant product. I used the West System 145 Resin with 226 Hardener which West System engineers assured me would do very nicely. The 145 Resin is very thick and preheating to get a good flow is helpful.

Page 6 of the plans show very good details and measurements of the header tank. I spend considerable time constructing a mould from plywood and metal and after much filling and sanding I applied 5 layers of 6 ounce cloth to the circumference of the mold. Each layer was 12 inches wide and about 9 feet long to allow for overlapping the ends.

I bent the cloth one inch over the front and back sides of the mold to form a flange. When the resin dried I cut the tank across the bottom to allow it to be removed from the mold. Removing the fiberglass from the mold without cracking it in numerous places proved to be impossible (for me anyway). Back to the drawing board.

Builder, Wayne Tomkins, Melbourne, Australia, who has many great ideas, recommended using styrofoam to form the mold and cover it with wide, clear, packaging tape. I was able to construct the mould in one day, applied a coating of mold release wax, buffed it up really good and was ready to apply the cloth.

I again did the circumference of the tank but also glassed in the front of the tank (the narrow end) at the same time. The front portion of the tank contains the filler cap, vent, and fuel gauge probe so this means you can install everything required in the tank and then put the back on as per instructions in Plan 6.

When the resin dried, I took a mini saw attached to my dremel and cut a one inch flange on the rear of the tank. I then starting digging out the fiberglass and it came out very easily with the packaging tape attached. I made two pieces of one inch thick styrofoam in the shape of the baffles and again applied tape and wax. I applied the cloth allowing it to wrap over the edges one inch. When it dried I had two baffles that fit perfectly. I glassed them in with resin and cloth after cutting out the fuel flow restricting holes and, using resin and hardener, painted areas that had any imperfections on the interior of the tank.

The overlapping of the tape on the mold does not seem to effect the appearance of the interior of the finished tank however you should try to apply the tape as wrinkle free as possible. A 1/8 overlap of each run of the tape is all that is required. The smoother the mold, the smoother the interior of the tank, so try not to stick you thumbs into the surface of the styrofoam. Be sure to generously round the corners of the mold to prevent the forming of air bubbles. (I did not round mine enough as you will note in the Photos)

I made the front and rear piece of styrofoam and after clamping the proper number of layers in between I used power sanders to shape them to the two outside pieces. Cutting the styrofoam on a bandsaw gives a surprisingly smooth edge.

Set your mold in the airframe and check to be certain it does not extend out into the area you will apply the exterior airframe plywood. Plans call for the mould to be 9.75 inches front to rear. I was anxious to gain more room behind the instrument panel to allow installation of a moving map GPS in the center of the panel so I shorten my tank mold to 7 and 5/8 inches.

Actual water fill tests showed the capacity diminished from 17 US gallons to 13.75 US gallons which gives a total on board fuel capacity of 50.75 US gallons. It calculates out to .22 US gallons per 1/8 inch of tank or one inch equals 1.75 US gallons.

I lost 3.25 US gallons of fuel capacity or from my wife's point of view, gained over 18 lbs of baggage capacity.

(Photos next page)

HEADER FUEL TANK




PLANS INCONSISTENCIES

- On drawing 9 the STA 78 Idler Arm Clevis is shown with a 3/8" inside width. The aft bearing, HF4C is 3/8" wide and appropriately fits. However, the forward bearing, F45-19M, is .59" wide and is too large for the clevis
- On drawing 9 the engine mount brackets show 5/16" holes. Drawing 54 shows the use of AN6-41A bolts in those holes. Dimension on drawing 9 is incorrect, the holes should be 3/8"

A group of headhunters sets up a small stand near a well-traveled road.

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Fried Diplomat	$14.00
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A customer, noticing the great price differential, asked why the FAA Inspectors cost so much. The Headhunter replied, "if you ever tried to clean one of those devils, you would understand."

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