The Glasair III, winner of the 1987 Sun 60 air race.

Carl Schuppel

SUN 60 AIR RACE

The Sun 60 Air Race is a pure speed event . . . one lap, from a standing start, around a triangular course . . . and let the devil take the hindmost!

by *JACK COX*

22 homebuilts started this year's event and, as expected, the mighty 300 hp Glasair III left all the other contestants bobbing in its wake. Bob Gavinsky blasted around the near sea level triangle at an astounding 266.90 mph! Equally predictable (but exciting, nonetheless) was the order of finish for second and third place, overall. Ray Ward pushed the White Lightning to a timed run of 256.25 mph, and last year's winner, Richard Porter, came in at 220.53 mph, quite an improvement over the 213.68 he posted in 1986.

The fourth fastest speed, however, was the sensation of the race and, indeed, of the entire week's activities at Lakeland. To avoid as much passing as possible during the race, the competitors are sent on their way at 20 second intervals, with those **thought** to be fastest going first. The 15th racer waved off was a Continental O-200 powered VariEze flown by Klaus Savier of Hermosa Beach, CA. In the 24 minutes and 52 seconds it took him to fly the race course, he passed nine airplanes and flashed across the finish line at an incredible 219.49 mph . . . just 1.04 mph slower than Richard Porter's hopped up turbocharged Lycoming O-360 powered Glasair RG!

Keep in mind that this speed was accomplished from a standing start and with fairly tight turns around two pylons, plus a shallow turn into the finish line. That meant the Eze had to be approaching 240 mph out on the straightaways! Who was this ringer sneaked in from the West Coast to clean the clocks of the eastern competition . . . and what did he have stuffed into the cowling in the innocent guise of an O-200?

Actually, Klaus Savier is no stranger, if you have been keeping up with coverage of the CAFE 400 here in **Sport Aviation**. He has been squaring off with Gary Hertzler and Gene Sheehan for the top spot in that event for several years now, but this was his first trip to Florida to compete in the Sun 60 race. Klaus was born in Germany and got into flying by means of sky diving and hang gliding. He came to the U. S. and lived in Oregon until 2 years ago when he moved to Los Angeles to go to work for an engineering firm doing research and development in composites. While still in Oregon, a friend, Larry Godsey, began work on the VariEze, but developed an epoxy allergy and Klaus finished it. He keeps the airplane in LA and had done all the modifications and

OVER ALL PLACE	SPEED MPH	AIRCRAFT TYPE	HP ENGINE	PILOT NAME
1st	266.90	Glasair III	300	Bob Gavinsky
2nd	256.25	White Lightning	210	Ray Ward
3rd	220.53	Glasair II Turbo	180	Richard Porter
4th	219.49	VariEze	100	Klaus Savier
5th Tie	212.38	Glasair FG	160	Jim Cline
5th Tie	212.38	Glasair FG	160	Robin Young
6th	212.24	Glasair FG	150	Don Conover
7th	206.10	Long-EZ	160	Steve Wiggins
8th	205.45	Lancair	115	Lance Neibauer
9th	200.18	RV-6	160	R. VanGrunsven
10th	199.08	Cassutt	100	Ed Albers
11th	198.24	RV-3	160	Frank Smith
12th	196.81	VariEze	100	Tim Gehres
13th	194.93	VariEze	100	Jack Fehling
14th	191.29	T-18	180	Bob Highley
15th	187.14	TC-2	100	Ken Wheeler
16th	171.01	Long-EZ	115	Mike Bush
17th	164.98	Q200	115	Earnest Elliott
18th	159.98	Air Shark	200	Ron Lueck
19th	137.95	VariEze	85	Ray LaRocque
20th	134.66	Dragonfly	60	Gary Konrad
21st	113.63	Silhouette	40	Johnny Murphy

testing for racing.

The work done on the O-200 has centered around pistons, carburetion, the oil pump, exhaust stacks and baffling. Since the VariEze runs a fixed propeller, its engine must be turned at high rpm to achieve the speeds owners covet. The stock cast pistons are 1940s technology and will not stand up at racing revs . . . so Klaus designed his own forged pistons and has had them machined to his specs. With modern rings and new pins, each weighs half a pound less than a stock piston. They up compression to 9.87 to 1 and, so far, are proving capable of sustained operation at 3300 to 3350 rpm.

An Ellison throttle body injector carb was installed recently and Klaus believes the mixture distribution to the cylinders is far better balanced than with the stock carburetor. He has also installed an oil pump from a six-cylinder Continental O-300 . . . which keeps the oil temperature at no more than 160 degrees, even at 3350 rpm. The stock VariEze 2 into 1 exhaust stacks were replaced by individual pipes for each cylinder . . . which resulted in a 100 rpm gain that makes a big difference, Klaus says, in take-off and climb performance.

Finally, Klaus' friend, John Parker of American Air Racing in Torrance, CA, built a set of Formula I type baffles that do a superb job of cooling the cylinders at racing speeds.

Klaus estimates his O-200 is now producing about 145 horsepower at 3350 rpm . . . so to put that to effective use, he has had to modify his wooden propellers. He thins the blades, yet substantially increases their torsional rigidity with laminates of carbon fiber. He raced with an old Ted Hendrickson 56" x 70" propeller reworked and extended to a diameter of 60 inches, the last two inches on each tip being solid carbon and only 8% thick.

The VariEze airframe has also seen its share of modification. Klaus has built and installed a new canard, based on the Long-EZ airfoil; has put a cover on the nose gear door so that it closes flush in front; and has installed a boattail cowl with a flush NACA inlet for the cooling air to the engine. Wheel pants that are carefully faired into the landing gear leg and a really weird shaped spinner complete what can readily be seen in the way of modifications to the basic shape of the VariEze. Less apparent is the fact that the cusp was taken out of the airfoil of the winglets and the portion extending below the wing was reshaped into an end plate of sorts, similar to that on a Long-EZ. Vortelons were also fitted, though Klaus says he does not fly the airplane very much at the high angles of attack at which they are most effective.

Otherwise, Klaus says the airplane is simply built very straight and has no significant waviness in any of its flying surfaces. It is not the world's lightest VariEze at an empty weight of just under 670 pounds, but it **goes**! On the trip east from California, with a 61" x 82" cruise propeller and two aboard (Marnie Keatts of Hermosa Beach in the rear seat), Klaus flew at over 10,000 ft. most

SUN 60
CLASS STANDINGS

Class 1-A — 1 to 99 HP
1st — Dragonfly — Cary Konrad ..... 134.66 mph
2nd — Silhouette — Johnny Murphy ..... 113.63 mph

Class 1-B — 100 to 149 HP
1st — Lancair — Lance Neibauer ..... 205.45 mph
2nd — Cassutt — Ed Albers ..... 199.08 mph
3rd — TC-2 (Aero Mirage) — Ken Wheeler .. 187.14 mph
4th — Q200 — Earnest Elliott ..... 164.98 mph

Class 1-C — 150 to 160 HP
1st — RV-6 — Richard VanGrunsven ..... 200.18 mph
2nd — RV-3 — Frank Smith ..... 198.24 mph

Class 1-D — 161 to 200 HP
1st — Glasair RF — Richard Porter ..... 220.53 mph
2nd — T-18 — Bob Highley ..... 191.29 mph
3rd — Air Shark — Ron Lueck ..... 159.98 mph

Class 1-E — 201 HP and Up
1st — Glasair III — Bob Gavinsky ..... 266.90 mph
2nd — White Lightning — Ray Ward ..... 256.25 mph

Class 2-A — Rutan VariEze
1st — Klaus Savier ..... 219.49 mph
2nd — Tim Gehres ..... 196.81 mph
3rd — Jack Fehling ..... 194.93 mph
4th — Ray Larocque ..... 137.95 mph

Class 2-B — Rutan Long-EZ to 149 HP
1st — Mike Bush ..... 171.01 mph

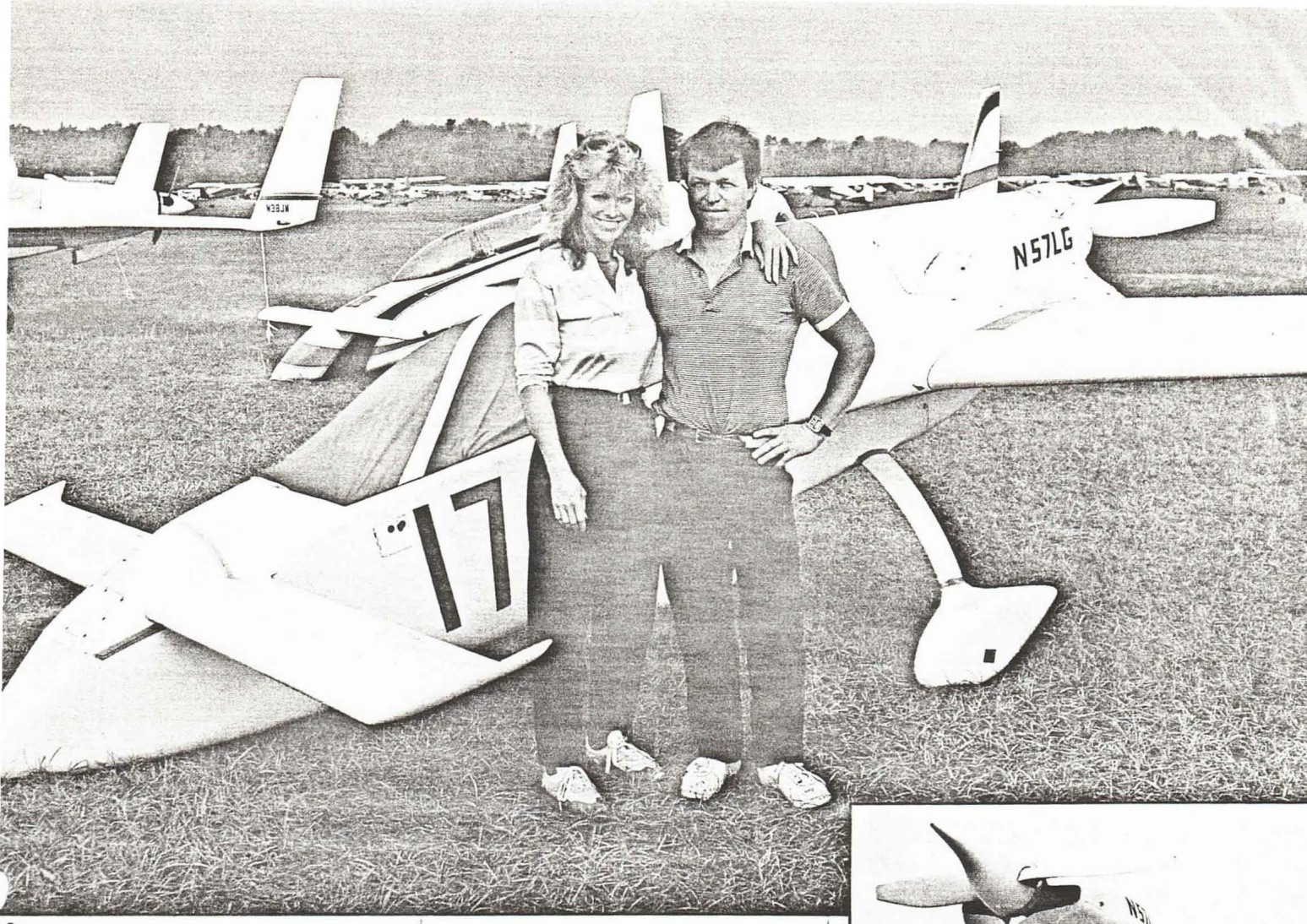
Class 2-C — Rutan Long-EZ 149 to 160 HP
1st — Steve Wiggins ..... 206.10 mph

Class 3-A — Glasair Fixed Gear 150 to 160 HP
1st (tie) — Jim Kline ..... 212.38 mph
Robin Young ..... 212.38 mph
2nd — Don Conover ..... 212.24 mph

Most Speed Per HP
1st — Silhouette — Johnny Murphy (40 hp) ..... 113.63 mph
2nd — Dragonfly — Gary Konrad (60 hp) ..... 134.66 mph

Best of Show
1st — Glasair RG Turbo — Richard Porter
2nd — Glasair III — Bob Gavinsky

Slowest
Silhouette — Johnny Murphy — 113.63 mph



Cox

Marnie Keatts and Klaus Savier with Klaus' ultra fast VariEze.

of the time, pulling 17.5 inches and 2750 rpm. At that power they were burning about 4.7 gph and truing 200 mph. Including the climbs, the fuel consumption averaged about 4.9 gph. About 3/4 quart of oil was burned in 13 hours. Solo climb rate with 5 to 10 gallons on board is nearly 2200 fpm, and at gross the cruise climb is about 500 fpm at 155-160 knots.

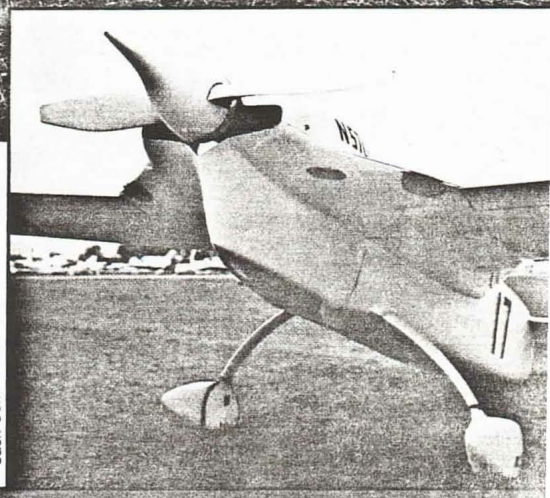
Now, about that spinner. Klaus thinks it is the optimum shape for a pusher installation. He flew it across the U. S., but did not use it in the Sun 60 race because it had not undergone the extensive testing it will in the future. It was made of Kevlar and carbon, and weighed just 6.5 ounces. It will not be subject to fatigue. The pay-off, Klaus believes, will be about 2 more knots of cruise speed.

Interestingly, Klaus is not seeking to go any faster with his VariEze. He believes he is close to the structural limit now. His real interest is in flying as **efficiently** as possible. All future development of the airplane will be aimed in that direction, he says.

RIGHT - Klaus Savier's wild new Kevlar/carbon fiber spinner. Note the tightly faired landing gear, the boat tail and four individual exhaust pipes.

BELOW - Ray Ward flew the White Lightning to the second fastest Sun 60 race speed.

Jack Cox



Carl Schuppel

AN Hardware Basics

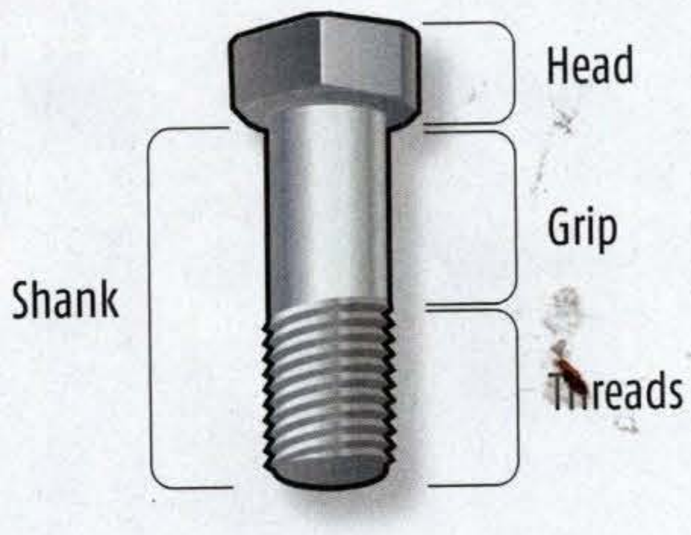
BY JOE NORRIS, EAA HOMEBUILDING PROGRAM SPECIALIST

Editor's note: This is adapted from a hint that first ran in the March 2010 issue of EAA Sport Aviation *magazine.*

YOU WON'T HANG AROUND a group of homebuilders or aircraft restorers for long before you start hearing about AN hardware. AN bolts and their accompanying nuts and washers are the focus of this hint.

AN stands for Army-Navy, the standards to which the hardware is manufactured and tested. Although the AN standard is being replaced by the mil (military) spec (MS) standard for some hardware items, AN is still the most commonly referred to standard among homebuilders. All AN hardware is identified by a code made up of numbers and letters that identify the item.

A bolt may look simple, but did you know it has several different sections? At the top of the bolt is the head, where you'll place the wrench upon installation. Beneath the head is the shank, which in turn is made up of the grip and the threads. Bolts come in different diameters and lengths to meet the requirements of the job at hand, and they are called out by numbers and letters so that we can get the size we need. For example, if your plans call for an AN4-12A bolt, what size is that? Well, the number after the "AN" indicates the diameter of the bolt shank in sixteenths of an inch. An AN4 bolt is 4/16 — or 1/4 inch in diameter.



The number after the dash indicates the total length of the bolt's shank in eighths of an inch, or inches and eighths for bolts more than 1 inch long. In this case, the 12 indicates 1 inch plus 2/8, or a total of 1 and 1/4-inch long. An AN4-24 bolt would be a 1/4-inch diameter bolt that is 2 inches plus 4/8-inch long — or 2 and 1/2 inches. The "A" at the end of our AN4-12A bolt mentioned above indicates that the bolt does not have a hole drilled in the shank for a cotter pin. The absence of the A would indicate a drilled bolt.

But how long of a bolt do you need? You want the grip of the bolt (that part of the shank that is unthreaded) to equal the thickness of the materials being joined. Sometimes you can't get an exact match, so in a pinch you can go a bit longer with the grip and take up the extra length with extra washers (up to three maximum). A normal bolt installation would include the bolt, one washer, and the nut. With a drilled bolt, use a castellated nut and cotter pin. With an undrilled bolt, use a self-locking nut. The washer should go under the nut to protect the base material from abrasion when the nut is torqued. If possible, always torque by turning the nut rather than the bolt. This will give you a more accurate torque reading and avoid wearing the plating off the bolt shank, which may lead to corrosion or loosening of the bolt in the hole.

If you are installing a bolt in a location that requires you to torque the bolt head, then put the washer under the head of the bolt.

As a general rule, bolts should be installed with the head up or forward. The logic is that gravity or slipstream will hold the bolt in if the nut comes off. In actuality, in many installations, the items being connected will come apart regardless of how the bolt is put in, so sometimes it's not going to matter. In other instances, restricted access will require a bolt to be put in "backward" or "upside down." Do what you have to do, but it's always good to follow the head up or forward convention if possible.

The accompanying chart will help you find the correct washers, nuts, and cotter pins for the popular size AN bolts used on most aircraft. Information on identifying bolts using the markings on the bolt head is also included. With this information, you should be able to select the proper hardware for your project and talk the talk when the AN hardware discussion starts.

GOT A HINT?

Want your own *EAA Sport Aviation* contributor hat? We'll send you one if you submit a hint that we run in this column. Send your tips to editorial@eaa.org.

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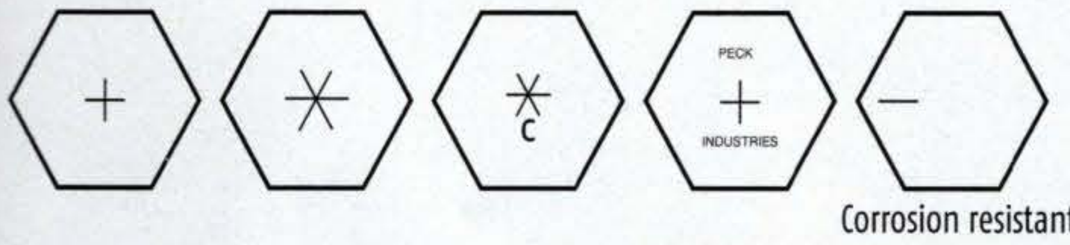
ILLUSTRATIONS BY **GARY COX**

BOLT BASICS

Standard Steel Bolt Head Markings



Corrosion resistant

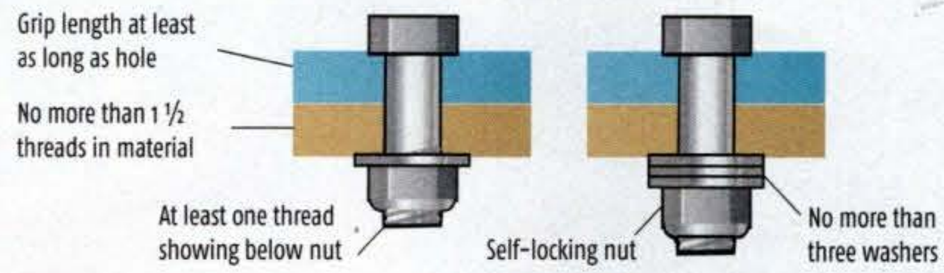
Close tolerance

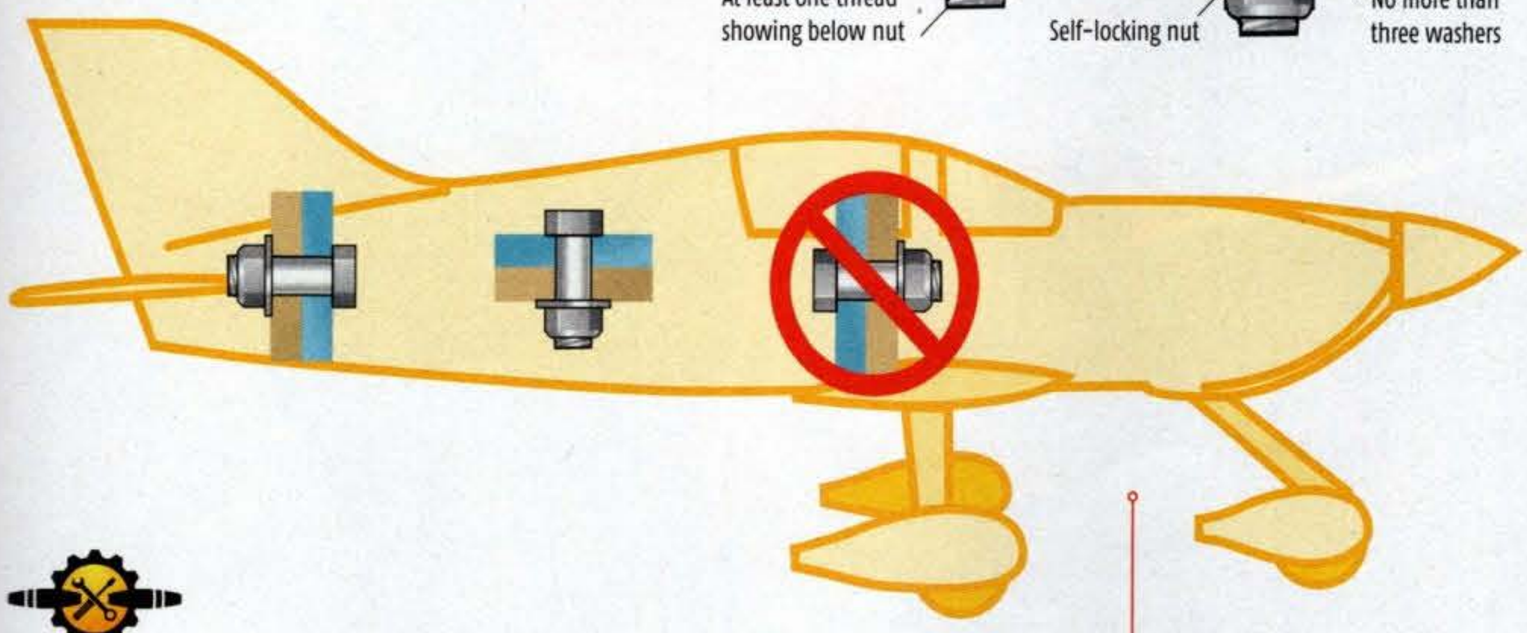
High strength

SUB-STRENGTH BOLTS

Aluminum

Non-AN (not for aircraft use)





Bolt Installation

Bolts should be installed with the head forward, upward, or outward to the extent possible. Bolts typically are not installed with the head toward the rear, bottom, or inside – except where clearance or access issues require such installation or when directed to do so by manufacturer's instructions.

APPROXIMATE SHANK LENGTH

Bolt	Wrench Size	Nut (Ny-Lock)	Nut (Castle)	Washer, Standard	Washer, Large	Cotter Pin	Torque Recommended	Torque Max.
AN 3	3/8"	AN365-1032	AN310-3	AN960-10	AN970-3	MS24665-132	20-25 in. lbs.	40 in. lbs.
AN 4	7/16"	AN365-428	AN310-4	AN960-416	AN970-4	MS24665-132	50-70 in. lbs.	100 in. lbs.
AN 5	1/2"	AN365-524	AN310-5	AN960-516	AN970-5	MS24665-134	100-140 in. lbs.	225 in. lbs.
AN 6	9/16"	AN365-624	AN310-6	AN960-616	AN970-6	MS24665-283	160-190 in. lbs.	390 in. lbs.